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CHAPTERWISE SOLUTIONS

BIOLOGY

STRUCTURED AS PER CLASS 11 & 12 NCERT BOOKS

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BIOLOGY

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Registered Office : 406, Taj Apt., Ring Road, Near Safdarjung Hospital, New Delhi-110029

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- Five kingdom classification; salient features and classification of Monera; Protista and Fungi into major groups; Lichens; Viruses and viroids.
- Salient features and classification of plants into major groups-Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms (three to five salient and distinguishing features and at least two examples of each category); Angiosperms - classification up to class, characteristic features and examples.
- Salient features and classification of animals-Nonchordate up to phyla level and Chordate up to classes level (three to five salient features and at least two examples).

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**For details, refer latest prospectus*

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CLASS XII

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- Ecosystem: Patterns, components; productivity and decomposition; Energy flow; Pyramids of number, biomass, energy; Nutrient cycling (carbon and phosphorus); Ecological succession; Ecological services-carbon fixation, pollination, oxygen release.
- Biodiversity and its conservation: Concept of biodiversity; Patterns of biodiversity; Importance of biodiversity; Loss of biodiversity; Biodiversity conservation; Hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, national parks and sanctuaries.
- Environmental issues: Air pollution and its control; Water pollution and its control; Agrochemicals and their effects; Solid waste management; Radioactive waste management; Greenhouse effect and global warming; Ozone depletion; Deforestation; Any three case studies as success stories addressing environmental issues.

Chapter 1

The Living World

1. The label of a herbarium sheet does not carry information on
(a) date of collection (b) name of collector
(c) local names (d) height of the plant.
(NEET-II 2016)

2. Match column I with column II for housefly classification and select the correct option using the codes given below.

Column I	Column II
A. Family	(i) Diptera
B. Order	(ii) Arthropoda
C. Class	(iii) Muscidae
D. Phylum	(iv) Insecta

(a) A-(iii), B-(i), C-(iv), D-(ii)
(b) A-(iii), B-(ii), C-(iv), D-(i)
(c) A-(iv), B-(iii), C-(ii), D-(i)
(d) A-(iv), B-(ii), C-(i), D-(iii)
(NEET-II 2016)

3. Study the four statements (A-D) given below and select the two correct ones out of them.
A. Definition of biological species was given by Ernst Mayr.
B. Photoperiod does not affect reproduction in plants.
C. Binomial nomenclature system was given by R.H. Whittaker.
D. In unicellular organisms, reproduction is synonymous with growth.
The two correct statements are
(a) B and C (b) C and D
(c) A and D (d) A and B.
(NEET-II 2016)

4. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of nomenclature?
(a) The names are written in Latin and are italicised.
(b) When written by hand the names are to be underlined.
(c) Biological names can be written in any language.
(d) The first word in a biological name represents the genus name and the second is a specific epithet.
(NEET-I 2016)

5. Which one of the following is not a correct statement?
(a) A museum has collection of photographs of plants and animals.
(b) Key is a taxonomic aid for identification of specimens.
(c) Herbarium houses dried, pressed and preserved plant specimens.
(d) Botanical gardens have collection of living plants for reference.
(NEET 2013)

6. The common characteristics between tomato and potato will be maximum at the level of their
(a) family (b) order
(c) division (d) genus.
(Karnataka NEET 2013)

7. Which one of the following organisms is scientifically correctly named, correctly printed according to the International Rules of Nomenclature and correctly described?
(a) *Musca domestica* - the common house lizard, a reptile
(b) *Plasmodium falciparum* - a protozoan pathogen causing the most serious type of malaria.
(c) *Felis tigris* - the Indian tiger, well protected in Gir forests.
(d) *E.coli* - full name *Entamoeba coli*, a commonly occurring bacterium in human intestine.
(Mains 2012)

8. Which one of the following animals is correctly matched with its particular taxonomic category?
(a) Tiger - *Tigris*, species
(b) Cuttlefish - mollusca, class
(c) Humans - primata, family
(d) Housefly - *Musca*, order *(2011)*

9. Which one of the following aspects is an exclusive characteristic of living things?
(a) Isolated metabolic reactions occur *in vitro*
(b) Increase in mass from inside only
(c) Perception of events happening in the environment and their memory.
(d) Increase in mass by accumulation of material both on surface as well as internally.
(Mains 2011)

10. ICBN stands for
(a) International Code of Botanical Nomenclature
(b) International Congress of Biological Names
(c) Indian Code of Botanical Nomenclature
(d) Indian Congress of Biological Names.
(2007)

11. The living organisms can be unexceptionally distinguished from the non-living things on the basis of their ability for
(a) interaction with the environment and progressive evolution
(b) reproduction
(c) growth and movement
(d) responsiveness to touch. *(2007)*

12. One of the most important functions of botanical gardens is that
(a) they provide a beautiful area for recreation
(b) one can observe tropical plants there
(c) they allow *ex situ* conservation of germplasm
(d) they provide the natural habitat for wild life. *(2005)*

13. Species are considered as
(a) real basic units of classification
(b) the lowest units of classification
(c) artificial concept of human mind which cannot be defined in absolute terms
(d) real units of classification devised by taxonomists. *(2003)*

14. Biosystematics aims at
(a) the classification of organisms based on broad morphological characters
(b) delimiting various taxa of organisms and establishing their relationships
(c) the classification of organisms based on their evolutionary history and establishing their phylogeny on the totality of various parameters from all fields of studies
(d) identification and arrangement of organisms on the basis of their cytological characteristics. *(2003)*

15. Which of the following is less general in characters as compared to genus?
(a) Species (b) Division
(c) Class (d) Family *(2001)*

16. The book '*Genera Plantarum*' was written by
(a) Engler and Prantl
(b) Bentham and Hooker
(c) Bessey (d) Hutchinson.
(1999)

17. 'Taxon' is the unit of a group of
(a) order (b) taxonomy
(c) species (d) genes. *(1996)*

18. Linnaeus is credited with
(a) binomial nomenclature
(b) theory of biogenesis
(c) discovery of microscope
(d) discovery of blood circulation. *(1993)*

19. Sequence of taxonomic categories is
(a) class–phylum–tribe–order–family–genus–species
(b) division–class–family–tribe–order–genus–species
(c) division–class–order–family–tribe–genus–species.
(d) phylum–order–class–tribe–family–genus–species. *(1992)*

20. The term phylum was given by
(a) Cuvier (b) Haeckel
(c) Theophrastus (d) Linnaeus. *(1992)*

21. A group of plants or animals with similar traits of any rank is
(a) species (b) genus
(c) order (d) taxon.
(1992, 1991)

22. A taxon is
(a) a group of related families
(b) a group of related species
(c) a type of living organisms
(d) a taxonomic group of any ranking.
(1992, 1990)

23. Basic unit or smallest taxon of taxonomy/ classification is
(a) species (b) kingdom
(c) family (d) variety. *(1990)*

24. Linnaeus evolved a system of nomenclature called
(a) mononomial (b) vernacular
(c) binomial (d) polynomial.
(1990)

25. The term "New Systematics" was introduced by
(a) Bentham and Hooker
(b) Linnaeus
(c) Julian Huxley
(d) A.P. de Candolle. *(1988)*

26. Static concept of species was put forward by
(a) de Candolle (b) Linnaeus
(c) Theophrastus (d) Darwin. *(1988)*

Answer Key

1.	(d)	**2.**	(a)	**3.**	(c)	**4.**	(c)	**5.**	(a)	**6.**	(a)	**7.**	(b)	**8.**	(a)	**9.**	(c)	**10.**	(a)
11.	(d)	**12.**	(c)	**13.**	(a)	**14.**	(c)	**15.**	(a)	**16.**	(b)	**17.**	(b)	**18.**	(a)	**19.**	(c)	**20.**	(a)
21.	(d)	**22.**	(d)	**23.**	(a)	**24.**	(c)	**25.**	(c)	**26.**	(c)								

EXPLANATIONS

1. (d) : A herbarium is a collection of plants, which have been dried, pressed, mounted on herbarium sheets, identified and classified according to some approved system of classification. The storage of herbarium sheets forms a repository for future use. A printed label (7 × 12 cm) giving the following information is fixed on the lower, right corner of herbarium sheet:
(i) Scientific name of plant (ii) Common/vernacular name (iii) Family (iv) Locality (v) Date of collection (vi) Collection number (vii) Name of collector (viii) Plant characteristics (optional) (ix) Name of institution (optional).

2. (a)

3. (c) : Photoperiod affects flowering and reproduction in plants. Binomial nomenclature system was given by Carolus Linnaeus.

4. (c) : Biological names are derived either from Latin language or are latinised. This is because Latin language is a dead language and therefore it will not change in form or spellings with the passage of time.

5. (a) : Museums have collections of preserved plant and animal specimens for study and reference. Specimens are preserved in the containers or jars in preservative solutions. Plant and animal specimens may also be preserved as dry specimens. Insects are preserved in insect boxes after collecting, killing and pinning. Larger animals like birds and mammals are usually stuffed and preserved. Museums often have collections of skeletons of animals too.

6. (a) : Potato (*Solanum tuberosum*) and tomato (*Lycopersicum esculentum*) both belong to family Solanaceae, which is commonly called as the "potato family". Many plants belonging to this family are sources of vegetables, fruits etc.

7. (b) : *Plasmodium falciparum* is a protozoan parasite, one of the species of *Plasmodium* that causes malaria in humans. Being digenetic, its life cycle is complete in two hosts — man and mosquito. Its sexual cycle is completed in female *Anopheles* mosquito and infective individuals called sporozoites are formed. Which are transmitted to humans with the bite of infected female *Anopheles*. Asexual cycle is passed in man in two phases. Malaria caused by *P. falciparum* (also known as aestivo-autumnal, malignant tertian or pernicious malaria) is the most dangerous form of malaria, with the highest rate of complication and mortality. In this case fever cycle is of 48 hours and is often fatal to patient as it affects the brain.
Scientific name of common house lizard is *Hemidactylus* whereas *Musca domestica* is the scientific name of common housefly. Scientific name of Indian tiger is *Panthera tigris*. Full name of *E.coli* is *Escherichia coli*.

8. (a) : Binomial nomenclature system of naming organisms using a two-part Latinized (or scientific) name that was devised by the Swedish botanist Linnaeus (Carl Linne); it is also known as the Linnaean system. The first part is the generic name, the second is the specific name. Zoological name of tiger is *Panthera tigris*. So, *tigris* is species name of Tiger.

9. (c)

10. (a) : The International Code of Botanical Nomenclature (ICBN) is a set of rules and recommendations dealing with the formal botanical names given to plant. The foundations of ICBN are given in book written by C. Linnaeus named *Philosophia Botanica*. It is independent of zoological nomenclature. The rank of species is basic and relative order of the ranks of taxa are as : species, genus, tribe, family, order, series, class, division and kingdom.
The different ranks or categories have following specific endings of their names as division – phyla, class-ae, family-aceae.

11. (d)

12. (c) : *Ex situ* conservation means "offsite conservation". It is the process of protecting endangered species of plants and animals by removing it from an unsafe or threatened habitat and placing it or part of it under the care of humans. Botanical garden serve as *ex situ* conservation of germplasm of different plants, to maintain rare and endemic plant species and also to provide recreation and knowledge about plants to a common man.

13. (a) : Species is a natural population or group of natural populations of individuals which are genetically distinct and reproductively isolated with similar essential morphological traits. Species is also a genetically closed system because its members do not interbreed with members of other species. Species

is lowest or basic taxonomic category, *e.g.*, mango (*Mangifera indica*), potato (*Solanum tuberosum*), lion (*Panthera leo*). Here *indica*, *tuberosum*, *leo* are species of genera *Mangifera*, *Solanum* and *Pantera* respectively. All other taxonomic categories are defined and described in relation to species. For example, a genus is a group of species and a subspecies or a variety is a part of species. New species originate from already existing species. Species is considered basic unit of taxonomy since in the greater majority of cases we do not have intraspecific names.

14. (c) : Biosystematics is the study of identification, nomenclature classification and relationships amongst living beings. In other words, it is the study of diversity of organisms, their comparative and evolutionary relationships based on comparative anatomy, ecology, physiology, biochemistry and other fields.

15. (a) : A taxonomic hierarchy is the sequence of arrangement of taxonomic categories in a descending order during the classification of an organism. There are seven obligate categories - kingdom, division , class, order, family, genus and species. Species is the lowest category while kingdom is the highest category. The number of common characters is maximum in case of organisms placed in the lowest category. Number of common characters decreases with the rise in category. Species are the smallest group of individuals which can be recognized by ordinary methods as groups and which are consistently and persistently different from other groups because their characters are less general.

16. (b) : Bentham and Hooker in their monumental work *Genera Plantarum* (1862-1883) have provided elaborate keys for the easy identification of 202 natural orders and genera. Engler and Prantl wrote *Die naturlichen pflanzen familien*. Huchinson wrote a book titled "The Families of Flowering Plants."

17. (b) : Taxon refers to all the categories in the taxonomic hierarchy. It may be a kingdom, class, order, family, genus or species. It is any level of grouping of organisms. Each of these categories has been divided further into intermediate categories like subkingdom, subdivision, superclass, subgenus, subspecies etc. This term was coined by ICBN in 1956.

18. (a) : Binomial nomenclature of scientific naming was first given by C. Linnaeus (1735) in his book *Systema Naturae* and later in "*Species Plantarum*" (1753). He used two latin words for any organism, the first being generic name and the second is specific name. The generic name begins with capital letter and the species name with small letter.

19. (c) : To construct the hierarchy of classification, one or more species are grouped into a genus, one or more of genera into a family, families are clubbed into order, orders into class, classes into phylum and various phyla into kingdom.

20. (a) : The term phylum was given by Cuvier.

21. (d) : A taxon (plural taxa) or taxonomic unit, is a name designating an organism or group of organisms. A taxon is assigned a rank and can be placed at a particular level in a systematic hierarchy reflecting evolutionary relationships.

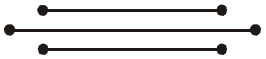
22. (d) : The word taxon signifies a taxonomic group of any rank which represents the real biological organisms included in a category. The term taxon was coined by Adolf Meyer (1926) for animals and H.J Lam (1948) used this term in plant science.

23. (a) : Basic unit or smallest taxon of taxonomy/ classification is species. Species is a group of individuals that remain relatively constant in their characteristics; can be distinguished from other species and do not normally interbreed.

24. (c) : *Refer to answer 18.*

25. (c) : The term "New Systematics" was given by Julian Huxley (1940). This classification takes into account the cytological, morphological, genetical, anatomical, palynological and physiological characters.

26. (c).



Chapter 2

Biological Classification

1. Which of the following are found in extreme saline conditions?
(a) Eubacteria (b) Cyanobacteria
(c) Mycobacteria (d) Archaebacteria
(NEET 2017)

2. Viroids differ from viruses in having
(a) DNA molecules without protein coat
(b) RNA molecules with protein coat
(c) RNA molecules without protein coat
(d) DNA molecules with protein coat.
(NEET 2017)

3. Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen?
(a) *Pseudomonas* (b) Mycoplasma
(c) *Nostoc* (d) *Bacillus*
(NEET 2017)

4. Which of the following components provides sticky character to the bacterial cell?
(a) Nuclear membrane
(b) Plasma membrane
(c) Glycocalyx
(d) Cell wall
(NEET 2017)

5. DNA replication in bacteria occurs
(a) within nucleolus
(b) prior to fission
(c) just before transcription
(d) during S phase. *(NEET 2017)*

6. Which one of the following is wrong for fungi?
(a) They are eukaryotic.
(b) All fungi possess a purely cellulosic cell wall.
(c) They are heterotrophic.
(d) They are both unicellular and multicellular.
(NEET-II 2016)

7. Methanogens belong to
(a) eubacteria (b) archaebacteria
(c) dinoflagellates (d) slime moulds.
(NEET-II 2016)

8. Select the wrong statement.
(a) The walls of diatoms are easily destructible.
(b) 'Diatomaceous earth' is formed by the cell walls of diatoms.
(c) Diatoms are chief producers in the oceans.
(d) Diatoms are microscopic and float passively in water. *(NEET-II 2016)*

9. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the
(a) methanogens
(b) eubacteria
(c) halophiles
(d) thermoacidophiles. *(NEET-I 2016)*

10. Which one of the following statements is wrong?
(a) Eubacteria are also called false bacteria.
(b) Phycomycetes are also called algal fungi.
(c) Cyanobacteria are also called blue-green algae.
(d) Golden algae are also called desmids.
(NEET-I 2016)

11. Which of the following statements is wrong for viroids?
(a) They cause infections.
(b) Their RNA is of high molecular weight.
(c) They lack a protein coat.
(d) They are smaller than viruses.
(NEET-I 2016)

12. One of the major components of cell wall of most fungi is
(a) cellulose (b) hemicellulose
(c) chitin (d) peptidoglycan.
(NEET-I 2016)

13. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the Kingdom
(a) Fungi (b) Animalia
(c) Monera (d) Protista.
(NEET-I 2016)

14. Which one is a wrong statement?
(a) Haploid endosperm is typical feature of Gymnosperms.
(b) Brown algae have chlorophyll *a* and *c* and fucoxanthin.
(c) Archegonia are found in Bryophyta, Pteridophyta and Gymnosperms.
(d) *Mucor* has biflagellate zoospores.
(2015)

15. The imperfect fungi which are decomposers of litter and help in mineral cycling belong to
(a) Phycomycetes (b) Ascomycetes
(c) Deuteromycetes (d) Basidiomycetes.
(2015)

16. The structures that help some bacteria to attach to rocks and/or host tissues are
(a) mesosomes (b) holdfast
(c) rhizoids (d) fimbriae.
(2015)

17. Select the wrong statement.
(a) The term '*contagium vivum fluidum*' was coined by M. W. Beijerinck.
(b) Mosaic disease in tobacco and AIDS in human being are caused by viruses.
(c) The viroids were discovered by D.J. Ivanowsky.
(d) W.M. Stanley showed that viruses could be crystallised. *(2015)*

18. In which group of organisms the cell walls form two thin overlapping shells which fit together?
(a) Dinoflagellates (b) Slime moulds
(c) Chrysophytes (d) Euglenoids
(2015)

19. Pick up the wrong statement.
(a) Some fungi are edible.
(b) Nuclear membrane is present in Monera.
(c) Cell wall is absent in Animalia.
(d) Protists have photosynthetic and heterotrophic modes of nutrition.
(2015)

20. Choose the wrong statement.
(a) Morels and truffles are poisonous mushrooms.
(b) Yeast is unicellular and useful in fermentation.
(c) *Penicillium* is multicellular and produces antibiotics.
(d) *Neurospora* is used in the study of biochemical genetics.
(2015)

21. Cell wall is absent in
(a) Mycoplasma (b) *Nostoc*
(c) *Aspergillus* (d) *Funaria*.
(2015)

22. True nucleus is absent in
(a) *Vaucheria* (b) *Volvox*
(c) *Anabaena* (d) *Mucor*.
(2015 Cancelled)

23. Which one of the following matches is correct?

(a)	*Mucor*	Reproduction by Conjugation	Ascomycetes
(b)	*Agaricus*	Parasitic fungus	Basidiomycetes
(c)	*Phytophthora*	Aseptate mycelium	Basidiomycetes
(d)	*Alternaria*	Sexual reproduction absent	Deuteromycetes

(2015 Cancelled)

24. Five kingdom system of classification suggested by R.H. Whittaker is not based on
(a) presence or absence of a well defined nucleus
(b) mode of reproduction
(c) mode of nutrition
(d) complexity of body organisation.
(2014)

25. Which of the following shows coiled RNA strand and capsomeres?
(a) Polio virus
(b) Tobacco mosaic virus
(c) Measles virus
(d) Retrovirus *(2014)*

26. Viruses have
(a) DNA enclosed in a protein coat
(b) prokaryotic nucleus
(c) single chromosome
(d) both DNA and RNA. *(2014)*

27. Archaebacteria differ from eubacteria in
(a) cell membrane structure
(b) mode of nutrition
(c) cell shape
(d) mode of reproduction. *(2014)*

28. Which structures perform the function of mitochondria in bacteria?
(a) Nucleoid (b) Ribosomes
(c) Cell wall (d) Mesosomes
(2014)

29. The motile bacteria are able to move by
(a) fimbriae (b) flagella
(c) cilia (d) pili.
(2014)

30. Anoxygenic photosynthesis is characteristic of
(a) *Rhodospirillum* (b) *Spirogyra*
(c) *Chlamydomonas* (d) *Ulva.*
(2014)

31. Which of the following are likely to be present in deep sea water?
(a) Blue-green algae (b) Saprophytic fungi
(c) Archaebacteria (d) Eubacteria
(NEET 2013)

32. Pigment containing membranous extensions in some cyanobacteria are
(a) pneumatophores (b) chromatophores
(c) heterocysts (d) basal bodies.
(NEET 2013)

33. Why is a capsule advantageous to a bacterium?
(a) It protects the bacterium from desiccation.
(b) It provides means of locomotion.
(c) It allows bacterium to "hide" from host's immune system.
(d) It allows the bacterium to attach to the surface.
(Karnataka NEET 2013)

34. Which one of the following is true for fungi?
(a) They lack a rigid cell wall.
(b) They are heterotrophs.
(c) They lack nuclear membrane.
(d) They are phagotrophs.
(Karnataka NEET 2013)

35. Which statement is wrong for viruses?
(a) All are parasites.
(b) All of them have helical symmetry.
(c) They have ability to synthesize nucleic acids and proteins.
(d) Antibiotics have no effect on them.
(2012)

36. Maximum nutritional diversity is found in the group
(a) fungi (b) animalia
(c) monera (d) plantae.
(2012)

37. Nuclear membrane is absent in
(a) *Penicillium* (b) *Agaricus*
(c) *Volvox* (d) *Nostoc.*
(2012)

38. The cyanobacteria are also referred to as
(a) protists (b) golden algae
(c) slime moulds (d) blue green algae.
(2012)

39. The most abundant prokaryotes helpful to humans in making curd from milk and in production of antibiotics are the ones categorised as
(a) cyanobacteria
(b) archaebacteria
(c) chemosynthetic autotrophs
(d) heterotrophic bacteria. *(2012)*

40. Which one single organism or the pair of organisms is correctly assigned to its or their named taxonomic group?
(a) *Paramecium* and *Plasmodium* belong to the same kingdom as that of *Penicillium*.
(b) Lichen is a composite organism formed from the symbiotic association of an algae and a protozoan.
(c) Yeast used in making bread and beer is a fungus.
(d) *Nostoc* and *Anabaena* are examples of protista. *(2012)*

41. Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition?
(a) *Azotobacter* (b) *Aspergillus*
(c) *Glomus* (d) *Trichoderma*
(2012)

42. In the five kingdom classification, *Chlamydomonas* and *Chlorella* have been included in

(a) protista (b) algae
(c) plantae (d) monera.
(Mains 2012)

43. Which one of the following also acts as a catalyst in a bacterial cell?
(a) 5S *r*RNA (b) snRNA
(c) hnRNA (d) 23S *r*RNA
(2011)

44. In eubacteria, a cellular component that resembles eukaryotic cell is
(a) plasma membrane (b) nucleus
(c) ribosomes (d) cell wall.
(2011)

45. Which one of the following organisms is not an eukaryote?
(a) *Paramecium caudatum*
(b) *Escherichia coli*
(c) *Euglena viridis*
(d) *Amoeba proteus* *(2011)*

46. Which one of the following is incorrectly matched?
(a) Root pressure-guttation
(b) *Puccinia*-smut
(c) Root-exarch protoxylem
(d) *Cassia*-imbricate aestivation
(2011)

47. The pathogen *Microsporum* responsible for ringworm disease in humans belongs to the same kingdom of organisms as that of
(a) *Taenia*, a tapeworm
(b) *Wuchereria*, a filarial worm
(c) *Rhizopus*, a mould
(d) *Ascaris*, a round worm. *(Mains 2011)*

48. Virus envelope is known as
(a) capsid (b) virion
(c) nucleoprotein (d) core.
(2010)

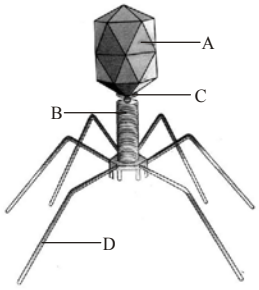
49. Single-celled eukaryotes are included in
(a) protista (b) fungi
(c) archaea (d) monera.
(2010)

50. Some hyperthermophilic organisms that grow in highly acidic (pH 2) habitats belong to the two groups
(a) eubacteria and archaea
(b) cyanobacteria and diatoms
(c) protists and mosses
(d) liverworts and yeasts. *(2010)*

51. One of the free-living, anaerobic nitrogen-fixer is
(a) *Beijernickia* (b) *Rhodospirillum*
(c) *Rhizobium* (d) *Azotobacter*.
(2010)

52. Membrane-bound organelles are absent in
(a) *Saccharomyces* (b) *Streptococcus*
(c) *Chlamydomonas* (d) *Plasmodium*.
(2010)

53. Give below is the diagram of a bacteriophage. In which one of the options all the four parts A, B, C and D are correct?



	A	B	C	D
(a)	Tail fibres	Head	Sheath	Collar
(b)	Sheath	Collar	Head	Tail fibres
(c)	Head	Sheath	Collar	Tail fibres
(d)	Collar	Tail fibres	Head	Sheath

(Mains 2010)

54. Select the correct combination of the statements (i-iv) regarding the characteristics of certain organisms.
(i) Methanogens are archaebacteria which produce methane in marshy areas.
(ii) *Nostoc* is a filamentous blue-green alga which fixes atmospheric nitrogen.
(iii) Chemosynthetic autotrophic bacteria synthesize cellulose from glucose.
(iv) Mycoplasma lack a cell wall and can survive without oxygen.
The correct statements are
(a) (ii) and (iii) (b) (i),(ii) and (iii)
(c) (ii), (iii) and (iv) (d) (i), (ii) and (iv).
(Mains 2010)

55. Black (stem) rust of wheat is caused by
(a) *Alternaria solani*
(b) *Ustilago nuda*
(c) *Puccinia graminis*
(d) *Xanthomonas oryzae.* *(Mains 2010)*

56. Phylogenetic system of classification is based on
(a) morphological features
(b) chemical constituents
(c) floral characters
(d) evolutionary relationships.
(2009)

57. T.O. Diener discovered a
(a) free infectious DNA
(b) infectious protein
(c) bacteriophage
(d) free infectious RNA. *(2009)*

58. Oxygenic photosynthesis occurs in
(a) *Oscillatoria* (b) *Rhodospirillum*
(c) *Chlorobium* (d) *Chromatium*.
(2009)

59. Which of the following is a symbiotic nitrogen fixer?
(a) *Azotobacter* (b) *Frankia*
(c) *Azolla* (d) *Glomus*
(2009)

60. Which one is the wrong pairing for the disease and its causal organism?
(a) Black rust of wheat-*Puccinia graminis*
(b) Loose smut of wheat-*Ustilago nuda*
(c) Root knot of vegetables-*Meloidogyne* sp.
(d) Late blight of potato-*Alternaria solani*
(2009)

61. Bacterial leaf blight of rice is caused by a species
(a) *Alternaria* (b) *Erwinia*
(c) *Xanthomonas* (d) *Pseudomonas*.
(2008)

62. *Thermococcus*, *Methanococcus* and *Methanobacterium* exemplify
(a) bacteria whose DNA is relaxed or positively supercoiled but which have a cytoskeleton as well as mitochondria
(b) bacteria that contain a cytoskeleton and ribosomes
(c) archaebacteria that contain protein homologous to eukaryotic core histones
(d) archaebacteria that lack any histones resembling those found in eukaryotes but whose DNA is negatively supercoiled.
(2008)

63. In the light of recent classification of living organisms into three domains of life (bacteria, archaea and eukarya), which one of the following statements in true about archaea?
(a) Archaea completely differ from both prokaryotes and eukaryotes.
(b) Archaea completely differ from prokaryotes.
(c) Archaea resemble eukarya in all respects.
(d) Archaea have some novel features that are absent in other prokaryotes and eukaryotes. *(2008)*

64. Which one of the following is a slime mould?
(a) *Physarum* (b) *Thiobacillus*
(c) *Anabaena* (d) *Rhizopus* *(2007)*

65. Which one of the following statements about mycoplasma is wrong?
(a) They are pleomorphic.
(b) They are sensitive to penicillin.
(c) They cause diseases in plants.
(d) They are also called PPLO. *(2007)*

66. Which pair of the following belongs to basidiomycetes?
(a) Puffballs and *Claviceps*
(b) *Peziza* and stink horns
(c) *Morchella* and mushrooms
(d) Birds nest fungi and puffballs *(2007)*

67. Curing of tea leaves is brought about by the activity of
(a) fungi (b) bacteria
(c) mycorrhiza (d) viruses. *(2006)*

68. Which of the following environmental conditions are essential for optimum growth of *Mucor* on a piece of bread ?
A. Temperature of about 25° C
B. Temperature of about 5° C
C. Relative humidity of about 5%
D. Relative humidity of about 95%
E. A shady place
F. A brightly illuminated place
Choose the answer from the following options.
(a) B, C and F only (b) A, C and E only
(c) A, D and E only (d) B, D and E only
(2006)

69. All of the following statements concerning the actinomycetous filamentous soil bacterium *Frankia* are correct except that *Frankia*
(a) can induce root nodules on many plant species
(b) can fix nitrogen in the free-living state
(c) cannot fix specialized vesicles in which the nitrogenase is protected from oxygen by a chemical barrier involving triterpene hopanoids

(d) like *Rhizobium*, it usually infects its host plant through root hair deformation and stimulates cell proliferation in the host's cortex. *(2005)*

70. For retting of jute the fermenting microbe used is
(a) methanophilic bacteria
(b) butyric acid bacteria
(c) *Helicobactor pylori*
(d) *Streptococcus lactin*. *(2005)*

71. Basophilic prokaryotes
(a) grow and multiply in very deep marine sediments
(b) occur in water containing high concentrations of barium hydroxide
(c) readily grow and divide in sea water enriched in any soluble salt of barium
(d) grow slowly in highly alkaline frozen lakes at high altitudes. *(2005)*

72. There exists a close association between the alga and the fungus within a lichen. The fungus
(a) provides protection, anchorage and absorption for the algae
(b) provides food for the alga
(c) fixes the atmospheric nitrogen for the alga
(d) releases oxygen for the alga. *(2005)*

73. Which of the following statements is *not* true for retroviruses?
(a) DNA is not present at any stage in the life cycle of retroviruses.
(b) Retroviruses carry gene for RNA-dependent DNA polymerase.
(c) The genetic material in mature retroviruses is RNA.
(d) Retroviruses are causative agents for certain kinds of cancer in man. *(2004)*

74. Viruses that infect bacteria multiply and cause their lysis, are called
(a) lysozymes (b) lipolytic
(c) lytic (d) lysogenic. *(2004)*

75. Phenetic classification of organisms is based on
(a) observable characteristics of existing organisms
(b) the ancestral lineage of existing organisms
(c) dendrogram based on DNA characteristics
(d) sexual characteristics. *(2004,2003)*

76. A free living nitrogen-fixing cyanobacterium which can also form symbiotic association with the water fern *Azolla* is
(a) *Tolypothrix* (b) *Chlorella*
(c) *Nostoc* (d) *Anabaena*. *(2004)*

77. During replication of a bacterial chromosome DNA synthesis starts from a replication origin site and
(a) RNA primers are involved
(b) is facilitated by telomerase
(c) moves in one direction of the site
(d) moves in bi-directional way. *(2004)*

78. Lichens are well known combination of an alga and a fungus where fungus has
(a) a saprophytic relationship with the alga
(b) an epiphytic relationship with the alga
(c) a parasitic relationship with alga
(d) a symbiotic relationship with alga. *(2004)*

79. Chromosomes in a bacterial cell can be 1 – 3 in number and
(a) are always circular
(b) are always linear
(c) can be either circular or linear, but never both within the same cell
(d) can be circular as well as linear within the same cell. *(2003)*

80. Which one of the following statements about viruses is correct ?
(a) Viruses possess their own metabolic system.
(b) All viruses contain both RNA and DNA.
(c) Viruses are obligate parasites.
(d) Nucleic acid of viruses is known as capsid. *(2003)*

81. Tobacco mosaic virus is a tubular filament of size
(a) 300 × 10 nm (b) 300 × 5 nm
(c) 300 × 20 nm (d) 700 × 30 nm. *(2003)*

82. Viruses are no more "alive" than isolated chromosomes because
(a) they require both RNA and DNA
(b) they both need food molecules
(c) they both require oxygen for respiration
(d) both require the environment of a cell to replicate. *(2003)*

83. In which kingdom would you classify the archaea and nitrogen-fixing organisms, if the five-kingdom system of classification is used ?
(a) Plantae (b) Fungi
(c) Protista (d) Monera *(2003)*

84. In five kingdom system, the main basis of classification is
(a) structure of nucleus
(b) mode of nutrition
(c) structure of cell wall
(d) asexual reproduction. *(2002)*

85. Which statement is correct for bacterial transduction?
(a) Transfer of some genes from one bacteria to another bacteria through virus.
(b) Transfer of genes from one bacteria to another bacteria by conjugation.
(c) Bacteria obtained its DNA directly from mother cell.
(d) Bacteria obtained DNA from other external source. *(2002)*

86. The growth curve of bacterial population in lab is plotted against time. What will be the shape of graph?
(a) Sigmoid (b) Hyperbolic
(c) Ascending straight line
(d) Descending straight line *(2002)*

87. Some bacteria are able to grow in streptomycin containing medium due to
(a) natural selection
(b) induced mutation
(c) reproductive isolation
(d) genetic drift. *(2002)*

88. In bacteria, plasmid is
(a) extra chromosomal material
(b) main DNA
(c) non functional DNA
(d) repetitive gene. *(2002)*

89. Choose the correct sequence of stages of growth curve for bacteria.
(a) Lag, log, stationary, decline phase
(b) Lag, log, decline, stationary phase
(c) Stationary, lag, log, decline phase
(d) Decline, lag, log phase, stationary *(2002)*

90. Which fungal disease spreads by seed and flowers?
(a) Loose smut of wheat
(b) Corn smut
(c) Covered smut of barley
(d) Soft rot of potato *(2002)*

91. Which of the following secretes toxins during storage conditions of crop plants?
(a) *Aspergillus* (b) *Penicillium*
(c) *Fusarium* (d) *Colletotrichum* *(2002)*

92. *Cauliflower mosaic* virus contains
(a) ss RNA (b) ds RNA
(c) ds DNA (d) ss DNA. *(2001)*

93. What is true for cyanobacteria?
(a) Oxygenic with nitrogenase
(b) Oxygenic without nitrogenase
(c) Non oxygenic with nitrogenase
(d) Non oxygenic without nitrogenase *(2001)*

94. What is true for archaebacteria?
(a) All halophiles
(b) All photosynthetics
(c) All fossils
(d) Oldest living beings *(2001)*

95. Difference in gram positive and gram negative bacteria is due to
(a) cell wall (b) cell membrane
(c) ribosome (d) cytoplasm. *(2001)*

96. Adhesive pad of fungi penetrate the host with the help of
(a) mechanical pressure and enzymes
(b) hooks and suckers
(c) softening by enzymes
(d) only by mechanical pressure. *(2001)*

97. Black rust of wheat is caused by
(a) *Puccinia* (b) *Ustilago*
(c) *Albugo* (d) *Phytophthora*. *(2000)*

98. A system of classification, in which a large number of traits are considered, is
(a) natural system
(b) phylogenetic system
(c) artificial system
(d) synthetic system. *(1999)*

99. Photosynthetic bacteria have pigments in
(a) chromoplasts (b) chromatophores
(c) leucoplasts (d) chloroplasts. *(1999)*

100. Columella is a specialized structure found in the sporangium of
(a) *Spirogyra* (b) *Ulothrix*
(c) *Rhizopus* (d) none of these. *(1999)*

101. In the five kingdom system of classification, which single kingdom out of the following can include blue-green algae, nitrogen fixing bacteria and methanogenic archaebacteria?
(a) Plantae (b) Protista
(c) Monera (d) Fungi *(1998)*

102. Transfer of genetic information from one bacterium to another in the transduction process is through
(a) bacteriophages released from the donor bacterial strain
(b) another bacterium having special organ for conjugation
(c) physical contact between donor and recipient strains
(d) conjugation between opposite strain bacterium. *(1998)*

103. A bacterium divides every 35 minutes. If a culture containing 10^5 cells per ml is grown for 175 minutes, what will be the cell concentration per ml after 175 minutes?
(a) 35×10^5 cells (b) 32×10^5 cells
(c) 175×10^5 cells (d) 85×10^5 cells *(1998)*

104. The DNA of *E.coli* is
(a) double stranded and linear
(b) double stranded and circular
(c) single stranded and linear
(d) single stranded and circular. *(1998)*

105. The main role of bacteria in the carbon cycle involves
(a) chemosynthesis
(b) digestion or breakdown of organic compounds
(c) photosynthesis
(d) assimilation of nitrogenous compounds. *(1998)*

106. A few organisms are known to grow and multiply at temperatures of 100-105°C. They belong to
(a) thermophilic sulphur bacteria
(b) hot spring blue-green algae
(c) methanogenic archaebacteria
(d) marine archaebacteria. *(1998)*

107. *Puccinia* forms uredia and
(a) telia on wheat leaves
(b) aecia on barberry leaves
(c) pycnia on barberry leaves
(d) aecia on wheat leaves. *(1998)*

108. Viruses possess
(a) ribosomes to synthesize protein
(b) organelle for its vital mechanism
(c) either DNA or RNA
(d) none of these. *(1997)*

109. Which of the following is free-living aerobic non-photosynthetic nitrogen-fixing bacterium?
(a) *Nostoc* (b) *Azospirillum*
(c) *Rhizobium* (d) *Azotobacter* *(1997)*

110. The site of respiration in bacteria is
(a) ribosome (b) microsome
(c) episome (d) mesosome. *(1997)*

111. The hereditary material present in the bacterium *E.coli* is
(a) single-stranded DNA
(b) double-stranded DNA
(c) DNA
(d) RNA. *(1997)*

112. Genes are packaged into a bacterial chromosome by
(a) acidic protein (b) actin
(c) histones (d) basic protein. *(1997)*

113. Most of the lichens consist of
(a) green algae and ascomycetes
(b) brown algae and higher plant
(c) blue green algae and basidiomycetes
(d) red algae and ascomycetes. *(1997)*

114. What is the genetic material in *influenza virus*?
(a) Double helical DNA
(b) RNA
(c) Single helix DNA
(d) None of these *(1996)*

115. BGA (blue green algae) are included in which of the following groups?
(a) Bryophytes (b) Prokaryotes
(c) Protista (d) Fungi *(1996)*

116. *Azotobacter* and *Bacillus polymyxa* are the examples of

(a) pathogenic bacteria
(b) decomposers
(c) symbiotic N_2 fixer
(d) non-symbiotic N_2 fixer. *(1996)*

117. What are the sex organs provided in some bacteria?
(a) Sex pili (b) Plasmid
(c) Circular DNA (d) Gametes *(1996)*

118. Which type of DNA is found in bacteria?
(a) Circular free DNA
(b) Membrane bound DNA
(c) Straight DNA
(d) Helical DNA *(1996)*

119. Which one of the following statement about lichens is wrong?
(a) These grow very rapidly (2 cm per day).
(b) They show fungal and algal symbiotic relationships.
(c) Some of its species are eaten by reindeers.
(d) These are pollution indicators. *(1996)*

120. *Mycorrhiza* is correctly described as
(a) parasitic association between roots and some fungi
(b) symbiotic relationship between fungi and roots of some higher plants
(c) symbiosis of algae and fungi
(d) relation of ants with the stem of some trees. *(1996)*

121. The tailed bacteriophages are
(a) motile on surface of bacteria
(b) non-motile
(c) motile on surface of plant leaves
(d) actively motile in water. *(1995)*

122. A large number of organic compounds can be decomposed by
(a) *Azotobacter*
(b) chemolithotrophs
(c) *Mycoplasma*
(d) *Pseudomonas*. *(1995)*

123. The black rust of wheat is a fungal disease caused by
(a) *Albugo candida*
(b) *Puccinia graminis tritici*
(c) *Melampsora lini*
(d) *Claviceps purpurea*. *(1995)*

124. *Tobacco mosaic virus* (*TMV*) genes are
(a) single stranded RNA
(b) double stranded DNA
(c) proteinaceous
(d) double stranded RNA. *(1994)*

125. Phylogenetic classification is one which is based on
(a) overall similarities
(b) utilitarian system
(c) habits of plants
(d) common evolutionary descent. *(1994)*

126. The protists have
(a) only free nucleic acid aggregates
(b) membrane bound nucleo proteins lying embedded in the cytoplasm
(c) gene containing nucleoproteins condensed together in loose mass
(d) nucleoprotein in direct contact with the rest of the cell substance. *(1994)*

127. Organisms, which fix atmospheric nitrogen in the soil, fall under the category of
(a) bacteria (b) green algae
(c) soil fungi (d) mosses. *(1994)*

128. Transduction in bacteria is mediated by
(a) plasmid vectors (b) phage vectors
(c) cosmids (d) F-factors. *(1994)*

129. A non-photosynthetic aerobic nitrogen fixing soil bacterium is
(a) *Rhizobium* (b) *Clostridium*
(c) *Azotobacter* (d) *Klebsiella*. *(1994, 1990)*

130. Mycorrhiza exhibits the phenomenon of
(a) parasitism (b) symbiosis
(c) antagonism (d) endemism. *(1994)*

131. Schizont stage of *Plasmodium* occurs in human cells
(a) erythrocytes (b) liver cells
(c) erythrocytes and liver cells
(d) erythrocytes, liver cells and spleen cells. *(1993)*

132. If all ponds and puddles are destroyed, the organism likely to be destroyed is
(a) *Leishmania* (b) *Trypanosoma*
(c) *Ascaris* (d) *Plasmodium*. *(1993)*

133. Genophore/bacterial genome or nucleoid is made of
(a) histones and nonhistones
(b) RNA and histones
(c) a single double stranded DNA
(d) a single stranded DNA. *(1993)*

134. *Escherichia coli* is used extensively in biological research as it is
(a) easily cultured
(b) easily available
(c) easy to handle
(d) easily multiplied in host. *(1993)*

135. The part of life cycle of malarial parasite *Plasmodium vivax*, that is passed in female *Anopheles* is
(a) sexual cycle
(b) pre-erythrocytic schizogony
(c) exoerythrocytic schizogony
(d) post-erythrocytic schizogony. *(1992)*

136. Bacteria lack alternation of generation because there is
(a) neither syngamy nor reduction division
(b) distinct chromosomes are absent
(c) no conjugation
(d) no exchange of genetic material.
(1992, 1991)

137. Organisms which are indicator of SO_2 pollution of air
(a) mosses (b) lichens
(c) mushrooms (d) puffballs.
(1992)

138. An important criterion for modern day classification is
(a) resemblances in morphology
(b) anatomical and physiological traits
(c) breeding habits
(d) presence or absence of notochord.
(1991)

139. In *Amoeba* and *Paramecium* osmoregulation occurs through
(a) pseudopodia
(b) nucleus
(c) contractile vacuole
(d) general surface. *(1991)*

140. African sleeping sickness is due to
(a) *Plasmodium vivax* transmitted by tse-tse fly
(b) *Trypanosoma lewsii* transmitted by bed bug
(c) *Trypanosoma gambiense* transmitted by *Glossina palpalis*
(d) *Entamoeba gingivalis* spread by housefly.
(1991)

141. Malignant tertian malarial parasite, belongs to class
(a) *Plasmodium falciparum*
(b) *P. vivax*
(c) *P. ovale*
(d) *P. malariae.* *(1991)*

142. Who discovered *Plasmodium* in R.B.C. of human beings?
(a) Ronald Ross (b) Mendel
(c) Laveran (d) Stephens *(1991)*

143. Name the organisms which do not derive energy directly or indirectly from sun.
(a) Chemosynthetic bacteria
(b) Pathogenic bacteria
(c) Symbiotic bacteria
(d) Mould *(1991)*

144. *Plasmodium*, the malarial parasite, belongs to class
(a) sarcodina (b) ciliata
(c) sporozoa (d) dinophyceae.
(1990)

145. Amoebiasis is prevented by
(a) eating balanced food
(b) eating plenty of fruits
(c) drinking boiled water
(d) using mosquito nets. *(1990)*

146. Which is true about *Trypanosoma*?
(a) Polymorphic
(b) Monogenetic
(c) Facultative parasite
(d) Non-pathogenic *(1990)*

147. Genetic information in *Paramecium* is contained in
(a) micronucleus (b) macronucleus
(c) both micronucleus and macronucleus
(d) mitochondria. *(1990)*

148. The infective stage of malarial parasite, *Plasmodium* that enters human body is
(a) merozoite (b) sporozoite
(c) trophozoite (d) minuta form.
(1990)

149. The main difference in Gram (+)ve and Gram (–)ve bacteria resides in their
(a) cell wall (b) cell membrane
(c) cytoplasm (d) flagella.
(1990)

150. Which one belongs to monera?
(a) *Amoeba* (b) *Escherichia*
(c) *Gelidium* (d) *Spirogyra*
(1990)

151. Absorptive heterotrophic nutrition is exhibited by
(a) algae (b) fungi
(c) bryophytes (d) pteridophytes. *(1990)*

152. System of classification used by Linnaeus was
(a) natural system
(b) artificial system
(c) phylogenetic system
(d) asexual system. *(1989)*

153. Artificial system of classification was first used by
(a) Linnaeus
(b) De Candolle
(c) Pliny the Edler
(d) Bentham and Hooker. *(1989)*

154. A bite of tse-tse fly may pass to humans
(a) *Leishmania donovani*
(b) *Trypanosoma gambiense*
(c) *Entamoeba histolytica*
(d) *Plasmodium vivax*. *(1989)*

155. Malaria fever coincides with liberation of
(a) cryptomerozoties
(b) metacryptomerozoites
(c) merozoites (d) trophozoites. *(1989)*

156. *Trypanosoma* belongs to class
(a) sarcodina (b) zooflagellata
(c) ciliata (d) sporozoa. *(1989)*

157. The vector for sleeping sickness is
(a) housefly (b) tse-tse fly
(c) sandfly (d) fruit fly. *(1989)*

158. The causal organism for African sleeping sickness is
(a) *Trypanosoma cruzi*
(b) *T. rhodesiense*
(c) *T. tangela*
(d) *T. gambiense*. *(1989)*

159. Lichens indicate SO_2 pollution because they
(a) show association between algae and fungi
(b) grow faster than others
(c) are sensitive to SO_2
(d) flourish in SO_2 rich environment. *(1989)*

160. Classification given by Bentham and Hooker is
(a) artificial (b) natural
(c) phylogenetic (d) numerical. *(1988)*

Answer Key

1.	(d)	**2.**	(c)	**3.**	(b)	**4.**	(c)	**5.**	(b)	**6.**	(b)	**7.**	(b)	**8.**	(a)	**9.**	(a)	**10.**	(a)
11.	(b)	**12.**	(c)	**13.**	(d)	**14.**	(d)	**15.**	(c)	**16.**	(d)	**17.**	(c)	**18.**	(c)	**19.**	(b)	**20.**	(a)
21.	(a)	**22.**	(c)	**23.**	(d)	**24.**	(b)	**25.**	(b)	**26.**	(a)	**27.**	(a)	**28.**	(d)	**29.**	(b)	**30.**	(a)
31.	(c)	**32.**	(b)	**33.**	(c)	**34.**	(b)	**35.**	(b)	**36.**	(c)	**37.**	(d)	**38.**	(d)	**39.**	(d)	**40.**	(c)
41.	(c)	**42.**	(a)	**43.**	(d)	**44.**	(a)	**45.**	(b)	**46.**	(b)	**47.**	(c)	**48.**	(a)	**49.**	(a)	**50.**	(a)
51.	(b)	**52.**	(b)	**53.**	(c)	**54.**	(d)	**55.**	(c)	**56.**	(d)	**57.**	(d)	**58.**	(a)	**59.**	(b)	**60.**	(d)
61.	(c)	**62.**	(c)	**63.**	(d)	**64.**	(a)	**65.**	(b)	**66.**	(d)	**67.**	(b)	**68.**	(c)	**69.**	(b)	**70.**	(b)
71.	(a)	**72.**	(a)	**73.**	(a)	**74.**	(c)	**75.**	(a)	**76.**	(d)	**77.**	(d)	**78.**	(d)	**79.**	(a)	**80.**	(c)
81.	(c)	**82.**	(d)	**83.**	(d)	**84.**	(b)	**85.**	(a)	**86.**	(b)	**87.**	(a)	**88.**	(a)	**89.**	(a)	**90.**	(a)
91.	(a,b)	**92.**	(c)	**93.**	(a)	**94.**	(d)	**95.**	(a)	**96.**	(a)	**97.**	(a)	**98.**	(a)	**99.**	(b)	**100.**	(c)
101.	(c)	**102.**	(a)	**103.**	(b)	**104.**	(b)	**105.**	(b)	**106.**	(a)	**107.**	(a)	**108.**	(c)	**109.**	(d)	**110.**	(d)
111.	(b)	**112.**	(d)	**113.**	(a)	**114.**	(b)	**115.**	(b)	**116.**	(d)	**117.**	(a)	**118.**	(a)	**119.**	(a)	**120.**	(b)
121.	(a)	**122.**	(b)	**123.**	(b)	**124.**	(a)	**125.**	(d)	**126.**	(b)	**127.**	(a)	**128.**	(b)	**129.**	(c)	**130.**	(b)
131.	(c)	**132.**	(d)	**133.**	(c)	**134.**	(a)	**135.**	(a)	**136.**	(a)	**137.**	(b)	**138.**	(b)	**139.**	(c)	**140.**	(c)
141.	(a)	**142.**	(c)	**143.**	(a)	**144.**	(c)	**145.**	(c)	**146.**	(a)	**147.**	(a)	**148.**	(b)	**149.**	(a)	**150.**	(b)
151.	(b)	**152.**	(b)	**153.**	(a)	**154.**	(b)	**155.**	(b)	**156.**	(b)	**157.**	(b)	**158.**	(d)	**159.**	(c)	**160.**	(b)

EXPLANATIONS

1. (d) : Halophiles, a type of archaebacteria, usually occur in extreme saline conditions like salt pans, salt beds and salt marshes.

2. (c) : Viroids are free RNA particles that lack protein coat. They are infectious agents smaller than viruses.

3. (b) : Mycoplasmas are the smallest living cells, known without a definite cell wall. They are pathogenic to both plants and animals and can survive without oxygen.

4. (c) : Glycocalyx is the outermost mucilage layer of the cell envelope which consists of non-cellulosic polysaccharides with or without proteins. It gives sticky character to the cell.

5. (b) : DNA replicates in bacteria just before they divide by fission.

6. (b) : Cell wall in fungi is composed of chitin, a polysaccharide comprising N-acetyl-D-glucosamine (a derivative of glucose).

7. (b) : Methanogens belong to archaebacteria. They include methane producing genera such as *Methanobacillus* and *Methanothrix*. Methanogens are obligate anaerobes found in oxygen-deficient environments, such as marshes, swamps, sludge (formed during sewage treatment), and the digestive systems of ruminants. Mostly they obtain their energy by reducing carbon dioxide and oxidising hydrogen, with the production of methane.

8. (a) : Diatoms are marine or freshwater unicellular organisms which have cell walls (frustules) composed of pectin impregnated with silica and consisting of two halves, one overlapping the other. The siliceous frustules of diatoms do not decay easily.

9. (a) : *Refer to answer 7.*

10. (a) : Eubacteria are also called true bacteria.

11. (b) : RNA of viroid has low molecular weight.

12. (c) : Fungal cell wall contains chitin or fungal cellulose along with other polysaccharides, proteins, lipids and a number of other substances.

13. (d) : Protista is a kingdom of unicellular eukaryotic organisms. It includes photosynthetic protists (dinoflagellates, chrysophytes and euglenoids), consumer-decomposer protists (slime moulds) and protozoan protists.

14. (d) : *Mucor* is a member of Zygomycetes (the conjugation fungi) in which motile cells *e.g.* zoospores, planogametes, etc. are absent. Asexual reproduction takes place by the formation of non-motile mitospores called sporangiospores. Sexual reproduction takes place by the formation of non-motile zygospores.

15. (c) : Deuteromycetes are the imperfect fungi which include all those fungi in which sexual stage is either absent or not known. Some members are saprophytes or parasites while a large number of them are decomposers of litter and help in mineral cycling. *E.g.*, *Colletotrichum*, *Helminthosporium* etc.

16. (d) : Fimbriae are small bristle-like solid structures arising from bacterial cell surface. There are 300-400 of fimbriae per cell. Their diameter is 3-10 nm while length is 0.5-1.5 μm. Fimbriae are involved in attaching bacteria to solid surfaces (*e.g.*, rock in water body) or host tissues (*e.g.*, urinary tract in *Neisseria gonorrhoeae*). Some fimbriae cause agglutination of RBCs. They also help in mutual clinging of bacteria.

17. (c) : Viroids are infectious RNA particles which were discovered by T.O. Diener (1971). These are devoid of protein coat and cause diseases in plants only, *e.g.*, potato spindle tuber, chrysanthemum stunt etc.

18. (c) : Chrysophytes include diatoms and desmids. The body of diatoms is covered by a transparent siliceous shell (silica deposited in cell wall) known as frustule. The frustule is made of two valves, epitheca and hypotheca, which fit together like a soap box.

19. (b) : Kingdom Monera consists of prokaryotic organisms, characterised by absence of nuclear envelope around nucleus and absence of membrane-bound cell organelles.

20. (a) : Morels are Ascomycetes with edible ascocarps that have fleshy sponge-like conical cap or pileus and a stalk like stipe, *e.g.*, *Morchella esculenta*. Truffles are also edible members of Ascomycetes with tuber-like subterranean ascocarps that are often dug out with the help of trained dogs and pigs, *e.g.*, *Tuber aestivum*.

21. (a) : Mycoplasma (Kingdom-Monera) are the simplest and smallest free living prokaryotes which

are devoid of a cell wall. Plasma membrane forms the outer boundary of the cell of mycoplasma.
Nostoc is a cyanobacterium (Kingdom- Monera), in which cell wall comprises of peptidoglycans. *Aspergillus* is a fungus (Kingdom-Fungi) in which cell wall is mainly made of chitin. *Funaria* is a bryophyte (Kingdom-Plantae) in which cell wall is cellulosic in nature.

22. (c) : *Anabaena* is a prokaryotic organism. It is a cyanobacteria (blue green algae) which belongs to Kingdom Monera. Like all other prokaryotes, it lacks a true nucleus and other cell organelles.

23. (d) : *Alternaria* is a Deuteromycetes member which are also known as fungi imperfecti. Their perfect stages (sexually reproducing stages) are either absent or not known.

24. (b) : R.H. Whittaker considered complexity of cell structure and structural (body) organisation, mode of nutrition, ecological life style and phylogenetic relationships for the five kingdom system of classification.

25. (b) : Tobacco mosaic virus is a RNA virus that causes tobacco mosaic disease. It has single stranded coiled RNA molecule as its genetic material a part of which hangs outside the protein coat. Protein coat consists of approximately 2130 capsomeres which are helically arranged to form a hollow cylinder of about 4 nm diameter.

26. (a) : Viruses are nucleoprotein entities which are able to utilize synthetic machinery of a living cell of the host organism for its multiplication which does not involve growth and division. They have either RNA or DNA as genetic material and a protein coat.

27. (a) : The archaebacteria are the 'ancient' bacteria that include extremophiles like methanogens, halophiles and thermophiles. They represent some of the most ancient of life forms that persist today. They have both eubacterial and eukaryotic characters besides the features unique to them. Their mode of reproduction, nutrition and cell shape and size resembles a typical eubacteria. Their cell walls are made of a variety of polymers, but do not contain peptidoglycan unlike eubacteria. Lipids of their cytoplasmic membranes are ether linked unlike eubacteria which contain glycerol ester lipids in their cell membrane.

28. (d) : Mesosome is a characteristic circular to villiform specialisation of bacterial cell membrane that develops as an ingrowth. It consists of vesicles, tubules and lamellae. Mesosomes may be septal or lateral. Septal mesosome connects nucleoid with plasma membrane and assists in replication and septum formation during cells division. Lateral mesosome is not connected with nucleoid and contains respiratory enzymes and performs functions similar to eukarytoic mitochondria and hence is also called chondrioid. They also increase the surface area of plasma membrane and enzymatic contact.

29. (b) : Flagellum is the organ of motility in bacteria. Bacterial flagella are unistranded, equivalent to a single microtubular fibre and formed of protein called flagellin. They perform rotatory movements.

30. (a) : In *Rhodospirillum,* electron donor is organic compound instead of water hence no oxygen is released, *i.e.,* anoxygenic photosynthesis occurs. In other plants water is used as electron donor and H^+ and O_2 are produced during photolysis of water.

31. (c) : Archaebacteria belong to a group of prokaryotic organisms called Monera. These include the methanogens, which produce methane; the thermoacidophilic bacteria, which live in extremely hot and acidic environments (such as hot springs); and the halophilic bacteria, which can only function at high salt concentrations and are abundant in the world's oceans.

32. (b) : Chromatophore is a pigmented lamellar or vesicular structure that can be isolated from disrupted photosynthetic bacteria or cyanobacteria. Their plasma membrane may be projected in folds into the cytoplasm forming lamellae that have, therefore, double unit-membrane structure. The pigments and most of the enzymes required for the light-induced electron transport and phosphorylation processes of photosynthesis, are located in the plasma membrane and lamellae.

33. (c) : S-type bacteria or virulent bacteria are capsulated. The capsule is made up of polysaccharides and amino acids. It is a tough and thick mucilage covering. It gives protection to bacteria against host's immune system.

34. (b) : Fungi are achlorophyllous, heterotrophic, spore forming, non-vascular, eukaryotic organisms which often contain chitin or fungal cellulose in their walls. Hence, their cell wall is rigid.

35. (b) : In viruses, three architectural forms are found – helical (elongated body, *e.g.*, TMV), cuboidal (short broad body with rhombic, rounded, polyhedral shape *e.g*,. poliovirus) and binal (with both cuboidal and helical parts *e.g.*, T_2 phage).

36. (c) : Though the bacterial structure is very simple, they are very complex in behaviour. Compared to many other organisms, bacteria as a group show the most extensive metabolic diversity. Some of the bacteria are autotrophic, *i.e.,* they synthesize their own food from inorganic substrates. They may be photosynthetic autotrophic or chemosynthetic autotrophic. The vast majority of bacteria are heterotrophs, *i.e.*, they do not synthesize their own food but depend on other organisms or on dead organic matter for food.

37. (d) : *Penicillium* and *Agaricus* are fungi while *Volvox* is an alga. All three are eukaryotes thus have a membrane bound nucleus. *Nostoc* is a cyanobacterium, *i.e.,* prokaryote, so it lacks true nucleus, thus nuclear membrane is absent.

38. (d) : Cyanobacteria is a phylum consisting of two groups of photosynthetic eubacteria: the blue-green bacteria (formerly known as blue-green algae, or cyanophyta), which comprise the vast majority of members, and the grass-green bacteria, or chloroxybacteria.

39. (d) : Maximum number of antibiotics are produced by mycelial bacteria known as actinomycetes and most of the actinomycetes are saprotrophic (heterotrophic). Lactic acid bacteria that are used in preparation of curd are also heterotrophic ones.

40. (c) : Yeast is a group of unicellular fungi of the class ascomycetes. They occur as single cell or as a group or chain of cells. Yeast of the genus *Saccharomyces* ferments sugar and are used to make bread and beer.

41. (c) : *Azotobacter*, *Aspergillus* and *Trichoderma* all are free living microbes that help plants in their nutrition. *Glomus* is a fungus that symbiotically forms endomycorrhiza that helps in absorption of nutrition specially phosphorus from soil.

42. (a) : In order to develop phylogenetic classification, R.H. Whittaker (1969), an American taxonomist, divided all the organisms into five kingdoms. Whittaker has used five criteria for delimiting the different kingdoms. (i) Complexity of cell structure, prokaryotic and eukaryotic (ii) Complexity of body structure or structural organization, unicellular and multicellular. (iii) Mode of nutrition which is divergent in multicellular kingdoms. (iv) Ecological life style like producers (plantae), decomposers (fungi) and consumers (animalia), (v) Phylogenetic relationship. When such characteristics were considered, the fungi were placed in a separate kingdom – Kingdom Fungi. All prokaryotic organisms were grouped together under Kingdom Monera and the unicellular eukaryotic organisms were placed in Kingdom Protista. Kingdom Protista has brought together *Chlamydomonas*, *Chlorella* (earlier placed in Algae within Plants and both having cell walls) with *Paramoecium* and *Amoeba* (which were earlier placed in the animal kingdom which lack cell wall). It has put together organisms which, in earlier classifications, were placed in different kingdoms. This happened because the criteria for classification changed.

43. (d) : The 23S *r*RNA is a component of the large prokaryotic (bacterial cell) subunit (50S). The ribosomal peptidyl transferase activity resides in this *r*RNA and acts as a ribozyme (catalytic RNA). In eukaryotic cells, the 60S (28S component) ribosome subunit contains the peptidyl transferase component and acts as the ribozyme.

44. (a) : Plasma membrane of eubacteria resembles plasma membrane of eukaryotic cell. But nucleus, ribosomes and cell wall are little different in eukaryotic cell in their structure and organization from eubacterial cell.

45. (b) : *Escherichia coli* (bacterium) is not an example of eukaryotic cell. It is a typical example of prokaryotic cell.

46. (b) : Rust is a group of parasitic fungi of the phylum Basidiomycota. Many of these species attack the leaves and stems of cereal crops. Pathogens of rust are *Puccinia*, *Uromyces*, *Melampsora*, *Hemileia*.

47. (c) : The pathogen *Microsporum* is genus of Kingdom Fungi that causes diseases of skin and hair in humans and animals like dog, cat, monkey. Ringworm is caused by the dermatophyte fungi-species of *Microsporum*, *Trichophyton* and *Epidermophyton*.
Rhizopus, a black bread mould belongs to group zygomycetes of Kingdom Fungi.

48. (a) : The nucleic acid of a virus is surrounded by a protein coat called the capsid. The capsid is composed of protein subunits called capsomeres. In some viruses, the capsid is covered by an envelope, which usually consists of some combination of lipids, proteins and carbohydrates.

49. (a) : Protista include all unicellular and colonial eukaryotes except those of green and red algae. The protistan cells are typically eukaryotic having membrane bound organelles like mitochondria, chloroplasts, Golgi bodies, endoplasmic reticulum, nucleus etc. Protista is commonly known as kingdom of unicellular eukaryotes. Kingdom fungi contains achlorophyllous, spore producing, heterotrophic, multicellular or multinucleate eukaryotic organisms (unicellular yeasts are also included amongst fungi because their sexual reproduction is similar to that of some fungi). Monerans are basically unicellular prokaryotes. Archaea (ancient bacteria) are also a type of monerans which live in primitive environment like high temperature, high salt content, acidic pH, etc.

50. (a) : There are two major groups of monerans archaebacteria (ancient bacteria) and eubacteria (true bacteria). Eubacteria is of further two types – bacteria and cyanobacteria. Thermoacidophiles are a type of archaebacteria which live in extremely acidic environment (pH 2) that have extremely high temperatures (upto 110°C). They are found in hot sulphur springs. Some of the eubacteria are also famous for living under the most hostile environment like salt pans, petroleum pans, spilled oil, hot springs, sulphur springs, snow, etc.

51. (b) : Many free living bacteria and blue green algae are capable to fix atmospheric nitrogen *Rhodospirillum* is a free living photosynthetic anaerobic nitrogen fixing non-sulphur bacteria. It is capable of synthesizing its organic food in presence of light and in absence of O_2 by a process known as bacterial photosynthesis. *Beijernickia* and *Azotobacter* are free living but aerobic nitrogen fixing bacteria. *Rhizobium* is a symbiotic nitrogen fixing bacteria.

52. (b) : *Streptococcus* is a bacteria which is included under Kingdom Monera. Monerans have prokaryotic cell organisation in which membrane bound organelles like mitochondria, E.R., Golgi bodies, etc. are absent. All the other three *i.e.*, *Saccharomyces* (a fungus) *Chlamydomonas* (an algae) and *Plasmodium* (a protozoan protist) are eukaryotes containing true membrane bound organelles.

53. (c) : A – Head
B – Sheath
C – Collar
D – Tail fibre

54. (d) : Chemosynthetic autotrophic bacteria oxidise various inorganic substances such as nitrates, nitrites and ammonia and use the released energy for their ATP production. They play a great role in recycling nutrients like nitrogen, phosphorous, iron and sulphur.

55. (c) : Black stem rust is caused by *Puccinia graminis tritici.* The genus *Puccinia* includes 700 species, which cause rust diseases of many economic plants such as wheat, barley, oats, etc.
It is called a rust because of the reddish brown color of the spores that are found chiefly upon the surface of the host leaves and stems. *P. graminis* is heteroecious *i.e.*, requiring two hosts, wheat and barberry for the completion of normal life cycle.
According to the nature of the spores, the life cycle of the *P. graminis* is divided into five stages. It is during, teleuto stage, the teliospore (or teleutospores) produce dark brown to black pustules on the surface of stems and leaves of the wheat that results into 'black stem rust of wheat'.

56. (d) : Plylogenetic system or cladistics is based on evolutionary sequence as well as the genetic relationship among the living beings. Engler and Prantl's System of Classification was jointly proposed in *Die Naturlichen Pflanzen Familien* in 1892. It is the first phylogenetic system of classification which includes all the plants from algae to angiosperms arranged in an evolutionary sequence from simplicity to complexity.

57. (d) : *Refer to answer 17.*

58. (a) : *Oscillatoria* is a filamentous Gram-ve cyanobacteria which perform oxygenic photosynthesis because of the presence of chlorophyll-*a* like eukaryotic algae and higher plants.

59. (b) : *Frankia*, is a nitrogen fixing symbiotic bacteria. It induces root nodules just like *Rhizobium*. It is associated symbiotically with the root nodules of several non-legume plants like *Casuarina*, *Alnus*, *Rubus* etc. It cannot fix nitrogen in free state.

60. (d) : Late blight of potato disease is caused by *Phytophthora infestans*. It is a phycomycetes fungus. *Alternaria solani* is the causal organism of early blight of potato disease.

61. (c) : Bacterial leaf blight of rice is caused by *Xanthomonas oryzae* a bacterium which is gram-negative, aerobic, capsulated, and motile with a single polar flagellum. Primary infection is carried through the infected seeds. The entry of the pathogen occurs through wounds and stomata. The symptoms of the disease is the appearance of linear, yellow to straw coloured stripes, usually on both the edges of the leaf. As the disease progresses, the drying and twisting of the leaf tip occurs. The most destructive phase of the disease is the 'Ikresek' or wilt resulting from early systematic infection.

62. (c) : *Thermococcus*, *Methanococcus* and *Methanobacterium* are examples of archaebacteria which are characterized by a unique cell wall that lack peptidoglycan and consist of polysaccharides and protein and closely resemble the eukaryotic cell in the mechanism of protein synthesis, structural protein and RNA compliments of the ribosomes.

63. (d) : Archaebacteria represent a cell type that seems to possess the characteristics of both prokaryotes as well as eukaryotes. In size, the archaebacteria are about 1 μm in diameter, the size of typical prokaryotes lack membrane-bound organelles, nuclear bodies are not bound by nuclear membranes as it is in eukaryotes and ribosomes are 70S, the size of those found in typical prokaryotes. They have unique cell wall that lacks peptidoglycan, closely resemble the eukaryotic cells in the mechanisms of protein synthesis, structural proteins, and RNA compliments of the ribosomes and a very distinctive feature of archeabacterial genes is the presence of introns, elements that are totally unknown in other prokaryotes, though relatively common in eukaryotes.Archaebacteria also possess unique characteristic found in neither eukaryotes nor prokaryotes. For example, their membrane contain branched chain lipids with ether. This enables them to tolerate extremes of heat and pH.

64. (a): Slime moulds are peculiar protista that normally take the form of amoebae, but under certain conditions develop fruiting bodies that release spores, superficially similar to the sporangia of fungi. The order physarales include *Physarum species*. The fruiting bodies (sporangia) are characterized by the presence of abundant amount of calcium salt. The order comprises 142 species which are placed under 12 genera. *Physarum polycephalam* is the best known. The somatic phase is multinucleate, diploid holocarpic plasmodium which is the product of syngamy.

65. (b) : Mycoplasma are small, unicellular, (non-motile) prokaryotic organisms. They are pleomorphic. Therefore they are known as pleuro pneumonia like organisms (PPLO). They lack cell wall. It contains cytoplasm, ribosomes and DNA. They are inhibited by tetracyclines but insensitive to penicillin. They cause various diseases.

66. (d) : The *Cyathus* is known as bird's nest fungi, and *Lycoperdon* is called puff balls. Both these fungi belong to the group of club fungi or basidiomycetes. These fungi produce spores inside club shaped fruit bodies called basidium. Typically basidium has 4 basidiospores produced exogenously. *Peziza* and *Morchella*, *Claviceps* belong to ascomycetes (produce ascospores in ascocarps). Mushroom are basidiomycetes fungi.

67. (b) : Curing is a process done to add special flavour and taste in tea leaves. It is also done for tobacco. In this process after harvesting the cured leaves are hung in shade and are permitted for the action of bacteria. The curing of tea leaves is done by *Mycrococcus candidans*. *Mycrococcus* is a gram positive aerobic bacterium which is a member of micrococcaceae.

68. (c) : *Mucor* is a filamentous fungus found in the humus of soil decaying fruits, vegetables. It is commonly known as black mould. Most of the *Mucor* sp. are unable to grow at 37ºC and the strains isolated from human infections are usually one of the few thermotolerant *Mucor* sp. Colonies of *Mucor* grow rapidly at 25-30ºC, humidity about 90-95% and quickly cover the surface of the agar. It requires moist and shady place for its growth. Many sp. of *Mucor* are responsible for causing roting of fruit and vegetables. A few sp. *e.g., Mucor pusillus* are pathogenic to man.

69. (b) : *Frankia*, is a nitrogen fixing symbiotic bacteria. It induces root nodules just like *Rhizobium*. It is associated symbiotically with the root nodules of several non-legume plants like *Casuarina*, *Alnus*, *Rubus* etc. It cannot fix nitrogen in free state.

70. (b) : Retting is the process of separating fibres that are held together in close association using a variety of bacteria. Fibres of jute are held together in

close association and they are separated by the action of butyric acid bacteria *e.g. Clostridium butyricum*. These plants are immersed in water so that they absorb water and swell. Due to the activity of bacteria, the pectic substances of middle lamella are hydrolysed and the fibres are separated. These separated fibres are used in making of ropes and sacks.

71. (a) : Basopilic prokaryotes are facultatively anaerobic bacteria. They grow and multiply in very deep marine sediments. Most basophiles grow better at a pH of 8.5 or higher.

72. (a) : Lichens are peculiar dual organisms produced by the intimate association of two organisms: a fungus and an alga. The association between the two organisms is symbiosis. Both the organisms are mutually benefitted in this association and are dependent on each other. The algal cell photosynthesizes with the help of chloroplast. Therefore lichens are autotrophic. A part of these manufactured carbohydrates are used by the alga in its nutrition, the rest is supplied to the fungal partner. The fungus in turn provides water and nutrients which it absorbs from the soil using the rhizoidal hyphae. Thus both the partners get benefitted from each other. The algal partner is called phycobiont and the fungal partner is called mycobiont.

73. (a) : Retroviruses contain RNA as genetic material and this RNA is converted to DNA using enzyme reverse transcriptase.

74. (c) : Viruses like bacteriophage T4 undergo lytic cycle that involves lysis of bacteria. The replication cycle of bacteriophage T4 consists of following phases –

(i) Adsorption of the phage to bacterial or host cell. Then the viral genetic material penetrates into the host cell.

(ii) Eclipse period involves the synthesis of new phage DNA and proteins.

(iii) Maturation involves the assembly of phage DNA into the protein coat.

(iv) Lysis of host cell occurs and releases infective progeny phases.

75. (a) : Phenetic classification is a type of numerical taxonomy. In this type of classification the organisms are arranged according to overall similarity of existing organisms based on available characters. It is also called adansonian taxonomy because the same was first attempted by Adanson (1763), of course on the basis of external traits only. Numerical taxonomy evolved around 1950. It has received impetus with the availability of calculating machines and computers. In numerical taxonomy as many characters as possible are employed for evaluating degree of similarity and difference. All characteristics used in analysis are given equal weightage and importance. A proper selection of characters, their organisation and analysis in the light of current knowledge is key to success of this method. A lot of subjectivity can creep in depending upon the judgement of the biosystematist. No weightage is given to the quantity of the character present.

76. (d) : *Anabaena* is a free living nitrogen fixing cyanobacterium which can form symbiotic association with the water fern *Azolla*.

77. (d) : Prokaryotic DNA acts as a single replicating unit called replicon. Each replicon has a particular region where replication starts. It is called origin of replication or ori. In the region of ori, there is a particular nucleotide sequence called autonomic replicating sequence or ARS. Replication proceeds bidirectionally from each ori. A replication fork is produced on each side of ori. Replication will continue till a replication fork meets another replication fork.

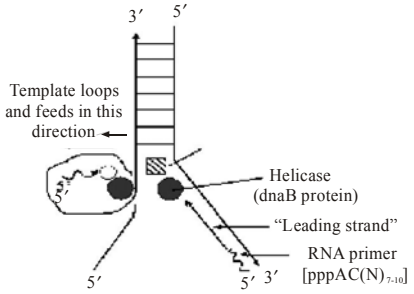


Fig. : DNA replication in prokaryotes.

78. (d) : *Refe to answer 72.*

79. (a) : Bacterial cells do not have nucleus, characteristic of eukaryotic cells. Nuclear material of bacteria lies free in the cell in the form of an irregular, thin, fibrillar and circular single molecule of DNA, called nucleoid or chromatin body. This DNA, sometimes attached at one or more points to a mesosome, frequently runs parallel to the axis of the cell. Bacterial DNA is not associated with histone protein and does not coil to form well-defined chromosomes during the multiplication. In addition to circular DNA, a small amount of subsidiary extrachromosomal DNA is also present as plasmids or episomes.

80. (c) : Viruses contain a protein coat known as capsid which encloses a single type of nucleic acid, either RNA or DNA. They do not have enzymes for protein synthesis. They multiply only inside the living host cell and for multiplication they take over the machinery of the host cell. Thus viruses are obligatory intercellular parasites. They lack cell division and enzymes for protein synthesis. They do not have cell organelles like mitochondria, Golgi complex, lysosomes, ribosomes etc. so they cannot live or reproduce separately.

81. (c) : TMV is rod shaped measuring 300 × 20 nm. It is made of RNA and proteins.

82. (d) : *Refer to answer 80.*

83. (d) : The Kingdom Monera includes all prokaryotes. They are basically unicellular but can be mycelial, colonial and filamentous. They contain peptidogycan in cell wall. Naked circular DNA coiled to form nucleoid without association with histones, ribosomes 70S, thylakoids present in photoautotrophs but other membrane bound organelles are absent. Nutrition is of various types - parasitic, chemoautotrophic, photoautotrophic and saprobic.

Some monerans have the ability to fix nitrogen. Due to presence of these characters in archaea and nitrogen-fixing organisms they are placed under monera.

All others fungi, plantae, protists and animalia are eukaryotic.

84. (b) : Whittaker's system is based on the following three criteria –

- complexity of cell structure.
- complexity of the body organization.
- mode of nutrition.

On the basis of these criteria, Whittaker divided organisms into five kingdoms. These five kingdoms are monera, protista, algae, fungi and animalia. In the five kingdom classification all, prokaryotes have been placed in kingdom monera, all unicellular eukaryotes in kingdom protista, fungi (except slime moulds and water moulds) in their separate kingdom while kingdom plantae and kingdom animalia have been retained for multicellular, autotrophic and multicellular holozoic organisms respectively.

85. (a) : In transduction, genetic material of one bacterial cell goes to other bacterial cell by agency of bacteriophages or phages (viruses, infecting bacteria).

Transduction was first of all reported in *Salmonella typhimurium* by Zinder and Lederberg (1952).

Transduction is used for gene mapping and analysis in bacteria and also for strain construction.

86. (b) : The growth curve for bacteria is hyperbolic. It shows various stages-lag phase, log phase or exponential phase, steady or stationary phase and decline phase. During lag phase there is very less growth of bacterial cells.

In log phase, once the metabolic machinery is running they start multiplying exponentially, doubling in number every few minutes. In stationary phase, booming growth stops and number of bacteria stabilises. Last is death phase when the bacteria die due to lack of nutrients.

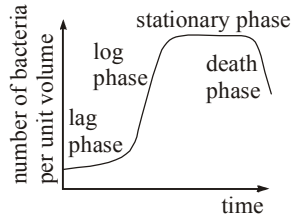


Fig. : Growth Curve

87. (a) : Normally bacteria cannot survive in antibiotic containing medium but if it does so it must have acquired resistance against that antibiotic. These are well adapted to grow in streptomycin containing medium and thus are more evolved. So due to natural selection only the more evolved and better adapted species is able to survive.

88. (a) : In addition to the nucleoid, bacterial cytoplasm normally contains many small, separate pieces of DNA, called plasmids. These circular DNA units are 1/100 the size of the main nuclear DNA (nucleoid) and are also not enclosed in a membrane structure. When found in cytoplasm, entirely independent of the bacterial chromosome, they replicate autonomously. Sometimes it becomes integrated into the main DNA and replicates with it. During conjugation, the plasmids, sometimes called episomes, help in the transfer of the genetic material between different bacteria. It may carry some genes of resistance to a variety of antibiotics.

89. (a) : *Refer to answer 86.*

90. (a) : Loose smut of wheat infects the healthy wheat plants at the time of flowering. Here chlamydospores, from smutted heads (blown by the wind) germinate on the stigmas and produce infection threads, infecting the ovaries and stigma.

Ultimately, the fungus continues to grow within the embryo, as the seed matures. With the germination of these infected seeds, internal dormant fungal mycelium resumes its activity again. In covered smut of Barley, fungal spores are liberated out only by rupturing the wall of the grains, specially at the time of threshing. This type of infection takes place during the young seedling stage. Seedling infection occurs in covered smut of Barley. Shoot infection occurs in corn smut.

91. (a, b) : *Penicillium* and *Aspergillus* both produce toxins in stored seeds and grains. *Aspergillus* produces aflatoxin in fruits, vegetables, food grains and seeds etc. *Penicillium* produces yellow rice toxins in rice, barley and corns.

92. (c) : Cauliflower mosaic virus contain dsDNA. It is circular and shows semidiscontinuous type of replication.

93. (a) : Cyanobacteria are gram negative prokaryotes which are popularly known as blue-green algae. Although cyanobacteria are true prokaryotes, but their photosynthetic system closely resembles with that of eukaryotes because they have chlorophyll *a* and photosystem II and they carry out oxygenic photosynthesis. Like the red algae, cyanobacteria use phycobiliproteins as accessory pigments. Photosynthetic pigments and electron transport chain components are located in thylakoid membranes lined with particles called phycobilisomes, which contain phycobilin pigments, particularly phycocyanin and transfer energy to photosystem II. They contain nitrogenase enzyme for nitrogen fixation. This enzyme becomes inactive in the presence of oxygen but the thick walled heterocysts provide suitable anaerobic enviornment for nitrogenase activity even in aerobic conditions.

94. (d) : Archaebacteria are believed to have originated at a time when there were extreme conditions in the biosphere. Even today they are found in environments where other kinds of bacteria cannot survive. So they are considered to be the oldest of the living fossils.

Eg. Methanobacterium, *Methonococcus* etc.

All of them are not halophiles. Only some forms like *Halobacterium*, *Halococcus* can survive under extreme saline conditions. All of them are not fossils because many forms are still surviving and flourishing.

95. (a) : Using Gram stain, developed by Danish physician, Christian Gram in 1884, two kinds of bacteria were noted - those species of bacteria that are decolorized by alcohol are called gram negative and those that retain the stain are called gram positive. This property of bacteria is related with the structure and compositional differences between the walls of gram positive and gram negative forms.

In the cell wall of Gram +ve bacteria, both horizontal and vertical peptide linkages are present, due to which mesh is dense and hence the stain does not come out. Further outer layer of cell wall of Gram +ve bacteria is made of teichoic acid.

In the cell wall of Gram –ve bacteria, either horizontal or vertical peptide linkage are present, due to which mesh is loose and hence stain comes out. Further outermost layer of cell wall of Gram –ve bacteria is made of lipopolysaccharides.

96. (a) : The adhesive pad of fungi penetrates the host with the help of mechanical pressure and enzymes. It pushes against the cell wall of the host and then releases cellulase to digest cellulose of the host cell wall so that the hypha is able to penetrate the host cell wall.

97. (a) : *Refer to answer 55.*

98. (a) : There are three systems of classification - artificial, natural and phylogenetic. In the natural system of classification the organisms are arranged on the basis of all known taxonomic characters instead of one or first few. These include morphological, anatomical, cytological, physiological and biochemical characters of the organisms.

The artificial system is based on one or a few characters that are easily observable. The phylogenetic system tries to organize organisms on the basis of their genetic and phylogenetic relationships besides taxonomic characters.

99. (b): Photosynthetic bacteria have chromatophores which are membrane bound vesicular structures which are extensions of cytoplasmic membrane. They contain photosynthetic pigments along with enzymes and electron carriers for photosynthetic phosphorylation. These pigments are bacteriochlorophyll and bacteriophaeophytin. Leucoplasts, chloroplasts and chromoplasts are different types of plasids which occur in plastids and some protistans.

100. (c) : *Rhizopus* is a saprophytic fungus that grows on dead organic matter. The mycelium is differentiated into three kinds of hyphae rhizoidal, stolons and sporangiophores. The rhizoidal

hyphae are for anchorage and absorbing food by secreting enzymes. Stolons grow horizontally over the surface of the substratum. Sporangiophores are specialized hyphae that bear a sporangium at their tip (inside columella a dome shaped sterile portion the sporangia). It helps in dispersal of spores and usually persists even after bursting of the sporangium.

101. (c) : R.H. Whittaker had proposed a five kingdom system of biological classification in 1969. It is based on complexity of cell structure, body organization and mode of nutrition. The kingdom monera includes all prokaryotes. They are basically unicellular with peptidoglycan in cell wall. Naked circular DNA coiled to form nucleoid without association with histones, ribosomes 70S, thylakoids present in photoautotrophs but other membrane bound organelles are absent. These are heterotrophic, phototrophic or chemotrophic in their mode of nutrition. The blue-green algae, nitrogen fixing bacteria and methanogenic archaebacteria are all unicellular prokaryotes so they are included in the kingdom monera.

102. (a) : Transduction is the phenomenon of transfer of genetic material from one bacterial cell to another through the agency of virus. The viruses carry a segment of DNA from one host and infect another host which is different from the first one, the latter may inherit some of the properties of the former host due to transfer of DNA segment through infecting phage.

103. (b) : A bacterium divides every 35 minutes.

$\therefore$ In 175 minutes it would be $2^{175/35}$ times $= 2^5$ times.

$\therefore$ In 175 minutes 105 bacterium cells would be $= 2^5 \times 10^5 = 32 \times 10^5$/ml.

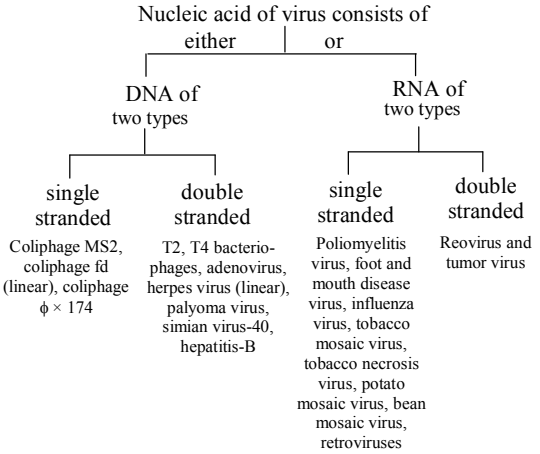
104. (b) : *E. coli* is a gram-negative, rod shaped, motile or nonmotile bacteria. *E. coli* contains a double stranded DNA as its genetic material. The DNA is not associated with any histone proteins so it is referred to as naked DNA. This DNA is circular with no free ends.

105. (b) : Bacteria are responsible for maintaining the conditions of life as the earth by virtue of their powers of decomposition of plant and animal bodies by which the limited supply by CO_2 available for photosynthesis is replenished. Thus, they act as decomposers in the carbon cycle. Bacteria mainly function as decomposers in the carbon cycle.

106. (a) : Thermoacidophiles (temperature and acid loving) archaebacteria are found in hot sulphur springs. Although they are microscopic, single-celled organisms, they flourish under conditions which would kill higher organisms. These are aerobic bacteria and have the capacity to oxidize sulphur to H_2SO_4 at high temperature and high acidity (pH = 2.0). Some of them are also able to reduce sulphur to H_2S under anaerobic conditions. As a rule, they grow best between 80º and 100ºC and several species do not grow below 80ºC.

107. (a) : *Puccinia* is a macrocyclic and heteroecious rust fungus. It produces uredia and telia stages on wheat plant. The spores produced on wheat are uredospores (stage II) and teleutospores (stage III). Uredospores can re-infect wheat but teleutospores cannot do it. Instead they give rise to basidia (stage IV). Basidiospores infect barberry. Pycnidia (stage I) develop on the upper surface of barberry leaves. Dikaryotisation occurs. It gives rise to aecidial stage (stage zero). Aecidia develop on the lower surface of barberry leaves. They form aecidiospores which infect Wheat. Thus basidial stage is produced on ground and pycnidial and aecidial stages are produced on barberry plant.

108. (c) : Viruses always contain only a single kind of nucleic acid. It can be either DNA or RNA. The nucleic acid may occur as single or double strands.



109. (d) : All plants need nitrogen to synthesize proteins, but for this purpose they are unable to utilize atmospheric nitrogen. Nitrogen fixation is brought about by two types of bacteria which are known as nitrogen fixing bacteria. One type is symbiotic nitrogen fixers that are associated with plants *e.g.*, *Rhizobium* and *Azospirillum*.

The other type of these bacteria are free living in the soil *e.g.*, *Azotobacter* and *Nostoc*.
Nostoc is photosynthetic and *Azotobacter* is non-photosynthetic.
So that, the free living aerobic non-photosynthetic nitrogen fixing bacterium is *Azotobacter*.

110. (d) : Mesosomes are complex, intracellular, membranous structures within the cytoplasm, that are formed by the infoldings of the cytoplasmic membrane. Surface of mesosomes have many enzymes which take part in respiration *e.g.,* oxidases and dehydrogenases. Mesosomes are also known to help in the separation of two daughter molecules of DNA during cell division. They are also called mitochondria of bacterial cell.

Ribosomes are cytoplasmic organelles that occur in both prokaryotes and eukaryotes. When plasmids associate temporarily with nucleoid these are called as episomes.

111. (b) : *Refer to answer 104.*

112. (d) : In bacteria, DNA is highly charged molecule. The adjacent bases are linked by phosphate groups, each with an ionized hydroxyl group. It results in negative charges which are therefore balanced by an equivalent number of cationic groups.
These charges are balanced by histones which are basic proteins in case of eukaryotes. Histones are absent in bacterial cells. In bacteria the charges are neutralized by polyamines such as spermine and spermidine and by Mg^{2+} ions.

113. (a) : Lichens are peculiar dual organisms produced by the intimate association of two organisms – a fungus and an alga. The association between the two organisms is called symbiosis. On the basis of fungal partner, lichens are of 2 types :
(i) Ascolichens : In which ascomycetes member is the fungal partner. Further in ascolichens, algal partner is mostly member of green algae and rarely blue-green algae.
(ii) Basidiolichens : Where basidiomycetes member is fungal partner. In them algal partner is generally blue-green algae. In 80% cases algal partner is member of green algae or chlorophyceae and in 20% cases, blue-green algae or myxophyceae. Important members of green algae found in lichens are: *Trebauxia*, *Pleurococcus*, *Trentepohlia* and *Cladophora*.

114. (b) : Influenza viruses are spherical in shape measuring about 800-1200Å in diameter. It has a protein capsid that encloses a single stranded RNA. The single stranded RNA is generally linear and constitutes about 10% of the virus particle. RNA is genetic material in other viruses like poliomyelitis, foot and mouth disease virus and tobacco mosaic virus etc.

115. (b)

116. (d) : Symbiosis is a mutually beneficial relationship or interaction between individuals of two different species with none of the two capable of living separately. *e.g., Rhizobium* is associated with root nodules of legumes. It fixes nitrogen for the plant and the plant provides it food and shelter. *Azotobacter* is a free-living bacteria which occurs in the soil and fixes nitrogen directly. *Bacillus* is also a free living bacteria which acts upon nitrogenous excretions and proteins of dead bodies of living organisms. These are therefore, non-symbiotic N_2 fixing bacteria.

117. (a) : Sex pili are minute and non-flagellar hairlike structures projecting from the wall of many gram negative bacteria and few Gram +ve ones. They are entirely composed of a protein called pilin. They are used as sex organs during conjugation, forms conjugation tube during conjugation. They confer the property of stickiness whereby bacteria tend to adhere to one another (clump formation). They are of two types-long conjugating pili and short attachment pili.

Naked circular DNA is the genetic material which is not enclosed by nuclear membrane non complexed with proteins. It is called nucleoid or genophore. Plasmids (Hayes and Lederberg, 1952) are additional or extrachromosomal small rings of DNA having a few useful but nonvital genes, e.g., For fertility factor, R-factors or resistance factor.

118. (a) : Bacterial cells do not have nucleus. Nuclear material of bacteria lies free in the cell in the form of an irregular, thin fibrillar and circular single molecule of DNA called nucleoid or chromatin body. This DNA is sometimes attached at one or more points to a mesosome. Bacterial DNA is not associated with histone proteins and does not coil to form well defined chromosomes during multiplication. This is the basic characteristic of all prokaryotes and bacteria is prokaryotic organism.

119. (a) : Lichens grow by extending their thallus outwards from either tips or edges. They grow very slowly. Rates of growth can vary from 0.5 mm per year to 500 mm per year. This slow growth rate equates with their long life.

120. (b) : Association between roots of higher plants *e.g.*, pine, birch and fungal hyphae is called mycorrhiza. It exhibits the phenomenon of symbiosis. Here both the organisms in association are mutually benefitted. In this, fungal hyphae take nutrition from the plant and in return increase surface area for absorption of water and minerals for the plant. Mycorrhizal roots occur in superficial layers of the soil. They are thick, irregular with wooly covering devoid of root hairs and root cap. They are of two types - ectomycorrhiza and endomycorrhiza. In the roots of *Pinus* is seen ectotrophic mycorrhiza as the root hairs are poorly developed. In ectomycorrhiza, the fungus partner is commonly a basidiomycete. It lives in intercellular spaces of cortex and forms a thick wooly covering on the outside. In endomycorrhiza, the fungus is commonly a zygomycete. The tips of fungal hyphae pass into cortical cells producing swollen vesicles or finely branched masses called arbuscules. Endomycorrhiza is, therefore, also called VAM or vesicular-arbuscular mycorrhiza. Outer covering is small. Parasitism is a phenomenon that involves a parasite which lives in constant association of the host and gets its food directly or indirectly without killing the host. Antagonism is the inhibition of growth of one organism by another. Endemism is the permanent occurrence of an organism inside another organism.

121. (a) : The tailed bacteriophages contain a hollow helical tail which serves both as cell attachment organ and as a tube that facilitates the entry of nucleic acid into the host cell. The tail consist of tail plate and the caudal fibres.

122. (b) : Chemolithotrophs can derive the energy required for growth from the oxidation of inorganic components.

123. (b) : *Puccinia graminis tritici* belongs to basidiomycotina and causes black rust of wheat. It is internal obligate parasite. It is found everywhere, where wheat is grown. The teleutospores of the fungus causes the rust. They are produced inside teleutosori. These telia form elongated, dark brown to black pustules on the surface of stems and leaves of the wheat. *Albugo candida* causes white rust of crucifers. *Melampsora lini* causes linseed rust. *Claviceps purpurea* causes ergot of graminae.

124. (a) : Tobacco Mosaic Virus is a ribovirus and contains single stranded RNA. It was proved by the experiments of Frankel Conart that RNA is the genetic material in this virus. It does not contain any DNA and is composed of 6 % RNA surrounded by a hollow cylinder of portion subunits.
Double stranded RNA is found in Reovirus and Tumor virus.
Retroviruses have two copies of single stranded RNA.

125. (d) : Phylogenetic systems of classification bring out evolutionary relationships of organisms. Phylogenetic systems of classification came into existence after acceptance of doctrine of evolution and natural selection propounded by Charles Darwin in his book "On the origin of Species" by means of Natural Selection. Darwin had put forward the view that the present day plants/animals originated from some ancestral ones after undergoing some periodical changes.
So the phylogenetic classification is based on the evolutionary descent of a group of organisms and the relationships are depicted through a phylogram and a cladogram.

126. (b) : Protists include all unicellular and colonial eukaryotes except those of green and red algae. They are broadly divided into three groups - photosynthetic, slime moulds and protozoans. The protistan cells are typically eukaryotic having membrane bound organelles like mitochondria, chloroplasts, golgi bodies, endoplasmic reticulum, nucleus etc. Nucleus is well defined. Protists can be uninucleate, binucleate or multinucleate. The genetic material is linear DNA, enclosed by nuclear envelope, complexed with proteins and organised into distinct chromosomes.

127. (a) : A few free living bacteria are able to pick up dinitrogen from the soil atmosphere and convert it into organic nitrogenous materials like amino acids. *e.g. Azotobacter*. Symbiotic nitrogen fixing bacteria of the genus *Rhizobium* occur in the root nodules of a number of legumes. Root nodules containing symbiotic nitrogen bacteria also occur in *Casuarina* and *Alnus*. Leaf nodules containing such bacteria are found in *Ardisia*. Many cyanobacteria (blue-green algae) fix atmospheric nitrogen due to presence of heterocysts.

128. (b) : In transduction, genetic material of one bacterial cell goes to other bacterial cell by agency of bacteriophages or phages (viruses, infecting bacteria).
Transduction was first of all reported in *Salmonella typhimurium* by Zinder and Lederberg (1952).
Transduction is used for gene mapping and analysis in bacteria and also for strain construction.

129. (c) : A non-photosynthetic aerobic nitrogen fixing soil bacterium is *Azotobacter*. *Azotobacter* is free living soil bacteria that are able to pick up dinitrogen from the soil and fixes it into organic nitrogenous material like amino acid.

130. (b) : *Refer to answer 120.*

131. (c) : Schizont stage of *Plasmodium* occurs in human erythrocytes and liver cells. Within the human blood the sporozoites, circulates about half an hour and enters into the liver cell. The kupffer cells of the liver clear the sporozoites from the blood stream and kill many of the organisms. A fraction of sporozoites escape destruction, however, and penetrate the hepatocytes where they take up the residence. Here they multiply by schizogony.

132. (d) : *Plasmodium* is digenetic *i.e.,* it completes its life cycle in two hosts, asexual cycle in man and sexual cycle in *Anopheles* mosquito. The breeding places of this mosquito is ponds, marshes, swampy areas etc. So, if all the ponds and puddles are destroyed, *Anopheles* will not be able to survive leading to destruction of its parasite, *Plasmodium*.

133. (c) : Bacteria has no nuclear membrane hence it is called as nucleoid. The genetic material is referred to as genophore. Genophore is the bacterial chromosome. It has a double stranded circular supercoiled DNA. DNA has about 10,000 genes in *E.coli*. Double stranded DNA in bacteria is without histones.

134. (a) : *E. coli* bacteria acts as a human symbionts and it is found in human intestine, synthesize vitamin K and B and also help in food fermentation. It is easily cultured in any nutrient medium in the laboratory.

135. (a) : *Plasmodium* has two hosts.
(i) Female *Anopheles* mosquito : Here the sexual phase of the malarial parasite occurs and it is considered the definitive host of malarial parasite.
(ii) Human beings : Here the asexual phase of malarial parasite occurs. It is considered as the intermediate host. Options (b), (c) and (d) are the stages of the asexual phase of *Plasmodium*.

136. (a) : In sexual reproduction, syngamy and meiotic division takes place but in bacteria, during sexual reproduction there is no formation of gametes hence no syngamy and reduction division occurs, bacteria lack alternation of generation. Conjugation and exchange of genetic material takes place in bacteria.

137. (b) : Lichens are found in Artic Tundra region where no other plant can grow. Lichens prefer to grow in pollution free environment. They are often used as a indicator of pollution and also they are very sensitive to SO_2. They are first to die in a polluted environment (more SO_2).

138. (b) : Taxonomy and classification are a part of the broader field of systematics which is the study of diversity of organisms. Classification of a part of systematics as it lists the unique characters of each taxon.

139. (c) : In *Amoeba* and *Paramecium,* osmoregulation occurs through contractile vacoule. Osmoregulation is a phenomenon in which contractile vacuole plays an important role in maintaining the water balance of the cell. *Paramecium* contains two contractile vacuoles which have fixed position. One contractile vacuole is present near the anterior end while another is present towards posterior end of the body. Each contractile vacuole is surrounded by 5-12 radial canals. Excess of water is transferred from the cytoplasm to the radial canals. The latter pour water into the contractile vacuole. The contractile vacuole expels water outside the body. Thus the contractile vacuoles and radial canals are for osmoregulation. In *Amoeba* the endoplasm, at its posterior end, contains a single, clear rounded and pulsating contractile vacuole, filled with a watery fluid and enclosed by a unit membrane. Surrounding this membrane is a region containing many tiny feeder vacuoles and mitochondria. It helps in the osmoregulatory and excretory activities of the animal.

140. (c) : *Trypanosoma gambiense* is the parasitic zooflagellate which causes one of the deadliest ailments in human beings called sleeping sickness or trypanosomiasis. The disease is common in humid and subhumid zones of the African continent. The disease is transmitted by shade loving tse-tse fly (*Glossina palpalis*) which acts as the vehicle that carries the culprit protozoan parasite.

141. (a) : *Plasmodium falciparum* is the greatest killer of human beings over most parts of Africa and else where in tropics. It causes malignant (or pernicious or cerebral or tropical) tertian malaria. This malaria is most harmful.
Plasmodium vivax causes benign tertian malaria. *Plasmodium malariae* causes quartan malaria. Plasmodium ovale is the rarest of the four species which infect man and it causes mild tertian malaria.

142. (c) : Laveran discovered that malaria is caused by protozoan parasite (*Plasmodium*) in 1880. He discovered *Plasmodium* and got nobel prize in 1907.

Sir Ronald Ross in 1897, a doctor in Indian Army, established that malarial parasite is transmitted by the bite of a female *Anopheles* mosquito and in 1902, he got Nobel prize for this discovery.

143. (a) : Chemosynthetic bacteria do not derive energy directly or indirectly from sun. The source of energy of these bacteria is inorganic substances. They utilise the energy liberated by oxidation of inorganic compounds and synthesize organic compounds.

144. (c) : These protozoans are adapted to parasitic mode of life. All of them are endoparasites. Locomotory organelles (cilia, flagella, pseudopodia, etc.) are absent. Organelles connected with ingestion are absent. Nutrition is parasitic (absorptive). Sexual reproduction takes place through syngamy. It is followed by spore formation, hence sporozoans. Life cycle consists of two distinct asexual and sexual phases. They may be passed in one (monogenetic) or two different hosts (digenetic).

145. (c) : Amoebiasis can be prevented by drinking boiled water as it mainly occurs by ingestion of cysts of *E. histolytica* in food or drinks. The contamination of food or drinks occurs by (i) unhygienic habits of food handlers who by habit scratch the anus and then put the fingers in the food which they serve, (ii) habit of defecating in open fields causing contamination of vegetables and then washing the bottom in ponds causing the contamination of water, (iii) transmission of cysts from stools to food and drinks by flies and cockroaches. So, one should take following preventive measures :
(I) Proper sanitation of roads, streets, lanes and open drains.
(II) Purification of drinking water (by boiling).
(III) Proper disposal of sewage.
(IV) Covering of the food articles by the traders.
(V) Chemical treatment of huma faeces to be used as fertilizer.

146. (a) : *Trypanosoma* is polymorphic *i.e.* it has more than one form. It has at least four forms that are recognized on the basis of the positions of kinetoplast and blepharoplast and the course taken by the flagellum. Two or more such forms occur either in one or both the hosts in the life cycles of various species of *Trypanosoma*. These forms are
(i) Leishmanial (amastigote) : Round or oval form with a nucleus, blepharoplast and kinetoplast. Flagellum reduced and fibril-like, embedded in cytoplasm.
(ii) Leptomonad (promastigote) : Body elongate, nucleus large and anteriorly located blepharoplast and kinetoplast. Flagellum short and unattached.
(iii) Crithidial (epimastigote) : Body elongate. Blepharoplast and kinetoplast placed immediately anterior to nucleus. Undulating membrane inconspicuous.
(iv) Trypanosomid (trypomastigote) : Body elongate and slender. Blepharoplast and kinetoplast situated at or near posterior end. Undulating membrane conspicuous.
Trypanosoma is digenetic *i.e.* it completes its life cycle in two hosts. It is an obligate parasite and is pathogenic.

147. (a) : *Paramecium* contains a single large macronucleus and one small micronucleus. The macronucleus controls metabolism such as feeding and maintaenance, whereas the micronucleus takes an important role in reproduction and stores genetic information, hence it is also termed as reproductive nucleus whereas macronucleus is termed as vegetative nucleus.

148. (b) : The infective stage of *Plasmodium* is a minute organism called sporozoite. When the mosquito bites man, sporozoites present in the salivary gland of female *Anopheles* mosquito are injected into the blood of the man. These sporozoites are spindle-shaped or sickle-shaped uninucleate organisms capable of wrigging (worm-like) movements. Each sporozoite consists of elastic pellicle, cytoplasm and nucleus.

149. (a) : Danish bacteriologists Christian Gram for the first time classified bacteria on the basis of the cell wall into two groups - Gram +ve and Gram –ve by staining with crystal violet and safranin. Gram +ve cell walls are less complex with peptidoglycan compounds and proteins and no lipids in the cell wall. Whereas in Gram –ve cell walls are more

complex with peptidoglycan compounds, phospholipids and lipopolysaccharides and contains 20% lipids.

150. (b) : All prokaryotic organisms come under Kingdom Monera. *Escherichia coli* is a bacterium. Monera includes bacteria, mycoplasmas, cyanobacteria (blue green algae) and actinomycetes.

151. (b) : The true fungi or the eumycetes are special types of achlorophyllous thallophytic organisms living a parasitic or a saprophytic mode of existence; they are always heterophytes and never autophytes. They depend on others for food, but all other groups as algae, bryophytes and pteridophytes are chlorophyll containing green plants that are autotrophic.

152. (b) : Linnaeus put forward an "Artificial system" of plant classification which was based on sexual characters like cryptogamia, monoecia, monandria, diandria, polyandria etc. It is commonly also called as sexual system of plant classification.

153. (a) : Artificial system of classification was first used by Linnaeus. The cryptogams were included in flowering plants. Linnaeus system is known as sexual system of classification. He classified on the basis of number, size and union of sex organs.

154. (b) : *Refer to answer 140.*

155. (b) : Symptoms of malaria first appear several days after the infection of the malaria parasite in man. This interval of time or the incubation period is utilized by the parasites to increase their progeny. To establish malarial symptoms, it is necessary that a large number of organisms must continue erythrocytic cycle at a time.

A healthy person acquires infection when a female *Anopheles* mosquito, containing infective stages of parasite (sporozoites) in its salivary glands, bites him for sucking his blood. Once within the numan blood, the sporozoites get into liver to invade the hepatic cells. Here they multiply asexually by schizogony. Liver schizogony has two phases, pre-erythrocytic and exo-erythrocytic:

Pre-erythrocytic phase : After penetrating a hepatic cell each sporozoite becomes a cryptozoite. It grows for a number of days and becomes a spherical and non-pigmented schizont. It divides by schizogony (multiple fission) and forms a large number of uninucleate cells, the cryptomerozoites. During pre-erythrocytic schizogony, blood remains sterile and its inoculation does not produce infection.

Exo-erythrocyic phase : Cryptomerozoites enter fresh liver cells to become metacryptozoites. They undergo schizogony similar to the previous one producing enormous number of metacrypto-merozoites.

Metacryptomerozoites, after escaping into blood stream, invade the erythrocytes or red blood corpuscles. This starts the erythrocytic schizogony. With erythrocytic schizogony, the symptoms of malaria starts appearing.

156. (b) : On the basis of locomotory organelles the protozoan protists are divided into four groups : Mastigophora, Sarcodina, Sporozoa and Ciliata. *Trypanosoma* belongs to class zooflagellata which comes under the group mastigophora. The characteristics are :

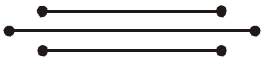
(i) These zooflagellates are generally uninucleate, occasionally multinucleate.
(ii) The body is covered by a firm pellicle.
(iii) Nutrition is holozoic, parasitic and saprobic.
(iv) Reserve food is glycogen.

157. (b) : *Refer to answer 140.*

158. (d) : *Trypanosoma gambiense* was first observed by Forde in 1901. It causes African sleeping sickness. The disease, also called trypanosomiasis, is found in western and central parts of Africa. The parasite is transmitted by blood sucking tse-tse fly, *Glossina palpalis*. Mouth and contractile vacuole are absent. Food is absorbed through the body surface. The parasite multiplies by fission. In human beings the parasite lives in the blood plasma. It causes trypanosoma fever. It is accompanied by glandular swelling. Later the parasite enters cerebrospinal fluid and damages the brain. It makes the patient lethargic and unconscious. Because of it, the disease is called sleeping sickness. If untreated, the disease leads to death.

159. (c) : Lichens are found in Artic Tundra region where no other plant can grow. Lichens prefer to grow in pollution free environment. They are often used as a indicator of pollution and also they are very sensitive to SO_2. They are first to die in a polluted environment (more SO_2).

160. (b) : Classification given by Bentham and Hooker is Natural System. Monocots were placed after dicots; closely related families were seperated; gymnosperms were placed between dicots and monocots.



Chapter

3

Plant Kingdom

1. An example of colonial alga is
(a) *Volvox* (b) *Ulothrix*
(c) *Spirogyra* (d) *Chlorella*.
(NEET 2017)

2. Select the mismatch.
(a) *Cycas* – Dioecious
(b) *Salvinia* – Heterosporous
(c) *Equisetum* – Homosporous
(d) *Pinus* – Dioecious
(NEET 2017)

3. Zygotic meiosis is characteristic of
(a) *Fucus* (b) *Funaria*
(c) *Chlamydomonas* (d) *Marchantia*.
(NEET 2017)

4. Life cycles of *Ectocarpus* and *Fucus* respectively are
(a) diplontic, haplodiplontic
(b) haplodiplontic, diplontic
(c) haplodiplontic, haplontic
(d) haplontic, diplontic. *(NEET 2017)*

5. Conifers are adapted to tolerate extreme environmental conditions because of
(a) broad hardy leaves
(b) superficial stomata
(c) thick cuticle
(d) presence of vessels.
(NEET-II 2016)

6. Which one of the following statements is wrong?
(a) Algae increase the level of dissolved oxygen in the immediate environment.
(b) Algin is obtained from red algae, and carrageenan from brown algae.
(c) Agar-agar is obtained from *Gelidium* and *Gracilaria*.
(d) *Laminaria* and *Sargassum* are used as food.
(NEET-II 2016)

7. Select the correct statement.
(a) *Sequoia* is one of the tallest trees.
(b) The leaves of gymnosperms are not well adapted to extremes of climate.
(c) Gymnosperms are both homosporous and heterosporous.
(d) *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms.
(NEET-I 2016)

8. In bryophytes and pteridophytes, transport of male gametes requires
(a) birds (b) water
(c) wind (d) insects.
(NEET-I 2016)

9. Which one of the following statements is wrong?
(a) *Chlorella* and *Spirulina* are used as space food.
(b) Mannitol is stored food in Rhodophyceae.
(c) Algin and carrageenan are products of algae.
(d) Agar-agar is obtained from *Gelidium* and *Gracilaria.* *(2015 Cancelled)*

10. In which of the following, gametophyte is not independent free living?
(a) *Pteris* (b) *Pinus*
(c) *Funaria* (d) *Marchantia*
(2015 Cancelled)

11. Read the following five statements (A to E) and select the option with all correct statements.
A. Mosses and lichens are the first organisms to colonise a bare rock.
B. *Selaginella* is a homosporous pteridophyte.
C. Coralloid roots in *Cycas* have VAM.
D. Main plant body in bryophytes is gametophytic, whereas in pteridophytes it is sporophytic.
E. In gymnosperms, male and female gametophytes are present within sporangia located on sporophyte.
(a) A, D and E (b) B, C and E
(c) A, C and D (d) B, C and D
(2015 Cancelled)

12. Male gametes are flagellated in
(a) *Ectocarpus* (b) *Spirogyra*
(c) *Polysiphonia* (d) *Anabaena.*
(2015 Cancelled)

13. Which one of the following is wrong about *Chara*?
(a) Upper oogonium and lower round antheridium
(b) Globule and nucule present on the same plant
(c) Upper antheridium and lower oogonium
(d) Globule is male reproductive structure
(2014)

14. Which of the following is responsible for peat formation?
(a) *Marchantia* (b) *Riccia*
(c) *Funaria* (d) *Sphagnum*
(2014)

15. Male gametophyte with least number of cells is present in
(a) *Pteris* (b) *Funaria*
(c) *Lilium* (d) *Pinus*. *(2014)*

16. Select the wrong statement.
(a) In Oomycetes, female gamete is smaller and motile, while male gamete is larger and non-motile.
(b) *Chlamydomonas* exhibits both isogamy and anisogamy and *Fucus* shows oogamy.
(c) Isogametes are similar in structure, function and behaviour.
(d) Anisogametes differ either in structure, function or behaviour. *(NEET 2013)*

17. Isogamous condition with non-flagellated gametes is found in
(a) *Volvox* (b) *Fucus*
(c) *Chlamydomonas* (d) *Spirogyra.*
(NEET 2013)

18. Monoecious plant of *Chara* shows occurrence of
(a) upper antheridium and lower oogonium on the same plant
(b) upper oogonium and lower antheridium on the same plant
(c) antheridiophore and archegoniophore on the same plant
(d) stamen and carpel on the same plant.
(NEET 2013)

19. Read the following statements (A - E) and answer the question which follows them.
(A) In liverworts, mosses and ferns gametophytes are free-living.
(B) Gymnosperms and some ferns are heterosporous.
(C) Sexual reproduction in *Fucus*, *Volvox* and *Albugo* is oogamous.
(D) The sporophyte in liverworts is more elaborate than that in mosses.
(E) Both, *Pinus* and *Marchantia* are dioecious.
How many of the above statements are correct?
(a) Three (b) Four
(c) One (d) Two
(NEET 2013)

20. Syngamy can occur outside the body of the organism in
(a) mosses (b) algae
(c) ferns (d) fungi.
(Karnataka NEET 2013)

21. What is common in all the three, *Funaria*, *Dryopteris* and *Ginkgo*?
(a) Presence of archegonia
(b) Well developed vascular tissues
(c) Independent gametophyte
(d) Independent sporophyte
(Karnataka NEET 2013)

22. Which one of the following is wrongly matched?
(a) *Spirogyra* - Motile gametes
(b) *Sargassum* - Chlorophyll
(c) Basidiomycetes - Puffballs
(d) *Nostoc* - Water blooms
(Karnataka NEET 2013)

23. The plant body is thalloid in
(a) *Sphagnum* (b) *Salvinia*
(c) *Marchantia* (d) *Funaria.*
(Karnataka NEET 2013)

24. Which one of the following is common to multicellular fungi, filamentous algae and protonema of mosses?
(a) Diplontic life cycle
(b) Members of Kingdom Plantae
(c) Mode of nutrition
(d) Multiplication by fragmentation *(2012)*

25. Which one of the following is a correct statement?
(a) Pteridophyte gametophyte has a protonemal and leafy stage.
(b) In gymnosperms, female gametophyte is free-living.
(c) Antheridiophores and archegoniophores are present in pteridophytes.
(d) Origin of seed habit can be traced in pteridophytes. *(2012)*

26. *Cycas* and *Adiantum* resemble each other in having
(a) seeds (b) motile sperms
(c) cambium (d) vessels.
(2012)

27. Which one of the following pairs is wrongly matched?
(a) *Ginkgo* – Archegonia
(b) *Salvinia* – Prothallus
(c) Viroids – RNA
(d) Mustard – Synergids
(Mains 2012)

28. Read the following five statements (A - E) and answer as asked next to them.
(A) In *Equisetum*, the female gametophyte is retained on the parent sporophyte.
(B) In *Ginkgo*, male gametophyte is not independent.
(C) The sporophyte in *Riccia* is more developed than that in *Polytrichum*.
(D) Sexual reproduction in *Volvox* is isogamous.
(E) The spores of slime moulds lack cell walls.
How many of the above statements are correct?
(a) Two (b) Three
(c) Four (d) One
(Mains 2012)

29. How many organisms in the list given below are autotrophs?
Lactobacillus, *Nostoc*, *Chara*, *Nitrosomonas*, *Nitrobacter*, *Streptomyces*, *Saccharomyces*, *Trypanosoma*, *Porphyra*, *Wolffia*
(a) Four (b) Five
(c) Six (d) Three
(Mains 2012)

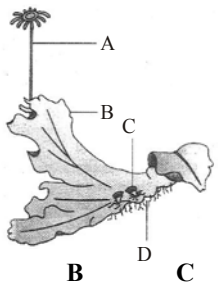
30. The gametophyte is not an independent, free-living generation in
(a) *Polytrichum* (b) *Adiantum*
(c) *Marchantia* (d) *Pinus.* *(2011)*

31. Compared with the gametophytes of the bryophytes, the gametophytes of vascular plants tend to be
(a) smaller but to have larger sex organs
(b) larger but to have smaller sex organs
(c) larger and to have larger sex organs
(d) smaller and to have smaller sex organs.
(2011)

32. Archegoniophore is present in
(a) *Marchantia* (b) *Chara*
(c) *Adiantum* (d) *Funaria.* *(2011)*

33. A prokaryotic autotrophic nitrogen fixing symbiont is found in
(a) *Alnus* (b) *Cycas*
(c) *Cicer* (d) *Pisum.* *(2011)*

34. Examine the figure given below and select the correct option giving all the four parts (A, B, C and D) rightly identified.



	A	B	C	D
(a)	Archego-niophore	Female thallus	Gemma cup	Rhizoids
(b)	Archego-niophore	Female thallus	Bud	Foot
(c)	Seta	Sporo-phyte	Proto-nema	Rhizoids
(d)	Antherid-iophore	Male-thallus	Globule	Roots

(Mains 2011)

35. *Selaginella* and *Salvinia* are considered to represent a significant step toward evolution of seed habit because
(a) female gametophyte is free and gets dispersed like seeds.
(b) female gametophyte lacks archegonia.
(c) megaspores possess endosperm and embryo surrounded by seed coat.
(d) embryo develops in female gametophyte which is retained on parent sporophyte.
(Mains 2011)

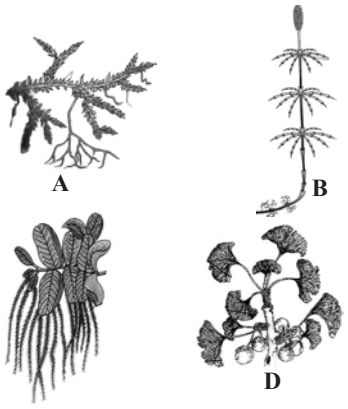
36. Consider the following four statements whether they are correct or wrong.
A. The sporophyte in liverworts is more elaborate than that in mosses.
B. *Salvinia* is heterosporous.
C. The life-cycle in all seed-bearing plants is diplontic.
D. In *Pinus* male and female cones are borne on different trees.
The two wrong statements together are
(a) A and C (b) A and D
(c) B and C (d) A and B.
(Mains 2011)

37. Algae have cells made up of
(a) cellulose, galactans and mannans
(b) hemicellulose, pectins and proteins
(c) pectins, cellulose and proteins
(d) cellulose, hemicellulose and pectins.
(2010)

38. Male and female gametophytes are independent and free-living in
(a) mustard (b) castor
(c) *Pinus* (d) *Sphagnum.*
(2010)

39. Which one of the following is monoecious?
(a) *Marchantia* (b) *Cycas*
(c) *Pinus* (d) Date palm
(Mains 2010)

40. Examine the figures A, B, C and D. In which one of the four options all the items A, B, C and D are correct?



	A	B	C	D
(a)	*Chara*	*Marchantia*	*Fucus*	*Pinus*
(b)	*Equisetum*	*Ginkgo*	*Selaginella*	*Lycopo-dium*
(c)	*Selaginella*	*Equisetum*	*Salvinia*	*Ginkgo*
(d)	*Funaria*	*Adiantum*	*Salvinia*	*Riccia*

(Mains 2010)

41. Which one of the following is a vascular cryptogam?
(a) *Ginkgo* (b) *Marchantia*
(c) *Cedrus* (d) *Equisetum*
(2009)

42. Mannitol is the stored food in
(a) *Porphyra* (b) *Fucus*
(c) *Gracillaria* (d) *Chara.* *(2009)*

43. Which one of the following is considered important in the development of seed habit?
(a) Heterospory
(b) Haplontic life cycle
(c) Free-living gametophyte
(d) Dependent sporophyte *(2009)*

44. Which one of the following has haplontic life cycle?
(a) *Polytrichum* (b) *Ustilago*
(c) Wheat (d) *Funaria* *(2009)*

45. Which one of the following plants is monoecious?
(a) *Pinus* (b) *Cycas*
(c) Papaya (d) *Marchantia*
(2009)

46. Select one of the following pairs of important features distinguishing *Gnetum* from *Cycas* and *Pinus* and showing affinities with angiosperms.
(a) Perianth and two integuments
(b) Embryo development and apical meristem
(c) Absence of resin duct and leaf venation
(d) Presence of vessel elements and absence of archegonia *(2008)*

47. In which one of the following male and female gametophytes do not have free living independent existence?
(a) *Polytrichum* (b) *Cedrus*
(c) *Pteris* (d) *Funaria* *(2008)*

48. Which one of the following is heterosporous?
(a) *Adiantum* (b) *Equisetum*
(c) *Dryopteris* (d) *Salvinia* *(2008)*

49. In gymnosperms, the pollen chamber represents
(a) a cavity in the ovule in which pollen grains are stored after pollination
(b) an opening in the megagametophyte through which the pollen tube approaches the egg
(c) the microsporangium in which pollen grains develop
(d) a cell in the pollen grain in which the sperms are formed.
(2007)

50. Spore dissemination in some liverworts is aided by
(a) indusium (b) calyptra
(c) peristome teeth (d) elaters. *(2007)*

51. Flagellated male gametes are present in all the three of which one of the following sets?
(a) *Zygnema*, *Saprolegnia* and *Hydrilla*
(b) *Fucus*, *Marsilea* and *Calotropis*
(c) *Riccia*, *Dryopteris* and *Cycas*
(d) *Anthoceros*, *Funaria* and *Spirogyra*
(2007)

52. If you are asked to classify the various algae into distinct groups, which of the following characters you should choose?
(a) Nature of stored food materials in the cell
(b) Structural organization of thallus

(c) Chemical composition of the cell wall
(d) Types of pigments present in the cell
(2007)

53. In the prothallus of a vascular cryptogam, the antherozoids and eggs mature at different times. As a result
(a) there is high degree of sterility
(b) one can conclude that the plant is apomictic
(c) self fertilization is prevented
(d) there is no change in success rate of fertilization. *(2007)*

54. Peat moss is used as a packing material for sending flowers and live plants to distant places because
(a) it serves as a disinfectant
(b) it is easily available
(c) it is hygroscopic
(d) it reduces transpiration. *(2006)*

55. Conifers differ from grasses in the
(a) formation of endosperm before fertilization
(b) production of seeds from ovules
(c) lack of xylem tracheids
(d) absence of pollen tubes. *(2006)*

56. In a moss, the sporophyte
(a) manufactures food for itself, as well as for the gametophyte
(b) is partially parasitic on the gametophyte
(c) produces gametes that give rise to the gametophyte
(d) arises from a spore produced from the gametophyte. *(2006)*

57. Auxospores and hormogonia are formed, respectively, by
(a) some diatoms and several cyanobacteria
(b) some cyanobacteria and many diatoms
(c) several cyanobacteria and several diatoms
(d) several diatoms and a few cyanobacteria. *(2005)*

58. Ectophloic siphonostele is found in
(a) *Osmunda* and *Equisetum*
(b) *Marsilea* and *Botrychium*
(c) *Adiantum* and *Cucurbitaceae*
(d) *Dicksonia* and *Maiden hair fern*. *(2005)*

59. Match items in column I with those in column II.

Column I	**Column II**
(A) Peritrichous flagellation	(J) *Ginkgo*
(B) Living fossil	(K) *Macrocystis*
(C) Rhizophore	(L) *Escherichia coli*
(D) Smallest flowering plant	(M) *Selaginella*
(E) Largest perennial alga	(N) *Wolffia*

Select the correct answer from the following.
(a) A - L; B - J; C - M; D - N; E - K
(b) A - K; B - J; C - L; D - M; E - N
(c) A - N; B - L; C - K; D - N; E - J
(d) A - J; B - K; C - N; D - L; E - K
(2005)

60. Top-shaped multiciliate male gametes and the mature seed which bears only one embryo with two cotyledons, are characterised features of
(a) cycads
(b) conifers
(c) polypetalous angiosperms
(d) gamopetalous angiosperms *(2005)*

61. Diversification in plant life appeared
(a) due to long periods of evolutionary changes
(b) due to abrupt mutations
(c) suddenly on earth
(d) by seed dispersal. *(2004)*

62. Angiosperms have dominated the land flora primarily because of their
(a) power of adaptability in diverse habitat
(b) property of producing large number of seeds
(c) nature of self pollination
(d) domestication by man. *(2004)*

63. Which one of the following pairs of plants are not seed producers ?
(a) Fern and *Funaria*
(b) *Funaria* and *Ficus*
(c) *Ficus* and *Chlamydomonas*
(d) *Funaria* and *Pinus* *(2003)*

64. Sexual reproduction in *Spirogyra* is an advanced feature because it shows
(a) different sizes of motile sex organs
(b) same size of motile sex organs
(c) morphologically different sex organs
(d) physiologically differentiated sex organs. *(2003)*

65. Plants reproducing by spores such as mosses and ferns are grouped under the general term
(a) cryptogams (b) bryophytes
(c) sporophytes (d) thallophytes. *(2003)*

66. Which one pair of examples will correctly represent the grouping spermatophyta according to one of the schemes of classifying plants ?
(a) *Acacia,* sugarcane
(b) *Pinus, Cycas*
(c) *Rhizopus, Triticum*
(d) *Ginkgo, Pisum* *(2003)*

67. Which of the following is without exception in angiosperms?
(a) Presence of vessels
(b) Double fertilisation
(c) Secondary growth
(d) Autotrophic nutrition *(2002)*

68. Which of the following plants produces seeds but not flowers?
(a) Maize (b) Mint
(c) Peepal (d) *Pinus* *(2002)*

69. *Cycas* has two cotyledons but not included in angiosperms because of
(a) naked ovules
(b) seems like monocot
(c) circinate ptyxis
(d) compound leaves. *(2001)*

70. A student observed an algae with chlorophyll *a*, *b* and phycoerythrin, it should belong to
(a) Phaeophyta (b) Rhodophyta
(c) Chlorophyta (d) Bacillariophyta. *(2000)*

71. In ferns, meiosis takes place at the time of
(a) spore formation
(b) spore germination
(c) gamete formation
(d) antheridia and archegonia formation. *(2000)*

72. Plant group with largest ovule, largest tree, and largest gametes is
(a) gymnosperm (b) angiosperm
(c) bryophyta (d) pteridophyta. *(2000)*

73. The antherozoids of *Funaria* are
(a) multiciliated (b) monociliated
(c) aciliated (d) biciliated. *(1999)*

74. Bryophytes comprise
(a) dominant phase of gametophyte which produces spores
(b) small sporophyte phase and generally parasitic on gametophyte
(c) sporophyte is of longer duration
(d) dominant phase of sporophyte which is parasitic. *(1999)*

75. In which of the following would you place the plants having vascular tissue lacking seeds?
(a) Pteridophytes (b) Gymnosperms
(c) Algae (d) Bryophytes *(1999)*

76. Which of the following is true about bryophytes?
(a) They are thalloid.
(b) They posses archegonia.
(c) They contain chloroplast.
(d) All of these *(1999)*

77. Dichotomous branching is found in
(a) liverworts (b) pteridophytes
(c) fern (d) *Funaria*. *(1999)*

78. Which one of the following statements about *Cycas* is incorrect?
(a) It has circinate vernation.
(b) Its xylem is mainly composed of xylem vessel.
(c) Its roots contain some blue-green algae.
(d) It does not have a well organized female flower. *(1998)*

79. Largest sperms in the plants world are found in
(a) Banyan (b) *Cycas*
(c) *Thuja* (d) *Pinus*. *(1998)*

80. *Ulothrix* can be described as a
(a) filamentous alga lacking flagellated reproductive stages
(b) membranous alga producing zoospores
(c) filamentous alga with flagellated reproductive stages
(d) non-motile colonial alga lacking zoospores. *(1998)*

81. Bryophytes are dependent on water, because
(a) water is essential for their vegetative propagation
(b) the sperms can easily reach upto egg in the archegonium
(c) archegonium has to remain filled with water for fertilization
(d) water is essential for fertilization for their homosporous nature. *(1998)*

82. The walking fern is so named because
(a) it propagates vegetatively by its leaf tips
(b) it knows how to walk by itself
(c) its spores are able to walk
(d) it is dispersed through the agency of walking animals.
(1998)

83. Transfusion tissue is present in the leaves of
(a) *Pinus* (b) *Dryopteris*
(c) *Cycas* (d) both (a) and (c).
(1998)

84. Heterospory and seed habit are often exhibited by a plant possessing
(a) petiole (b) ligule
(c) bract (d) spathe. *(1997)*

85. An alga, very rich in protein, is
(a) *Chlorella* (b) *Nostoc*
(c) *Spirogyra* (d) *Ulothrix*.
(1997)

86. *Ulothrix* filaments produce
(a) heterogametes (b) basidiospores
(c) isogametes (d) anisogametes.
(1997)

87. Bryophytes can be separated from algae, because they
(a) possess archegonia
(b) contain chloroplast
(c) are thalloid forms
(d) have no conducting tissue. *(1997)*

88. Multicellular branched rhizoids and leafy gametophytes are the characteristics of
(a) some bryophytes (b) pteridophytes
(c) all bryophytes (d) gymnosperms.
(1997)

89. Brown algae is characterised by the presence of
(a) fucoxanthin (b) haematochrome
(c) phycocyanin (d) phycoerythrin.
(1997)

90. The smallest plant family 'Gymnosperm' has how many species?
(a) 640 (b) 300
(c) 1000 (d) 900 *(1996)*

91. Which of the following plant kingdom is called 'amphibians'?
(a) Pteridophyta (b) Thallophyta
(c) Tracheophyta (d) Bryophyta
(1996)

92. Elater mechanism for spore dispersal is exhibited by
(a) liverworts (b) *Marchantia*
(c) *Riccia* (d) *Funaria*. *(1996)*

93. A gymnospermic leaf carries 16 chromosomes. The number of chromosomes in its endosperm will be
(a) 12 (b) 8
(c) 16 (d) 24. *(1996)*

94. The pyrenoids are made up of
(a) proteinaceous centre and starchy sheath
(b) core of nucleic acid surrounded by protein sheath
(c) core of protein surrounded by fatty sheath
(d) core of starch surrounded by sheath of protein.
(1995)

95. The plant body of moss (*Funaria*) is
(a) completely sporophyte
(b) predominantly gametophyte with sporophyte
(c) completely gametophyte
(d) predominantly sporophyte with gametophyte.
(1995)

96. The sexual reproduction is absent in
(a) *Spirogyra* (b) *Nostoc*
(c) *Ulothrix* (d) *Volvox*. *(1995)*

97. A well developed archegonium with neck consisting of 4-6 rows and neck canal cells, characterises
(a) gymnosperms and flowering plants
(b) pteridophytes and gymnosperms
(c) gymnosperms only
(d) bryophytes and pteridophytes. *(1995)*

98. Many blue-green algae occur in thermal springs (hot water springs). The temperature tolerance of these algae have been attributed to their
(a) mitochondrial structure
(b) importance of homopolar bonds in their proteins
(c) cell wall structure
(d) modern cell organization. *(1994)*

99. In Chlorophyceae, the mode of sexual reproduction is
(a) isogamy (b) anisogamy
(c) oogamy (d) all of these.
(1994)

100. In *Pinus*, the wings of the seed develops from
(a) ovuliferous scale (b) integument
(c) nucellus (d) bract. *(1994)*

101. In bryophytes
(a) both generations are independent
(b) gametophytes are dependent upon sporophytes
(c) sporophytes complete their life cycle
(d) sporophytes are dependent upon gametophytes.
(1994)

102. Which one is the most advanced from evolutionary view point?
(a) *Selaginella* (b) *Funaria*
(c) *Chlamydomonas* (d) *Pinus* *(1993)*

103. *Pinus* differs from mango in having
(a) tree habit
(b) green leaves
(c) ovules not enclosed in ovary
(d) wood. *(1993)*

104. Pyrenoids are the centres for formation of
(a) *Porphyra* (b) enzymes
(c) fat (d) starch. *(1993)*

105. Pteridophytes differ from bryophytes and thallophytes in having
(a) vascular tissues
(b) motile antherozoids
(c) archegonia
(d) alternation of generations. *(1993)*

106. Chloroplast of *Chlamydomonas* is
(a) stellate (b) cup-shaped
(c) collar-shaped (d) spiral. *(1993)*

107. In *Ulothrix*/*Spirogyra*, reduction division (meiosis) occurs at the time of
(a) gamete formation
(b) zoospore formation
(c) zygospore germination
(d) vegetative reproduction. *(1993)*

108. Pteridophytes differ from mosses/bryophytes in possessing
(a) independent gametophyte
(b) well developed vascular system
(c) archegonia
(d) flagellate spermatozoids. *(1993)*

109. Protonema occurs in the life cycle of
(a) *Riccia* (b) *Funaria*
(c) *Anthoceros* (d) *Spirogya*.
(1993, 1990)

110. Resin and turpentine are obtained from
(a) *Cycas* (b) *Pinus*
(c) *Cedrus* (d) *Abies*. *(1992)*

111. Turpentine is got from
(a) angiospermous wood
(b) bryophytes
(c) gymnospermous wood
(d) ferns. *(1992)*

112. In *Pinus*, the pollen grain has 6 chromosomes then in its endosperm will have
(a) 12 (b) 18
(c) 6 (d) 24. *(1992)*

113. A plant having seeds but lacking flowers and fruits belongs to
(a) pteridophytes (b) mosses
(c) ferns (d) gymnosperms.
(1992)

114. Which one of the following is not common between *Funaria* and *Selaginella*?
(a) Archegonium (b) Embryo
(c) Flagellate sperms (d) Roots *(1992)*

115. The plant group that produces spores and embryo but lacks vascular tissues and seeds is
(a) Pteridophyta (b) Rhodophyta
(c) Bryophyta (d) Phaeophyta.
(1992)

116. A plant in which sporophytic generation is represented by zygote is
(a) *Pinus* (b) *Selaginella*
(c) *Chlamydomonas* (d) *Dryopteris*.
(1992)

117. Bryophytes are amphibians because
(a) they require a layer of water for carrying out sexual reproduction
(b) they occur in damp places
(c) they are mostly aquatic
(d) all the above. *(1991)*

118. Which one has the largest gametophyte?
(a) *Cycas* (b) Angiosperm
(c) *Selaginella* (d) Moss *(1991)*

119. The common mode of sexual reproduction in *Chlamydomonas* is
(a) isogamous (b) anisogamous
(c) oogamous (d) hologamous.
(1991)

120. The product of conjugation in *Spirogyra* or fertilization of *Chlamydomonas* is
(a) zygospore (b) zoospore
(c) oospore (d) carpospore.
(1991)

121. Moss peristome takes part in
(a) spore dispersal (b) photosynthesis
(c) protection (d) absorption.
(1990)

122. Apophysis in the capsule of *Funaria* is
(a) lower part (b) upper part
(c) middle part (d) fertile part.
(1990)

123. In *Pinus*/gymnosperms, the haploid structure are
(a) megaspore, endosperm and embryo
(b) megaspore, pollen grain and endosperm
(c) megaspore, integument and root
(d) pollen grain, leaf and root. *(1989)*

124. Sperms of both *Funaria* and *Pteris* were released together near the archegonia of *Pteris*. Only its sperms enter the archegonia as
(a) *Pteris* archegonia repel *Funaria* sperms
(b) *Funaria* sperms get killed by *Pteris* sperms
(c) *Funaria* sperms are less mobile
(d) *Pteris* archegonia release chemical to attract its sperms.
(1989)

125. Evolutionary important character of *Selaginella* is
(a) heterosporous nature
(b) rhizophore
(c) strobili
(d) ligule. *(1989)*

126. In *Pinus*/*Cycas*/gymnosperms, the endosperm is
(a) triploid (b) haploid
(c) diploid (d) tetraploid.
(1988)

127. Prothallus (gametophyte) gives rise to fern plant (sporophyte) without fertilization. It is
(a) apospory
(b) apogamy
(c) parthenocarpy
(d) parthenogenesis. *(1988)*

128. Sexual reproduction involving fusion of two cells in *Chlamydomonas* is
(a) isogamy (b) homogamy
(c) somatogamy (d) hologamy.
(1988)

Answer Key

1.	(a)	**2.**	(d)	**3.**	(c)	**4.**	(b)	**5.**	(c)	**6.**	(b)	**7.**	(a)	**8.**	(b)	**9.**	(b)	**10.**	(b)
11.	(a)	**12.**	(a)	**13.**	(c)	**14.**	(d)	**15.**	(c)	**16.**	(a)	**17.**	(d)	**18.**	(b)	**19.**	(a)	**20.**	(b)
21.	(a)	**22.**	(a)	**23.**	(c)	**24.**	(d)	**25.**	(d)	**26.**	(b)	**27.**	(b)	**28.**	(d)	**29.**	(c)	**30.**	(d)
31.	(d)	**32.**	(a)	**33.**	(b)	**34.**	(a)	**35.**	(d)	**36.**	(b)	**37.**	(a)	**38.**	(d)	**39.**	(c)	**40.**	(c)
41.	(d)	**42.**	(b)	**43.**	(a)	**44.**	(d)	**45.**	(a)	**46.**	(d)	**47.**	(b)	**48.**	(d)	**49.**	(c)	**50.**	(d)
51.	(c)	**52.**	(d)	**53.**	(c)	**54.**	(c)	**55.**	(a)	**56.**	(b)	**57.**	(d)	**58.**	(a)	**59.**	(a)	**60.**	(a)
61.	(a)	**62.**	(a)	**63.**	(a)	**64.**	(d)	**65.**	(a)	**66.**	(d)	**67.**	(b)	**68.**	(d)	**69.**	(a)	**70.**	(b)
71.	(a)	**72.**	(a)	**73.**	(d)	**74.**	(b)	**75.**	(a)	**76.**	(d)	**77.**	(a)	**78.**	(b)	**79.**	(b)	**80.**	(c)
81.	(b)	**82.**	(a)	**83.**	(d)	**84.**	(b)	**85.**	(a)	**86.**	(c)	**87.**	(a)	**88.**	(a)	**89.**	(a)	**90.**	(d)
91.	(d)	**92.**	(b)	**93.**	(b)	**94.**	(a)	**95.**	(b)	**96.**	(b)	**97.**	(d)	**98.**	(c)	**99.**	(d)	**100.**	(a)
101.	(d)	**102.**	(d)	**103.**	(c)	**104.**	(d)	**105.**	(a)	**106.**	(b)	**107.**	(c)	**108.**	(b)	**109.**	(b)	**110.**	(b)
111.	(c)	**112.**	(c)	**113.**	(d)	**114.**	(d)	**115.**	(c)	**116.**	(c)	**117.**	(a)	**118.**	(d)	**119.**	(a)	**120.**	(a)
121.	(a)	**122.**	(a)	**123.**	(b)	**124.**	(d)	**125.**	(a)	**126.**	(b)	**127.**	(b)	**128.**	(d)				

EXPLANATIONS

1. (a)

2. (d) : *Pinus* is a monoecious plant, *i.e*., in *Pinus* the male and female cones or strobili are borne on the same plant.

3. (c) : In *Chlamydomonas*, zygote divides by meiosis. It exhibits haplontic type of life cycle.

4. (b) : *Ectocarpus* possesses haplodiplontic whereas *Fucus* possesses diplontic life cycle.

5. (c) : Needle like leaves with thick cuticle and sunken stomata are xerophytic adaptations of conifers for tolerating extreme environmental conditions.

6. (b) : Alginic acid is obtained from brown algae whereas carrageenan is obtained from red algae.

7. (a) : *Sequoia sempervirens* is the tallest gymnosperm. The leaves of gymnosperms are well adapted to extremes of climate. This is the reason for gymnosperm to flourish in cold areas where instead of rain, snow is the source of water. Gymnosperms are heterosporous *i.e*., produce two different kinds of spores-microspores and megaspores. *Salvinia* is an aquatic pteridophyte.

8. (b) : The sperms of bryophytes and pteridophytes are flagellated and hence require an external supply of water to reach archaegonia.

9. (b) : Laminarin and mannitol are food reserves of brown algae or Phaeophyceae. Rhodophycean algae store food in the form of floridean starch.

10. (b) : In gymnosperms (like *Pinus*), the male and female gametophyte do not have an independent free living existence. They remain within the sporangia retained on the sporophytes *i.e*., female gametophyte (within megasporangium) and male gametophyte (within microsporangium).

11. (a) : *Selaginella* is a heterosporous pteridophyte. Corralloid roots of *Cycas* harbour blue green algae like *Nostoc, Anabaena* and are not a type of VAM (vesicular arbuscular mycorrhiza) which is a symbiotic association with fungus.

12. (a) : *Ectocarpus* produces biflagellate gametes. *Anabaena* is a cyanobacteria and does not reproduce sexually. *Spirogyra* produces non-flagellated male gamete during conjugation, where entire cell content functions as gamete. *Polysiphonia* also produces non-flagellated spermatia.

13. (c) : All species of *Chara* reproduce sexually and show highly advanced oogamy. The sex organs are the most distinctive features of the Order Charales and are the most complicated among the thallophytes. Male and female gametangia are called antheridia and oogonia respectively. Male fructification (cluster of antheridia) is called globule and the female is nucule. They are borne at the nodes of short branches, globule towards lower side and nucule (female structure) towards upper side.

14. (d) : Among the bryophytes *Sphagnum* accounts by far the most important place economically. It is popularly called bog moss or peat moss. It is perennial and its growth continues year after year. Older portions undergo death but do not decompose due to secretion of acid that accounts for the antibacterial and antifungal actions. The increasing mass of dead remains accumulate year after year and form a compact dark coloured mass rich in carbon which is called peat. Peat is used as fuels. Paraffin, acetic acid, peat tar and ammonia are formed as by-products of peat obtained for industrial uses.

15. (c) : *Pteris* has a multicellular gametophytic prothallus which has both antheridia and archegonia. *Funaria* has a bisexual leafy gametophyte which is the dominant phase of life. In both *Lilium* (an angiosperm) and *Pinus* (a gymnosperm) male gametophyte is highly reduced and is 2 celled and 3 celled respectively. Thus male gametophyte with least number of cells is present in *Lilium*.

16. (a) : In oomycetes, like other oogamous organisms female gamete is large and non- motile, while male gamete is small and motile.

17. (d) : *Chlamydomonas* has flagellated gametes which are similar or dissimilar in size. In *Volvox* and *Fucus*, non-motile female gametes and motile male gametes are produced (oogamy). *Spirogyra* has gametes that are similar in size (isogamous) and are non-flagellated.

18. (b) : *Refer to answer 13.*

19. (a)

20. (b) : Syngamy is the complete and permanent fusion of male and female gametes to form the zygote. When fertilization occurs outside the body of the organism, this type of gametic fusion is called external fertilization or external syngamy. In majority of algae, external fertilization occurs.

21. (a) : In *Funaria* (Bryophyta), *Dryopteris* (Pteridophyta) and *Ginkgo* (Gymnosperm) female sex organ archaegonium is formed. *Funaria* lacks independent sporophyte and vascular tissues while independent gametophyte is absent in *Ginkgo*.

22. (a) : In *Spirogyra*, gametes are non-motile and sexual reproduction takes place by conjugation. *Sargassum* belongs to Phaeophyceae group of algae. They are commonly called as 'brown algae' and contain photosynthetic pigments chlorophyll *a* and *c*. Puffballs are Basidomycetes with a stalked rounded structure that sends out puffs of spores, *e.g.*, *Lycoperdon oblongisporum*. *Nostoc* is a colonial cyanobacterium. It enriches its habitat with nitrogen by fixing atmospheric nitrogen and also causes water bloom.

23. (c) : *Sphagnum* and *Funaria* belong to Class Bryopsida of Division Bryophyta. They are typically mosses. The plant body has radial symmetry and is essentially leafy.
Salvinia belongs to division Pteridophyta. It has a sporophyte plant body with true leaves, stem and roots. *Marchantia* belongs to Class Hepaticopsida of Division Bryophyta. They are also called liverworts. The plant body is a dorsoventrally flattened thallus.

24. (d) : Algae and moss are included in plant kingdom while fungi constitute a separate kingdom. Among them, mosses invariably show diplontic life cycle while others may or may not. Algae and moss are autotrophic while fungi are heterotrophs. But they all show multiplication by fragmentation.

25. (d) : In majority of the pteridophytes all the spores are of similar kinds; such plants are called homosporous. Genera like *Selaginella* and *Salvinia* which produce two kinds of spores, macro (large) and micro (small) spores, are known as heterosporous. The megaspores and microspores germinate and give rise to female and male gametophytes, respectively. The female gametophytes in these plants are retained on the parent sporophytes for variable periods. The development of the zygotes into young embryos take place within the female gametophytes. This event is a precursor to the seed habit considered an important step in evolution.

26. (b) : *Cycas* is a gymnosperm and *Adiantum* is a pteridophyte. Cambium and seeds are absent in pteridophytes, while vessels are absent in both of these two groups. Both *Cycas* and *Adiantum* resemble each other in having multi-ciliated sperms.

27. (b)

28. (d) : *Equisetum* is a pteridophyte and in pteridophytes, the main plant body is a sporophyte which is differentiated into true root, stem and leaves. Gametophytes are small or inconspicuous and free living, mostly photosynthetic thalloid called prothallus.
Riccia is a liverwort and *Polytrichum* is a moss. The sporophyte in mosses is more elaborate than that in liverworts.
Volvox shows oogamous type of sexual reproduction, *i.e.*, fusion between one large, non motile (static) female gamete and a smaller, motile male gamete.
During unfavourable conditions, the slime mould differentiates and forms fruiting bodies bearing spores at their tips. The spores possess true walls. They are extremely resistant and survive for many years, even under adverse conditions.

29. (c) : Autotrophic nutrition involves manufacture of organic materials from inorganic raw materials with the help of energy obtained from outside sources. It is of two types – chemosynthesis and photosynthesis. The organisms which are able to manufacture their organic food from inorganic raw materials with the help of energy derived from exergonic chemical reactions are called chemoautotrophs. *Nitrosomonas* and *Nitrobacter* are chemoautotrophic nitrifying bacteria.

Those organisms who can manufacture organic compounds from inorganic raw materials with the help of solar energy in the presence of photosynthetic pigments are called photoautotrophs. *E.g.*, *Nostoc*, *Chara*, *Porphyra* and *Wolffia*.

30. (d) : *Refer to answer 10.*

31. (d) : In bryophytes, the dominant phase of life cycle is gametophytic plant body. In contrast, vascular plants have sporophytic plant body in most of their life cycle and reduced, smaller gametophyte which have smaller sex organs.

32. (a) : *Marchantia* is a dioecious plant. Male plants bear antheridiophores and female plants bear archegoniophores. Antheridiophores consists of a stalk and a disc like portion called receptacle. Archegoniophore is composed of a stalk and disc like receptacle at its distal end.

33. (b) : *Cycas* forms facultative symbiotic association with autotrophic nitrogen fixing cyanobacteria. *Cycas* provides fix carbon and a stable environment to the cyanobacteria in exchange for fixed nitrogen. These cyanobacteria are endosymbionts and

live within the roots of *Cycas*. In addition to normal roots, *Cycas* develops specialised symbiotic organs at a young age called pre-coralloid roots which transform into coralloid roots upon successful colonisation by cyanobacteria.

34. (a) : The given figure is of female thallus of *Marchantia* (bryophyte) in which A, B, C and D are archegoniophore, female thallus, gemma cup and rhizoids respectively.

35. (d) : *Refer to answer 25.*

36. (b) : The sporophyte in mosses is more elaborate than that in liverworts. The male and female cones or strobili is borne on same tree in (*Pinus*). In *Cycas* male cones and megasporophylls are borne on different trees.

37. (a) : Majority of algae (eukaryotes) possess a definite cell wall containing cellulose and other carbohydrates. In algal cell wall, different chemical components are present which vary widely among different groups (*e.g.*, xylan, mannan, galactan, alginic acid, silica, agar, pectin, carrageenin, etc.). Cell wall of blue-green algae is made up of micro-peptides (proteins). This micro-peptide is not found in eukaryotic algae.

38. (d) : *Sphagnum* is a bryophyte in which dominant phase or plant body is independent and free living gametophyte. The sporophyte is parasitic over gametophyte. In *Pinus* (a gymnosperm), mustard and castor (angiosperms), the main plant body is sporophytic. Gametophyte is highly reduced and is completely dependent on sporophyte.

39. (c) : Monoecious plants have separate male and female flowers on the same plant. *Pinus* have both the male and female cones or strobili on the same tree.

40. (c) : A – *Selaginella*
B – *Equisetum*
C – *Salvinia*
D – *Ginkgo*

41. (d) : Pteridophytes are known as vascular cryptogams (Gk *kryptos* = hidden + *gamos*= wedded). They reproduce by spores rather than seeds. They are the first vascular land plant.

The pteridophyte *Equisetum* belongs to the Class Sphenophtya. All vegetative parts of it possess vascular tissues (*i.e.* hadrome equivalent to xylem and leptome equivalent to phloem) organised in definite groups of steles.

42. (b) : *Fucus* is a brown algae *i.e.* belongs to Class Phaeophyta. In this alga the accumulation product of photosynthesis is D-mannitol (a sugar alcohol) and the reserve food material is laminarin.

43. (a) : The differentiation of spores into microspores and megaspores, and their dependence on the parent sporophyte for the nutrition, are certain features in the life cycle of *Selaginella*, which have been considered as the essential pre-requisties for the formation of seeds, characteristic of spermatophytes. It is generally agreed, that the seed plants arose from the heterosporous vascular plants that instead of discharging the megaspore acquired the habit of retaining it within the megasporangium.

44. (d) : *Funaria* exhibits gametophytic (*n*) as well as sporophytic (*2n)* generation in its life cycle. The gametophytic generation is represented by a short lived protonema which produces spermatozoids in antheridium of male shoot and egg in archegonium of female shoot. Egg and spermatozoids are fused to form zygote. From zygote diploid sporophyte is produced. The capsule of sporophyte produces haploid spores. Then the haploid gametophyte is produced from the haploid spores. So, the zygote is the only diploid stage in the life cycle. Hence, the life cycle is haplontic life cycle.

45. (a) : *Refer to answer 39.*

46. (d) : In gymnosperm except Order Gnetales (*Gnetum*) xylem consist of xylem parenchyma and tracheids with bordered pits but lacks vessels. So, Gnetales are the most advanced among gymnosperms. They lack archegonia in female gametophyte thus showing similarity with angiosperm and act as connecting link between the two.

47. (b) : In gymnosperm (like *Cedrus*) the male and female gametophyte do not have an independent free living existence. They remain within the sporangia retained on the sporophytes *i.e.*, female gametophyte with megasporangium and male gametophyte within microsporangium.

48. (d) : The sporophyte of pteridophyte produces meiospores inside sporangia, which may be homosporous (*e.g.*, *Equisetum*, *Adiantum*, *Dryopteris,* etc.) or heterosporous (*e.g., Salvinia, Selaginella* etc.).

49. (c) : In gymnosperms, pollen chamber represents the microsporangium in which pollen grains develop. The microspore is generally a globular sac like structure having large number of microspores. The microspores are also termed as pollen grains.

50. (d) : An elater is a cell (or structure attached to a cell) that is hygroscopic, and therefore will change shape in response to changes in moisture in the environment. Elaters come in a variety of forms, but are always associated with plant spores. In plants that do not have seeds, they function in dispersing the spores to a new location. In the liverworts, elaters are cells that develop in the sporophyte alongside the spores. They are complete cells, usually with helcial thickenings at maturity that respond to moisture content. In most liverworts, the elaters are unattached, but in some leafy species (such as *Frullania*) a few elaters will remain attached to the inside of the sporangium (spore capsule). The elaters by hygroscopic movement help in spore dispersal.

51. (c) : Flagellated male gametes are mostly seen lower groups of plants like algae, bryophytes, pteridophytes. It is also seen in certain gymnosperms like *Cycas*. The bryophytes like *Riccia* have the male gametes which are biflagellate.

52. (d): Algae are a group of chlorophyllous, non-vascular plants with thallose plant body. Different algae show different pigments present in the cell like chlorophyll - *a, b,* xanthophylls, carotenes, etc. These pigments provide the base for classification of various groups of algae into different classes. Members of Chlorophyceae possess chlorophyll - *a, b* pigments, Bacillariophyceae contains diatomin pigment whereas that of Phaeophyceae has fucoxanthin, Rhodophyceae has *r*-phycocyanin and *r*-phycoerythrin and cyanophyceae has phycobilin pigment.

53. (c) : In prothallus of vascular cryptogams the antherozoids and eggs mature at different times. The spores on germination gives rise to prothallus. The antherozoids are biflagellated or multiflagellated. The egg is produced inside the venter, water is essential for fertilization and it is always cross-fertilization. Self fertilization is prevented.

54. (c) : The partially decomposed *Sphagnum* mass accumulates to form compressed mass called peat, which after drying is used as coal. So it is also called peat moss. *Sphagnum* has the capacity to retain water for long periods and thus it is used to cover plant roots during transportation.

55. (a) : Conifers belong to gymnosperms. They are seed bearing plants in which the sporophylls are aggregated to form cones and the seeds develop in exposed state over the surface of megasporophylls. Vascular strand consists of tracheids and sieve cells. Female gametophyte forms archegonia, provides nourishment to developing embryo and later gets transformed into food-laden tissue or endosperm inside the seed. This endosperm is formed before fertilization so it is haploid in nature. It provides nourishment for growth of seedlings at the time of seed germination. Grass is an angiospermic plant and endosperm is produced after fertilization.

56. (b)

57. (d) : Until 1907, auxospore formation was regarded as asexual process but now it is considered as an act of sexual process. The auxospores may be autogamous, isogamous, anisogamous or oogamous. Their pattern of formation differs in pennate and centric diatoms.

Formation of hormogonia is the common method of reproduction in *Nostoc* which are produced by accidental breaking of trichome into several pieces. It may also be formed by death and decay of ordinary intercalary cells. Soon, the hormogonium escapes from mucilage and grows into a new filament and then into a new colony.

58. (a) : Stele is a column containing vascular tissues which is surrounded by pericycle and separated from ground tissue by endodermis.

Siphonostele is medullated protostele or protostele with a central non-vascular pith. Leaf gaps are absent. Siphonostele is of two types :

In Ectophloic siphonostele, central pith is surrounded successively by xylem, phloem, pericycle and endodermis. In amphiphloic siphonostele there is a central pith and xylem is surrounded on either side by phloem, pericycle and endodermis. It is found in *Osmunda* and *Equisetum*.

59. (a) : Flagellation is the arrangement of flagella over the body surface of a bacterial cell. Peritrichous flagellation has flagella all over the surface of a bacterial cell *e.g. E. coli*.

Ginkgo belongs to Order Ginkgoales of gymnosperms. It is called living fossil because it is the single living genus in a big fossilized order. *Macrocystis* belongs to Class Phaeophyceae. It is the largest perennial alga, about 40-60 m in size. *Wolffia* is the smallest flowering plant. Rhizophore is a leafless, colourless, positively geotropic elongated structure that grows down from the point of bifurcation of stem. It occurs in *Selaginella*.

60. (a) : *Cycas* is an evergreen palm like plant. The plant body is sporophytic differentiated into root, stem

and leaves, sexual reproduction is of oogamous type takes place by the fusion of distinct male and female gametes. The male and female gametes are formed by the germination of microspores and megaspores which are borne on microsporophylls and megasporophylls. These microspores germinate to form male gametophyte that produces male gametes. The male gametes of *Cycas* are largest (300 μ) in nature, visible to naked eye, oval in form and top shaped. It is spirally coiled in the anterior half with thousands of small cilia. After fertilization the ovule is connected into a seed. In the endosperm of seed lies a well developed embryo having two cotyledons, a plumule and a radicle.

61. (a) : Diversification in plant life appeared due to long periods of evolutionary changes. Algae and bryophytes have thalloid plant body with no differentiation into root, stem and leaves. They had no vascular tissues but later in pteridophytes vascular tissues (xylem and phloem) developed and plant body became differentiated into root, stem and leaves. But the vascular tissues lack vessels and companion cells and they reproduce by spores. In gymnosperms seed habit developed but the seeds are not enclosed inside fruit. In angiosperms vessels and companion cells are present, flowers are present and seeds are enclosed inside fruits. Thus the path of evolution is from algae to bryophytes to pteridophytes to gymnosperms and finally to angiosperm.

62. (a) : Angiosperms are highly evolved and well adapted land plants. They have both vessels and tracheids in xylem for better conduction of water. Roots are modified into taproots, adventitious roots, pneumatophores, etc. to suit the desired climate.
Sex organs are highly developed, sporophylls are organized into flowers and the flowers are highly coloured or modified to attract pollinators at different times and places. Insect pollination is more prevalent because it is more efficient and leads to less wastage of pollen grains as compared to wind pollination. So the flowers are made attractive to attract a variety of insects. Seed are more protected as they are enclosed inside a fruit.
All these adaptations have made angiosperms more adaptive in diverse habitats.

63. (a) : Seed producing plants belong to spermatophyta. It includes gymnosperms and angiosperms. Seed habit or seed formation originated in gymnosperms. It requires the retention of megasporangium or the only on the parent plant and non-shedding of megaspore, development of integument and in site formation of female gametophyte. All these features developed in gymnosperms and angiosperms. Thallophytes, bryophytes and pteridophytes lack these features and thus do not reproduce by producing seeds.
Fern and *Funaria* belong to pteridophytes and bryophytes respectively so they do not reproduce by producing seeds.

64. (d) : *Spirogyra* is a freshwater green alga which belongs to Class Chlorophyceae. The sexual reproduction in *Spirogyra* is called conjugation. It involves the fusion of two morphologically identical but physiologically dissimilar non-ciliated gametes. For development of gametes, some of the cells start to act like male and female gametangia in which the cell contents become separated from the cell wall, shrink and ultimately forms gametes. The fusion of these gametes takes place by scalariform conjugation or lateral conjugation.

65. (a) : Eichler divided plant kingdom into two sub-kingdoms - Cryptogamae and Phanerogamae. All plants without flowers and seeds are included in the Sub-kingdom Cryptogamae whereas Phanerogamae includes plants which bear flowers and seeds.
Cryptogams are further classified into three divisions. Thallophyta, Bryophyta and Pteridophyta.
Spore bearing plants such as mosses and ferns belong to cryptogams because instead of reproducing by flowers and seeds they reproduce by means of spores.

66. (d) : Spermatophyta includes seed bearing plants and this includes gymnosperms and angiosperms. *Acacia* and sugarcane both are angiosperms. *Pinus* and *Cycas* both are gymnosperms. *Rhizopus* belongs to Kingdom Fungi and *Tritcum* is an angiosperm. *Ginkgo* is gymnosperm and *Pisum* is an angiosperm. So *Ginkgo* and *Pisum* correctly represent the grouping spermatophyta.

67. (b) : In angiosperms presence of vessels is not an universal feature as there are certain angiosperms where vessels are absent *e.g.*, *Wintera*, *Trochodendron* etc.
Secondary growth is increase in the girth or diameter of axis (root and stem) of the plant by formation of secondary tissue by the activity of lateral meristem. It occurs in dicotyledons of angiosperms and gymnosperms. But in monocotyledons of angiosperms the primary plant body is complete in itself and doesn't produce any secondary tissue.
Autotrophic plants are those which synthesise their organic food themselves by the process of photosynthesis. But certain angiospermic plants have

heterotrophic mode of nutrition. *E.g. Rafflesia*, *Orobanche*, *Striga* are root parasites.
But double fertilization is universal in all angiosperms. It involves fusion of one male gamete with the egg cell and another male gamete with the diploid secondary nuclei.

68. (d)

69. (a) : *Cycas* belongs to Order Cycadales of gymnosperms because it has naked seed. It is not enclosed inside a fruit. It does not have double fertilization and so the endosperm formed is haploid in nature and not triploid. So it is not included in angiosperms as they have ovules (or seeds) produced inside fruit. This is the main difference between gymnosperms and angiosperms.

70. (b) : The algal Class Rhodophyceae contains a red pigment (*r*-phycocrythrin) and a blue pigment (*r*-phycocynin) in the chromatphores.
These pigments can utilize those wavelengths of light (blue-green region of spectrum, *i.e.*, 480-520 nm) that are not absorbed by chlorophyll. This enables red algae to grow at greater depths than other plants (upto 300 ft. below water). In addition to these, chl.-*a*, chl.-*d*, carotenes and xanthophylls are present.
In phaeophyceae chromatophores are yellowish brown in colour possessing xanthophylls in abundance.
Bacillariophyceae are called 'diatoms' due to presence of an accessory brown pigment called 'diatomin', other pigments are chl.-*a*, chl.-*c* (but not chl.-*b*), carotenes and xanthophylls.
In chlorophyceae colouring pigments are just like higher plants, *i.e.*, Chl.-*a*, Chl.-*b*, xanthophylls and carotenes.

71. (a) : A fern plant body is sporophytic (2n) and is differentiated into roots, stems and leaves. On the ventral surface of leaves sporangia are borne in a group called sori. Inside the sporangium are present the spores which are formed by reduction duvsion. Thus the spores produced are haploid in nature and germinate to produce a prothallus that represents the gametophytic generation. Antheridium and archegonium are borne on this prothallus. Thus meiosis takes place at the stage of spore formation.

72. (a) : Gymnosperms are the most primitive seed plants. The plants are generally perennial, woody trees or shrubs. In general, tallest trees are in gymnosperms *e.g.*, *Sequoia sempervirens* is 366 ft. in height. The male gametes of *Cycas* are largest (300 μ) in size, they are visible to naked eye and are oval in form and top-shaped. The ovule of *Cycas* is also largest in the plant kingdom.

73. (d) : Androcytes or antherozoid mother cell of *Funaria* metamorphoses into a single biflagellate spermatozoid (antherozoids). It is a spirally coiled biflagellate (biciliated) structure.

74. (b) : In bryophytes the main plant body is gametophytic which is independent and may be thallose (no differentiation in root, stem and leaves) *e.g.*, *Riccia*, *Marchantia*, *Anthoceros* etc. or foliose (having leafy axis) *e.g. Sphagnum*, *Funaria* etc. The gametophyte bears the sex organs antheridium and archegonium. Sexual reproduction is of oogamous type. It forms zygote that gives rise to the sporophytic phase. It is differentiated into foot, seta and capsule. The capsule produces spores after meiosis that again gives rise to gametophytic phase. The sporophyte is partially or full dependent upon the gametophyte and is of shorter duration.

75. (a) : Algae, bryophyte and pteridophyte are cryptogams, but out of them algae, and bryophytes are lower cryptogams and do not possess vascular tissue (xylem and phloem), whereas in pteridophytes, vascular tissue system is well developed and so these are higher cryptogams or vascular cryptogams. The term cryptogams means that these plants reproduce by means of spores and do not produce seeds.
The vascular tissue of pteridophytes is well developed. They contain both xylem and phloem. In xylem, vessels are absent and in phloem companion cells are absent.
So pteridophytes or vascular cryptogams are a group of seedless vascular plants, that have successfully invaded the land and reproduce by means of spores. Gymnosperms are naked seed bearing plants called phanerogams.

76. (d) : Bryophytes are green photosynthetic and thalloid structures where the plant body root, stem and leaves. Instead of roots, rhizoids are present for attachment and absorption purpose. They have motile sperms and so they need water for fertilization. Archegonia evolved for the first time in bryophytes in the plant kingdom. It is a flask shaped structure with swollen base called venter and upper elongated neck. The venter contains a venter canal cell and an egg cell. It is surrounded by one celled thick sterile jacket layer.

77. (a) : Dichotomous branching is characteristic feature of liverworts *e.g. Riccia, Marchantia, Pellia* etc. It is a primitive form of branching. It is also called forked branching. In liverworts the thallus is flat and dorsiventral and dichotomously branched. The thallus has a notch at the anterior end. At the base of the

notch, there is a growing point consisting of a single apical cell. It divides repeatedly to form two branches of the same size.

78. (b) : *Cycas* belongs to Order Cycadales of gymnosperms. Its leaves show circinate vernation *i.e.* the leaves are coiled in young stage. The coralloid roots in *Cycas* arise from the lateral branches of the normal roots and contain blue-green algae like *Nostoc* and *Anabaena*. A well developed flower like that of angiosperms is absent in *Cycas*. It has compact cones containing microsporophylls and megasporophylls. The megaspores are loosely arranged on the megasporophyll. The male cone is a compac structure. Vessels in xylem are absent and it contains only tracheids for conduction of water.

79. (b) : *Refer to answer 72.*

80. (c) : *Ulothrix* is a green filamentous alga, belonging to Class Chlorophyceae. The plant body is an unbranched filament consisting of numerous cylindrical cells joined end and end. Under favourable conditions, each cell produces zoospores except holdfast. These zoospores are of two types – macrozoospores and microzoospores. The macrozoospores are larger in size and are quadriflagellate and the microzoospores are smaller zoospores which may be biflagellate or quadrifagelleate. Under unfavourable conditions, nonmotile mitospores called aplanospores are produced. Sexual reproduction in *Ulothrix* is of isogamous type. The isogametes fuse to form a quadriflagellate zygospore which after meiosis forms 16 aplanospores or zoospores.

81. (b) : Bryophytes are called amphibians of plant kingdom because they complete their vegetative phase on land but water is necessary for their reproductive phase. Water helps in maturation and dehiscence of sex organs in bryophytes. It also helps in the transfer of sperms to the archegonium that make water essential for completion of life cycle of bryophytes.

82. (a) : Walking fern is named so because when its leaf tips come in contact with soil, form new plants as adventitious buds develop at leaf tips. This helps in the spread of fern over a large soil surface and thus the name 'walking fern'.

83. (d) : Transfusion tissue is a specialized tissue present on either side of midrib in between the palisade and spongy tissues of the leaf of *Cycas* and also in *Pinus* leaf at the sides of the sclerenchymtous region. It is made of horizontally arranged tracheids. These supply water and minerals to mesophyll tissue upto margins so that the mesophyll cells can carry out photosynthesis. It is of two types primary transfusion tissue present next to the midrib bundle and secondary transfusion tissue that runs upto margins of the leaf. In *Pinus* it consists of tracheids and albuminous cells.

84. (b) : Heterospory means production of two different sizes of spores-megaspore and microspore. All bryophytes are homosporous. Heterospory originated in some pteridophytes like *Selaginella*. It is commonly called club moss or spike moss. Its leaves contain a flap-like outgrowth at the base on the adaxial side called ligule. The leaves are of two types - megasporophyll bearing megasporangia and microsporophylls bearing microsporangia. The megasporangia contains four large megaspores and the microsporangia contains large number of small microspores. Thus *Selaginella* is heterosporous. In some species of *Selaginella* the embryo remains attached to the sporophyte for a long time and it is the habit towards seed habit.

85. (a) : *Chlorella* is a unicellular green alga that contains high percentage of proteins, lipids and most of the known vitamins (carotene, riboflavin, vitamin B_{12}, choline etc) and grows more quickly than *Porphyra*, so scientists are doing research to obtain food from it. The nutritional value is comparable to the mixture of soybeans and spinach.

86. (c) : *Ulothrix* belongs to Class Chlorophyceae of Division Thallophyta. The plant body consists of an unbranched filament, consisting of numerous cylindrical cells joined end to end. It is heterothallic and sexual reproduction is of isogamous type. Except holdfast each cell of the filament can give rise to 64 to 128 gametes. The gametes are similar in size, shape and other features. So these gametes are called isogametes. When two gametes of (+) and (–) strain come together they fuse and a quadriflagellate zygospore is formed.

87. (a) : Bryophytes and algae are both autotrophic, plant body thallus like and devoid of vascular tissues. Instead of roots, rhizoids are present for attachment and absorption purpose. Both algae and bryophytes have motile sperms and need water for fertilization. But bryophytes can be separated from algae because archegonium originated for the first time in bryophytes in plant kingdom. It is a flask shaped structure with swollen base called venter and upper elongated neck. The venter contains a venter canal cell and an egg cell.

It is surrounded by one celled thick sterile jacket layer. In algae sex organs are non-jacketed and unicellular.

88. (a) : The Division Bryophyta includes three classes Hepaticopsida, Anthocerotopsida and Bryopsida. The members of Hepaticopsida and Anthocerotopsida have a thallose plant body which is dorsiventrally differentiated and dichotomously branched. On the ventral surface unicellular or multicellular rhizoids are present. The member of Bryopsida have a main plant body that has a leafy gametophore made up of an axis having spirally arranged leaves. The rhizoids are multicellular and branched *e.g. Sphagnum*, *Funaria, Riccia*, *Anthoceros*. So only few member of bryophytes have leafy gametophytes.

89. (a) : Brown algae are the members of the Class Phaeophyceae. Their chromatopores are ellipsoidal or discoid. They contain chlorophyll *a*, chl *c*, β- and *c*-carotenes and xanthophyll pigments (*e.g.*, lutein, flavoxanthin, violaxanthin). They also contain large amount of a brown pigment – fucoxanthin which masks the green colour of chlorophyll pigment. This gives characteristic brown colour to these plants, hence the name brown algae.

90. (d) : Gymnosperms originated about 200 million years ago and were dominant species at that time. However most of the members have become extinct now and only few living forms are known today. There are around 900 living species of this group.

91. (d) : *Refer to answer 81.*

92. (b) : *Marchantia* is a liverwort in which the sex organs are borne on disc shaped 8-lobed receptacles borne at the tip of vertical gametophores. Sperms are attracted to opened archegonia by proteins and K^+ salts. Fertilization produces a parasitic sporophyte made of foot, seta and capsule. The capsule encloses sporocytes and elaters. These elaters show twisting movements due to spiral bands of thickenings and this leads to liberation and dispersal of spores. In *Riccia* elaters are absent and in *Funaria* peristome teeth help in spore dispersal.

93. (b) : Gymnosperms show distinct alternation of generations. The sporophytic phase is dominant. The sporphyte is differentiated into root, stem and leaves. So the number of chromosomes in a leaf cell is diploid (2n), (2n = 16). Double fertilization is absent in gymnosperms. The endosperm develops before fertilization directly from the megaspore. So the number of chromosomes in endosperm will be 8(n = 8).

94. (a) : Pyrenoids are found in many bryophytes and algae. They are small, spherical bodies found in the cytoplasm of a plant cell. They are rich in proteins and are surrounded by a starch sheath.

95. (b) : *Funaria* is known as common moss or green moss. The plant body is foliose that consists of stem axis which bears many leaves and instead of roots, rhizoids are present. It is gametophytic (n) and independent.

It bears antheridia and archegonia on the same plant but on different branches.

After fertilization the zygote (2n) divides to form the sporophyte which consists of foot, seta and capsule. The basal foot is embedded in the apex of female branch. It absorbs nutrients and provides support for the sporophyte. Inside the capsule haploid spores are produced as a result of meiosis. Thus again the gametophytic phase starts. So the gametophytic phase is the dominant phase of the life cycle of *Funaria*.

96. (b) : *Nostoc* belongs to Cyanophyceae. In this entire class sexual reproduction is completely absent. It reproduces by colony formation, hormogonia, akinetes, heterocysts and endospres. However genetic recombination has been observed. It may be probably through transformation or conjugation.

The other three algae- *Spirogyra*, *Ulothrix* and *Volvox* belong to Chlorophyceae. The members of this class show isogamous, anisogamous and oogamous type of sexual reproduction.

97. (d) : Bryophytes and pteridophytes both have alternation of generation. The gametophytic phase is dominant in bryophytes whereas in pteridophytes it is short lived. Sex organs are embedded is some members of bryophytes and pteridophytes. Sperms are flagellate and so water is required for fertilization. Sterile jacket is present around the sex organs for protection. Archegonium appeared for the first time in bryophytes in plant kingdom. It is a flask shaped structure. It has swollen basal portion called venter and upper elongated neck. The venter has egg cell and venter canal cell. There are 4-6 vertical rows of neck cells enclosing neck canal cells in bryophytes. The archegonia have short neck made of four rows of vertically elongated cells that encloses four neck canal cells in pteridophytes.

98. (c) : Some algae withstand or tolerate a very high temperature and these are often called thermal algae. Such forms are known to grow upto 85ºC, nearly boiling water.

Their cell wall is hard and protective. A typical cell wall of algae consists of two nonliving layers. The inner layer is firm consisting of microfibrils and outer layer is gelatinous and amorphous. Various polysaccharides such as cellulose, pectin, mucilage constitute the typical cell wall. The mucilage covering of the cell is thick and dense and is called the sheath. This sheath holds the cells in colonies together, is having water absorbing and water retaining capacity. It thus protects them under dessicating conditions. Thus they are able to survive under high temperature.

99. (d) : *Refer to answer 96.*

100. (a) : Mature ovule with embryo constitutes seed. The seed is covered with hard seed coat. The outer layer of the seed coat is testa (from middle stony layer). Testa encloses a brown, thin membranous tegmen (from inner fleshy layer). The tegmen surrounds fleshy endosperm.

Inside endosperm is present the embryo. At maturity of seed, a thin layer of ovuliferous scale fuses with testa to form a wing (*i.e.*, seeds are winged) which helps in the dispersal of seed.

101. (d)

102. (d) : *Pinus* is more advanced from the evolutionary point of view. It is a gymnosperms (of phanerogams) having well developed vascular conducting system and bears seeds. While others *Selaginella*, *Funaria* and *Chlamydomonas* do not bear seeds.

103. (c) : *Pinus* is a gymnospermic plant which has a well developed conducting tissue system but seeds are naked. Whereas mango is an angiospermic plant in which seed are enclosed in the ovary and fruit is present.

104. (d) : Pyrenoids are the centres for formation of starch. There are present in chloroplast and are proteinaceous in nature covered by starch plate. They synthesizes and store starch in them.

105. (a) : Pteridophytes differs from bryophytes and thallophytes in having well developed vascular tissue system. Vascular tissues plays an important role in conducting water and food materials to the plants. Whereas these are absent in bryophytes and thallophytes.

106. (b) : Chloroplast in *Chlamydomonas* is cup-shaped. It is one celled structure whereas stellate, spiral and collar shaped chloroplasts are present in *Zygnema*, *Spirogyra* and *Ulothrix* respectively.

107. (c) : In *Ulothrix*/*Spirogyra* reduction division (meiosis) occurs at the time of zygospore formation. Plant body of *Ulothrix* and *Spirogyra*, is gametophytic (haploid), they produce zoogametes (n) which fuses to form zygosporic (2n) diploid, which is a resting spore. Onset of favourable condition zygospore undergoes reductional division, or meiosis to produce zoo-meiospores.

108. (b) : *Refer to answer 105.*

109. (b) : Protonema occurs in the life cycle of *Funaria*. The spore is the first cell of gametophytic generation and it germinates to form a filamentous branched alga like structure called protonema. If gives rise to new plant.

110. (b) : Resins and turpentine are obtained from *Pinus* which is gymnospermic plant. *Cycas* is an ornamental plant. Paper and Canada balsam are obtained from *Abies* and timber is obtained from *Cedrus deodara*.

111. (c) : *Refer to answer 110.*

112. (c) : In *Pinus*, if the pollen grain has 6 chromosomes then in its endosperm will also have 6 chromosomes as endosperm and pollen grains are both haploid structures.

113. (d) : A plant having seed but lacking flowers and fruit belongs to gymnosperms. Gymnosperms are vascular land plants and bears seeds which are naked *i.e.*, ovules not enclosed in the ovary. Hence, flowers are absent.

114. (d) : Root is not common between *Funaria* and *Selaginella*. *Funaria* is a bryophyte and have archegonium, embryo, flagellated sperms which are also present in *Selaginella*. *Selaginella* is a pteridophyte and it has root which is absent in *Funaria*.

115. (c) : Bryophytes are the plants which produces spores and embryos but they do not have vascular tissue system. While rhodophytes and phaeophytes are algae and produces spores (no embryos) only and pteridophytes produces spores, embryo and well developed vascular tissue system.

116. (c) : A plant in which sporophytic generation is represented by zygote is *Chlamydomonas*. It is a type of algae that has gametophytic plant body (haploid). It reproduce sexually by gametes which are isogametes that fuses to produce diploid zygote which is the only sporophytic generation.

117. (a) : *Refer to answer 81.*

118. (d) : Moss has the largest gametophyte. Mosses are small, soft plants that are typically 1-10 cm tall, some species are much larger. They commonly grow close together in clumps or mats in damp or shady locations. They do not have flowers or seeds and their simple leaves cover the thin wiry stem.

119. (a) : In *Chlamysomonas* sexual reproduction takes place through isogamy, anisogamy, and oogamy. Isogamy *i.e.,*the fusion of similar gametes is the common mode of sexual reproduction in it. Anisogamy is fusion of morphologically similar but physiologically different cells. Oogamy is fusion of different gametes.

120. (a) : The product of conjugation in *Spirogyra* or fertilization of *Chlamydomonas* is zygospore. Both are the members of green algae where gametes are fused to form zygote which develops into a thick walled zygospore.

121. (a) : Moss peristome is present in capsule and takes part in spore dispersal. The hygroscopic action of peristomial teeth help in the removal of operculum. The lengthening and shortening of peristomial teeth help in the dispersal of spores. The inner peristome acts as a sieve allowing only a few spores to escape at a time.

122. (a) : Apophysis is basal portion of capsule in continuation with seta. The outer layer of apophysis is epidermis which has stomata for gaseous exchange. In capsule of *Funaria* stomata are present only in apophysis.

123. (b) : In *Pinus*/gymnosperms, endosperm is produced before fertilization and hence it is haploid. Megaspore and pollen grains are structures of male gametophytes and it is also haploid.

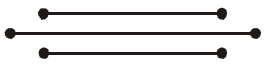
124. (d) : Sperms of both *Funaria* and *Pteris* were released together near the archegonia. But only the sperms of *Pteris* enter the archegonia, as *Pteris* archegonia releases a chemical malic acid to attract its sperms for fertilization.

125. (a) : Evolutionary important character of *Selaginella* is heterosporous nature. *Selaginella* produces two types of spores microspores and megaspores. Heterospory in the life cycle of *Selaginella* leads to the formation of seed habit.

126. (b) : In *Pinus*/*Cycas*/gymnosperms the endosperm is haploid because it is produced before fertilization.

127. (b) : Prothallus (gametophyte) gives rise to fern plant (sporophyte) without fertilization. This phenomenon is called apogamy. Development of sporophyte from gametophyte without forming gamete is apogamy. Such sporophyte is haploid in nature.

128. (d) : Isogamy involves the fusion of gametes which are morphologically and physiologically similar. They are called isogametes. In *Chlamydomonas*, two vegetative cells may fuse to form a zygospore and the phenomenon is called as hologamy. As a result of fusion of two gametes, zygospore is formed.



Chapter

4

Animal Kingdom

1. Important characteristic that hemichordates share with chordates is
(a) ventral tubular nerve cord
(b) pharynx with gill slits
(c) pharynx without gill slits
(d) absence of notochord. *(NEET 2017)*

2. Which among these is the correct combination of aquatic mammals?
(a) Dolphins, Seals, *Trygon*
(b) Whales, Dolphins, Seals
(c) *Trygon*, Whales, Seals
(d) Seals, Dolphins, Sharks *(NEET 2017)*

3. Which of the following represents order of 'Horse'?
(a) Perissodactyla (b) Caballus
(c) Ferus (d) Equidae
(NEET 2017)

4. In case of poriferans, the spongocoel is lined with flagellated cells called
(a) oscula (b) choanocytes
(c) mesenchymal cells (d) ostia.
(NEET 2017)

5. Choose the correct statement.
(a) All mammals are viviparous.
(b) All cyclostomes do not possess jaws and paired fins.
(c) All reptiles have a three-chambered heart.
(d) All pisces have gills covered by an operculum.
(NEET-II 2016)

6. Which one of the following characteristics is not shared by birds and mammals?
(a) Viviparity
(b) Warm blooded nature
(c) Ossified endoskeleton
(d) Breathing using lungs
(NEET-I 2016)

7. Which of the following characteristic features always holds true for the corresponding group of animals?

(a)	Possess a mouth with an upper and a lower jaw	Chordata
(b)	3–chambered heart with one incompletely divided ventricle	Reptilia
(c)	Cartilaginous endoskeleton	Chondrichthyes
(d)	Viviparous	Mammalia

(NEET-I 2016)

8. Which of the following features is not present in the Phylum Arthropoda?
(a) Parapodia
(b) Jointed appendages
(c) Chitinous exoskeleton
(d) Metameric segmentation
(NEET-I 2016)

9. Body having meshwork of cells, internal cavities lined with food filtering flagellated cells and indirect development are the characteristics of Phylum
(a) Mollusca (b) Protozoa
(c) Coelenterata (d) Porifera.
(2015)

10. Metagenesis refers to
(a) occurrence of a drastic change in form during post-embryonic development
(b) presence of a segmented body and parthenogenetic mode of reproduction
(c) presence of different morphic forms
(d) alternation of generation between asexual and sexual phases of an organism.
(2015)

11. A jawless fish, which lays eggs in fresh water and whose ammocoetes larvae after metamorphosis return to the ocean is
(a) *Neomyxine* (b) *Petromyzon*
(c) *Eptatretus* (d) *Myxine*.
(2015)

12. Which of the following endoparasites of humans does show viviparity?
(a) *Trichinella spiralis*
(b) *Ascaris lumbricoides*
(c) *Ancylostoma duodenale*
(d) *Enterobius vermicularis*
(2015 Cancelled)

13. Which of the following represents the correct combination without any exception ?

	Characteristics	Class
(a)	Sucking and circular mouth; jaws absent, integument without scales; paired appendages.	Cyclostomata
(b)	Body covered with feathers; skin moist and glandular, fore-limbs form wings; lungs with air sacs.	Aves
(c)	Mammary gland; hair on body; pinnae; two pairs of limbs.	Mammalia
(d)	Mouth ventral; gills without operculum; skin with placoid scales; persistent notochord.	Chondrichthyes

(2015 Cancelled)

14. Which of the following animals is not viviparous?
(a) Platypus (b) Whale
(c) Flying fox (Bat) (d) Elephant
(2015 Cancelled)

15. Which of the following characteristics is mainly responsible for diversification of insects on land?
(a) Exoskeleton (b) Eyes
(c) Segmentation (d) Bilateral symmetry
(2015 Cancelled)

16. Select the taxon mentioned that represents both marine and fresh water species.
(a) Echinoderms (b) Ctenophora
(c) Cephalochordata (d) Cnidaria
(2014)

17. Which one of the following living organisms completely lacks a cell wall?
(a) Cyanobacteria
(b) Sea - fan (*Gorgonia*)
(c) *Saccharomyces*
(d) Blue - green algae *(2014)*

18. *Planaria* possesses high capacity of
(a) metamorphosis (b) regeneration
(c) alternation of generation
(d) bioluminescence. *(2014)*

19. A marine cartilaginous fish that can produce electric current is
(a) *Pristis* (b) *Torpedo*
(c) *Trygon* (d) *Scoliodon*.
(2014)

20. Which of the following are correctly matched with respect to their taxonomic classification?
(a) House fly, butterfly, tse-tse fly, silver fish - Insecta
(b) Spiny anteater, sea urchin, sea cucumber - Echinodermata
(c) Flying fish, cuttle fish, silver fish - Pisces
(d) Centipede, millipede, spider, scorpion - Insecta
(NEET 2013)

21. Which group of animals belong to the same phylum?
(a) Prawn, Scorpion, *Locusta*
(b) Sponge, Sea anemone, Starfish
(c) Malarial parasite, *Amoeba*, Mosquito
(d) Earthworm, Pinworm, Tapeworm
(NEET 2013)

22. Match the name of the animal (column I), with one characteristic (column II), and the phylum/class (column III) to which it belongs.

	Column I	Column II	Column III
(a)	*Limulus*	Body covered by chitinous exoskeleton	Pisces
(b)	*Adamsia*	Radially symmetrical	Porifera
(c)	*Petromyzon*	Ectoparasite	Cyclostomata
(d)	*Ichthyophis*	Terrestrial	Reptilia

(NEET 2013)

23. One of the representatives of Phylum Arthropoda is
(a) puffer fish (b) flying fish
(c) cuttle fish (d) silver fish.
(NEET 2013)

24. The characteristics of Class Reptilia are
(a) body covered with moist skin which is devoid of scales, the ear is represented by a tympanum, alimentary canal, urinary and reproductive tracts open into a common cloaca
(b) fresh water animals with bony endoskeleton, air-bladder to regulate buoyancy
(c) marine animals with cartilaginous endoskeleton, body covered with placoid scales
(d) body covered with dry and cornified skin, scales over the body are epidermal, they do not have external ears.
(Karnataka NEET 2013)

25. Which one of the following groups of animals reproduces only by sexual means?
(a) Cnidaria (b) Porifera
(c) Protozoa (d) Ctenophora
(Karnataka NEET 2013)

26. Which one of the following animals is correctly matched with its one characteristic and the taxon?

	Animal	Characteristic	Taxon
(a)	Millipede	Ventral nerve cord	Arachnida
(b)	Sea anemone	Triploblastic	Cnidaria
(c)	Silverfish	Pectoral and pelvic fins	Chordata
(d)	Duckbilled platypus	Oviparous	Mammalia

(Karnataka NEET 2013)

27. Sharks and dogfishes differ from skates and rays because
(a) gill slits are ventrally placed
(b) head and trunk are widened considerably
(c) distinct demarcation between body and tail
(d) their pectoral fins distinctly marked off from cylindrical bodies.
(Karnataka NEET 2013)

28. Which one of the following is one of the paths followed by air or O_2 during respiration in the adult male *Periplaneta americana* as it enters the animal body?
(a) Spiracle in metathorax, trachea, tracheloes, oxygen diffuses into cells
(b) Mouth, bronchial tube, trachea, oxygen enters cells
(c) Spiracles in prothorax, tracheoles, trachea, oxygen diffuses into cells.
(d) Hypopharynx, mouth, pharynx, trachea, tissues
(Karnataka NEET 2013)

29. *Pheretima* and its close relatives derive nourishment from
(a) sugarcane roots
(b) decaying fallen leaves and soil organic matter
(c) soil insects
(d) small pieces of fresh fallen leaves of maize, etc. *(2012)*

30. In which one of the following, the genus name, its two characters and its phylum are not correctly matched, whereas the remaining three are correct?

(a)	*Pila*	(i)	Body segmented Mollusca
		(ii)	Mouth with radula
(b)	*Asterias*	(i)	Spiny skinned Echinodermata
		(ii)	Water vascular system
(c)	*Sycon*	(i)	Pore bearing Porifera
		(ii)	Canal system
(d)	*Periplaneta*	(i)	Jointed appendages Arthropoda
		(ii)	Chitinous exoskeleton

(2012)

31. Which one of the following pairs of animals are similar to each other pertaining to the feature stated against them?
(a) *Pteropus* and *Ornithorhynchus* - Viviparity
(b) Garden lizard and crocodile - Three chambered heart
(c) *Ascaris* and *Ancylostoma* - Metameric segmentation
(d) Sea horse and flying fish - Cold blooded (poikilothermal)
(Mains 2012)

32. Which one of the following categories of animals, is correctly described with no single exception in it?
(a) All reptiles possess scales, have a three chambered heart and are cold blooded (poikilothermal).
(b) All bony fishes have four pairs of gills and an operculum on each side.

(c) All sponges are marine and have collared cells.
(d) All mammals are viviparous and possess diaphragm for breathing.

(Mains 2012)

33. What will you look for to identify the sex of the following?
(a) Female *Ascaris*-sharply curved posterior end
(b) Male frog- a copulatory pad on the first digit of the hind limb
(c) Female cockroach-anal cerci
(d) Male shark-claspers borne on pelvic fins

(2011)

34. Which one of the following groups of animals is correctly matched with its characteristic feature without any exception?
(a) Reptilia : possess 3-chambered heart with an incompletely divided ventricle
(b) Chordata : possess a mouth with an upper and a lower jaw
(c) Chondrichthyes : possess cartilaginous endoskeleton
(d) Mammalia : give birth to young ones

(2011)

35. In which one of the following the genus name, its two characters and its class/phylum are correctly matched?

Genus name	Two characters	Class/ Phylum
(a) *Ascaris*	(i) Body segmented (ii) Males and females distinct	Annelida
(b) *Salamandra*	(i) A tympanum represents ear (ii) Fertilization is external	Amphibia
(c) *Pteropus*	(i) Skin possesses (ii) Oviparous	Mammalia
(d) *Aurelia*	(i) Cnidoblasts (ii) Organ level of organization	Coelenterata

(2011)

36. Which one of the following statements is totally wrong about the occurrence of notochord, while the other three are correct?
(a) It is present only in larval tail in ascidian.
(b) It is replaced by a vertebral column in adult frog.
(c) It is absent throughout life in humans from the very beginning.
(d) It is present throughout life in *Amphioxus*.

(Mains 2011)

37. Consider the following four statements (A–D) related to the common frog *Rana tigrina*, and select the correct option stating which ones are true (T) and which ones are false (F).

Statements:
A. On dry land it would die due to lack of O_2 if its mouth is forcibly kept closed for a few days.
B. It has four-chambered heart.
C. On dry land it turns uricotelic from ureotelic.
D. Its life-history is carried out in pond water.

	A	B	C	D
(a)	T	F	F	T
(b)	T	T	F	F
(c)	F	F	T	T
(d)	F	T	T	F

(Mains 2011)

38. The figures (A – D) show four animals. Select the correct option with respect to a common characteristic of two of these animals.

(A)  (B) 

(C)  (D) 

(a) (A) and (D) respire mainly through body wall
(b) (B) and (C) show radial symmetry
(c) (A) and (B) have cnidoblasts for self-defence
(d) (C) and (D) have a true coelom.

(Mains 2011)

39. Ureters act as urinogenital ducts in
(a) human males
(b) human females
(c) both male and female frogs
(d) male frogs. *(Mains 2011)*

40. One example of animals having a single opening to the outside that serves both as mouth as well as anus is
(a) *Octopus* (b) *Asterias*
(c) *Ascidia* (d) *Fasciola*.
(2010)

41. Which one of the following statements about all the four of *Spongilla*, leech, dolphin and penguin is correct?
(a) Penguin is homoiothermic while the remaining three are poikilothermic.
(b) Leech is a fresh water form while all others are marine.
(c) *Spongilla* has special collared cells called choanocytes, not found in the remaining three.
(d) All are bilaterally symmetrical.
(2010)

42. Which one of the following kinds of animals are triploblastic?
(a) Flatworms (b) Sponges
(c) Ctenophores (d) Corals
(2010)

43. Which one of the following statements about certain given animals is correct?
(a) Roundworms (Aschelminthes) are pseudocoelomates
(b) Molluses are acoelomates
(c) Insects are pseudocoelomates
(d) Flatworms (Platyhelminthes) are coelomates.
(2010)

44. In which one of the following organisms its excretory organs are correctly stated?
(a) Humans – Kidneys, sebaceous glands and tear glands
(b) Earthworm – Pharyngeal, integumentary and septal nephridia
(c) Cockroach – Malpighian tubules and enteric caeca
(d) Frog – Kidneys, skin and buccal epithelium
(Mains 2010)

45. Crocodile and penguin are similar to whale and dogfish in which one of the following features?
(a) Possess a solid single stranded central nervous system
(b) Lay eggs and guard them till they hatch
(c) Possess bony skeleton
(d) Have gill slits at some stage
(Mains 2010)

46. Which one of the following groups of animals is bilaterally symmetrical and triploblastic?
(a) Aschelminthes (round worms)
(b) Ctenophores
(c) Sponges
(d) Coelenterates (cnidarians) *(2009)*

47. If a live earthworm is pricked with a needle on its outer surface without damaging its gut, the fluid that comes out is
(a) coelomic fluid (b) haemolymph
(c) slimy mucus (d) excretory fluid.
(2009)

48. Which one of the following pairs of animals comprises 'jawless fishes'?
(a) Mackerals and rohu
(b) Lampreys and hag fishes
(c) Guppies and hag fishes
(d) Lampreys and eels *(2009)*

49. Which one of the following in birds, indicates their reptilian ancestry?
(a) Two special chambers crop and gizzard in their digestive tract
(b) Eggs with a calcareous shell
(c) Scales on their hind limbs
(d) Four-chambered heart *(2008)*

50. *Ascaris* is characterized by
(a) presence of true coelom but absence of metamerism
(b) presence of true coelom and metamerism (metamerisation)
(c) absence of true coelom but presence of metamerism
(d) presence of neither true coelom nor metamerism. *(2008)*

51. Which one of the following groups of three animals each is correctly matched with their one characteristic morphological feature?

	Animals	Morphological features
(a)	Scorpion, spider, cockroach	- ventral solid central nervous system
(b)	Cockroach, locust, *Taenia*	- metameric segmentation
(c)	Liver fluke, sea anemone, sea cucumber	- bilateral symmetry
(d)	Centipede, prawn, sea urchin	- jointed appendages

(2008)

52. Which one of the following pairs of items correctly belongs to the category of organs mentioned against it?
(a) Nephridia of earthworm and Malpighian tubules of cockroach - excretory organs
(b) Wings of honey bee and wings of crow - homologous organs
(c) Thorn of *Bougainvillea* and tendrils of *Cucurbita* - analogous organs
(d) Nictitating membrane and blind spot in human eye - vestigial organs

(2008)

53. Which one of the following phyla is correctly matched with its two general characteristics?
(a) Echinodermata - pentamerous radial symmetry and mostly internal fertilization
(b) Mollusca - normally oviparous and development through a trochophore or veliger larva
(c) Arthropoda - body divided into head, thorax and abdomen and respiration by tracheae
(d) Chordata - notochord at some stage and separate anal and urinary openings to the outside.

(2008)

54. Which one of the following is not a characteristic of Phylum Annelida?
(a) Pseudocoelom
(b) Ventral nerve cord
(c) Closed circulatory system
(d) Segmentation *(2008)*

55. Which of the following pairs are correctly matched?

	Animals		Morphological features
(i)	Crocodile	-	4-chambered heart
(ii)	Sea urchin	-	Parapodia
(iii)	*Obelia*	-	Metagenesis
(iv)	Lemur	-	Thecodont

(a) (ii), (iii) and (iv) (b) only (i) and (iv)
(c) only (i) and (ii) (d) (i), (iii) and (iv)

(2007)

56. Which one of the following is a matching pair of a body feature and the animal possessing it?

(a)	Ventral central nervous system	- Leech
(b)	Pharyngeal gill slits absent in embryo	- Chamaeleon
(c)	Ventral heart	- Scorpion
(d)	Post-anal tail	- Octopus

(2007)

57. What is common between parrot, platypus and kangaroo?
(a) Toothless jaws
(b) Functional post-anal tail
(c) Ovoparity
(d) Homoiothermy *(2007)*

58. What is true about *Nereis*, scorpion, cockroach and silver fish?
(a) They all possess dorsal heart.
(b) None of them is aquatic.
(c) They all belong to the same phylum.
(d) They all have jointed paired appendages.

(2007)

59. Biradial symmetry and lack of cnidoblasts are the characteristics of
(a) *Hydra* and starfish
(b) starfish and sea anemone
(c) *Ctenoplana* and *Beroe*
(d) *Aurelia* and *Paramecium.* *(2006)*

60. Two common characters found in centipede, cockroach, and crab are
(a) book lungs and antennae
(b) compound eyes and anal cerci
(c) jointed legs and chitinous exoskeleton
(d) green gland and tracheae. *(2006)*

61. In which one of the following sets of animals do all the four give birth to young ones?
(a) Kangaroo, hedgehog, dolphin, *Loris*
(b) Lion, bat, whale, ostrich
(c) *Platypus*, penguin, bat, hippopotamus
(d) Shrew, bat, cat, kiwi *(2006)*

62. Which one of the following is not a living fossil?
(a) *Peripatus* (b) King crab
(c) *Sphenodon* (d) *Archaeopteryx*
(2006)

63. Annual migration does not occur in the case of
(a) arctic tern (b) salmon
(c) siberian crane (d) salamander.
(2006)

64. Metameric segmentation is the characteristic of
(a) mollusca and chordata
(b) platyhelminthes and arthropoda
(c) echinodermata and annelida
(d) annelida and arthropoda. *(2006)*

65. Which one of the following is a matching set of a phylum and its three examples?
(a) Porifera - *Spongilla, Euplectella, Pennatula*
(b) Cnidaria - *Bonellia, Physalia, Aurelia*
(c) Platyhelminthes - *Planaria, Schistosoma, Enterobius*
(d) Mollusca - *Loligo, Teredo, Octopus*
(2006)

66. What is common about *Trypanosoma, Noctiluca, Monocystis* and *Giardia* ?
(a) These are all parasities.
(b) These are all unicellular protists.
(c) They have flagella.
(d) They produce spores. *(2006)*

67. In contrast to annelids the platyhelminthes show
(a) absence of body cavity
(b) bilateral symmetry
(c) radial symmetry
(d) presence of pseudocoel. *(2005)*

68. From the following statements select the wrong one.
(a) Prawn has two pairs of antennae.
(b) Nematocysts are characteristics of the phylum cnidaria.
(c) Millepedes have two pairs of appendages in each segment of the body.
(d) Animals belonging to phylum porifera are marine and fresh water. *(2005)*

69. Which of the following unicellular organisms has a macronucleus for trophic function and one or more micronuclei for reproduction?
(a) *Euglena* (b) *Amoeba*
(c) *Paramecium* (d) *Trypanosoma*
(2005)

70. Which one of the following characters is not typical of the class mammalia?
(a) Thecodont dentition
(b) Alveolar lungs
(c) Ten pairs of cranial nerves
(d) Seven cervical vertebrae *(2005)*

71. In Arthropoda, head and thorax are often used to form cephalothorax, but in which one of the following classes, is the body divided into head thorax and abdomen?
(a) Insecta
(b) Myriapoda
(c) Crustacea
(d) Arachnida and curstacea *(2004)*

72. The animals with bilateral symmetry in young stage, and radial pentamerous symmetry in the adult stage, belong to the Phylum
(a) Annelida (b) Mollusca
(c) Cnidaria (d) Echinodermata.
(2004)

73. Presence of gills in the tadpole of frog indicates that
(a) fish were amphibious in the past
(b) fish evolved from frog-like ancestors
(c) frogs will have gills in future
(d) frogs evolved from gilled ancestors.
(2004)

74. Uricotelism is found in
(a) mammals and birds
(b) fish and fresh water protozoans
(c) birds, land reptiles and insects
(d) frogs and toads. *(2004)*

75. One of the following is a very unique feature of the mammalian body
(a) homeothermy
(b) presence of diaphragm
(c) four chambered heart
(d) rib cage. *(2004)*

76. When a fresh-water protozoan possessing a contractile vacuole, is placed in a glass containing marine water, the vacuole will
(a) increase in number
(b) disappear
(c) increase in size
(d) decrease in size. *(2004)*

77. Bartholin's glands are situated
(a) on the sides of the head of some amphibians
(b) at the reduced tail end of birds
(c) on either side of vagina in humans
(d) on either side of vas deferens in humans.
(2003)

78. The chief advantage of encystment of an *Amoeba* is
(a) the ability to survive during adverse physical conditions
(b) the ability to live for some time without ingesting food
(c) protection from parasites and predators
(d) the chance to get rid of accumulated waste products. *(2003)*

79. Systemic heart refers to
(a) the heart that contracts under stimulation from nervous system
(b) left auricle and left ventricle in higher vertebrates
(c) entire heart in lower vertebrates
(d) the two ventricles together in humans. *(2003)*

80. *Sycon* belongs to a group of animals, which are best described as
(a) unicellular or acellular
(b) multicellular without any tissue organization
(c) multicellular with a gastrovascular system
(d) multicellular having tissue organization, but no body cavity. *(2003)*

81. During the life-cycle, *Fasciola hepatica* (liver fluke) infects its intermediate host and primary host at the following larval stages respectively
(a) redia and miracidium
(b) cercaria and redia
(c) metacercaria and cercaria
(d) miracidium and metacercaria. *(2003)*

82. Ommatidia serve the purpose of photoreception in
(a) cockroach (b) frog
(c) humans (d) sunflower. *(2003)*

83. Which one of the following is a matching pair of an animal and a certain phenomenon it exhibits?
(a) *Pheretima* – Sexual dimorphism
(b) *Musca* – Complete metamorphosis
(c) *Chameleon* – Mimicry
(d) *Taenia* – Polymorphism *(2003)*

84. Given below are four matchings of an animal and its kind of respiratory organ :
(A) Silver fish – Trachea
(B) Scorpion – Book lung
(C) Sea squirt – Pharyngeal slits
(D) Dolphin – Skin
The correct matchings are
(a) (A) and (B) (b) (A), (B) and (C)
(c) (B) and (D) (d) (C) and (D). *(2003)*

85. In which of the following animals nerve cell is present but brain is absent?
(a) Sponge (b) Earthworm
(c) Cockroach (d) *Hydra* *(2002)*

86. In which of the following animals dimorphic nucleus is found?
(a) *Amoeba proteus*
(b) *Trypanosoma gambiense*
(c) *Plasmodium vivax*
(d) *Paramecium caudatum* *(2002)*

87. In which of the following, notochord is present in embryonic stage?
(a) All chordates (b) Some chordates
(c) Vertebrates (d) Non chordates *(2002)*

88. In protozoa like *Amoeba* and *Paramecium*, the organ for osmoregulation is
(a) contractile vacuole (b) mitochondria
(c) nucleus (d) food vacuole. *(2002)*

89. In which of the following animals, haemocyanin pigment is found?
(a) Annelida (b) Echinodermata
(c) Insecta (d) Mollusca *(2001)*

90. In which of the following animals post anal tail is found?
(a) Earthworm
(b) Lower invertebrates
(c) Scorpion
(d) Snake *(2001)*

91. In *Hydra*, waste material of food digestion and nitrogenous waste material are removed respectively from
(a) mouth and mouth
(b) body wall and body wall
(c) mouth and body wall
(d) mouth and tentacles. *(2001)*

92. Cleavage in mammals is
(a) holoblastic equal
(b) holoblastic unequal
(c) superficial
(d) discoidal. *(2000)*

93. Which of the following animals have scattered cells with cell - tissue grade organisation?
(a) Sponge (b) *Hydra*
(c) Liver fluke (d) *Ascaris* *(2000)*

94. Similarity in *Ascaris lumbricoides* and *Anopheles stephensi* is
(a) sexual dimorphism
(b) metamerism
(c) anaerobic respiration
(d) endoparasitism. *(2000)*

95. What happens if bone of frog is kept in dilute hydrochloric acid?
(a) Will become flexible
(b) Will turn black
(c) Will break into pieces
(d) Will shrink *(2000)*

96. Which of the following characters is absent in all chordates?
(a) Diaphragm
(b) Coelom
(c) Pharyngeal gill clefts
(d) Dorsal nerve cord *(2000)*

97. What is true for mammalia?
(a) *Platypus* is oviparous.
(b) Bats have feather.
(c) Elephant is ovoviviparous.
(d) Diaphragm is absent in them. *(2000)*

98. Aquatic reptiles are
(a) ureotelic
(b) ureotelic in water
(c) ammonotelic
(d) ureotelic over land. *(1999)*

99. Temperature changes, in the environment, affect most of the animals which are
(a) poikilothermic (b) homoiothermic
(c) aquatic (d) desert living. *(1999)*

100. The canal system is a characteristic feature of
(a) echinoderms (b) sponges
(c) helminthes (d) coelenterates. *(1999)*

101. Which of the following is not found in birds?
(a) Pelvic girdle (b) Pectoral girdle
(c) Hindlimb (d) Forelimb *(1999)*

102. The long bones are hollow and connected by air passages. They are the characteristics of
(a) reptilia (b) land vertebrates
(c) aves (d) mammals. *(1998)*

103. Solenocytes are the main excretory structures in
(a) echinodermates (b) platyhelminthes
(c) annelids (d) molluscs. *(1998)*

104. Most appropriate term to describe the life cycle of *Obelia* is
(a) metamorphosis (b) neoteny
(c) metagenesis (d) all of these. *(1998)*

105. The lower jaw in mammals is made up of
(a) dentary (b) maxills
(c) angulars (d) mandible. *(1998)*

106. Which one of the following cells, found in testes of rabbit, secretes male hormone?
(a) Epithelial cells (b) Spermatocytes
(c) Leydig's cell (d) Sertoli cells *(1998)*

107. What is common among silverfish, scorpion, crab and honey bee?
(a) Jointed legs (b) Metamorphosis
(c) Compound eyes (d) Poison glands *(1997)*

108. The embryonated egg of *Ascaris* represents
(a) an egg with blastula
(b) an egg with a juvenile
(c) an egg with an egg
(d) an egg with gastrula. *(1997)*

109. Which of the following statements is without exception for sponges?
(a) They all have calcareous spicules.
(b) They have high regenerative power.
(c) They are found only in marine water.
(d) They are all radially symmetrical. *(1996)*

110. When an animal has both the characters of male and female, it is called
(a) super female (b) super male
(c) intersex (d) gynandromorph. *(1996)*

111. Coelom is found between
(a) body wall and ectoderm
(b) ectoderm and endoderm
(c) mesoderm and body wall (endoderm)
(d) mesoderm and ectoderm. *(1996)*

112. Pneumatic bone is found in
(a) shark (b) *Rana*
(c) pigeon (d) whale. *(1996)*

113. The nephridia in earthworm are analogous to
(a) nematoblasts of *Hydra*
(b) flame cells of *Planaria*
(c) gills of prawn
(d) trachea of insects. *(1996)*

114. Which of the following is common among mammals?
(a) They undergo no moulting.
(b) They have seven cervical vertebrae.
(c) They are carnivores.
(d) They have ventral nerve cord. *(1996)*

115. The formation of canal system in sponges is due to
(a) folding of inner walls
(b) gastro-vascular system
(c) reproduction
(d) porous walls. *(1996)*

116. Which of the following organisms possesses characteristics of a plant and an animal?
(a) *Euglena* (b) *Paramecium*
(c) Bacteria (d) *Mycoplasma*
(1995)

117. Besides annelida and arthropoda, the metamerism is exhibited by
(a) mollusca (b) acanthocephala
(c) cestoda (d) chordata. *(1995)*

118. The function of contractile vacuole, in protozoa, is
(a) osmoregulation (b) reproduction
(c) locomotion (d) digestion of food.
(1995)

119. The organisms attached to the substratum, generally, possess
(a) one single opening of the digestive canal
(b) cilia on the surface to create water current
(c) radial symmetry
(d) asymmetrical body. *(1995)*

120. The sympathetic nerves, in mammals, arise from
(a) sacral nerves
(b) 3rd, 7th, 9th and 10th cranial nerves
(c) thoraco-lumbar nerves
(d) cervical nerves. *(1995)*

121. The oestrous cycle is a characteristic of
(a) human females only
(b) mammalian females other than primates
(c) human males only
(d) mammalian males other than primates.
(1995)

122. A common characteristic of all vertebrates without exception is
(a) the division of body into head, neck, trunk and tail
(b) their body covered with an exoskeleton
(c) the possession of two pairs of functional appendages
(d) the presence of well-developed skull.
(1994)

123. One of the special characters of coelenterata only is the occurrence of
(a) polymorphism (b) flame cells
(c) hermaphroditism (d) nematocysts.
(1994)

124. Radial symmetry is, usually, exhibited in animals which
(a) are attached to the substratum
(b) have one opening of alimentary canal
(c) live in water
(d) have ciliary mode of feeding. *(1994)*

125. Which of the following is an example of platyhelminthes?
(a) *Plasmodium* (b) *Schistosoma*
(c) *Trypanosoma* (d) *Wuchereria*
(1994)

126. Among the following organisms point out a completely non-parasitic form
(a) tape worm (b) mosquito
(c) sea anemone (d) leech. *(1994)*

127. Tube feet are the characteristic structures of
(a) starfish (b) jellyfish
(c) crayfish (d) cuttlefish. *(1994)*

128. Two examples in which the nitrogenous wastes are excreted from body in the form of uric acid are
(a) birds and lizards
(b) frogs and cartilaginous fish
(c) insects and bony fish
(d) mammals and molluscs. *(1994)*

129. In man and mammals, air passes from outside into the lungs through
(a) nasal cavity, larynx, pharynx, trachea, bronchi, alveoli
(b) nasal cavity, larynx, pharynx, trachea, bronchioles, alveoli
(c) nasal cavity, pharynx, larynx, trachea, bronchioles, bronchi, alveoli
(d) nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, alveoli. *(1994)*

130. Which of the following does not have an open circulatory system?
(a) Frog's tadpole (b) Prawn
(c) *Chelifer* (d) Cockroach
(1994)

131. Which is common between ostrich, penguin and kiwi?
(a) Running birds (b) Migratory birds
(c) Flightless birds (d) Four toed birds
(1993)

132. Which one assists in locomotion?
(a) Trichocysts in *Paramecium*
(b) Pedicellariae of star fish
(c) Clitellum in *Pheretima*
(d) Posterior sucker in *Hirudinaria* *(1993)*

133. What is true about *Taenia saginata*?
(a) Life history has pig as intermediate host.
(b) There are two large suckers on scolex.
(c) Rostellar hooks are absent.
(d) Rostellum has double circle of hooks. *(1993)*

134. Which one of the following animals possesses nerve cells but no nerves?
(a) *Hydra* (b) Tapeworm
(c) Earthworm (d) Frog's tadpole *(1993)*

135. Budding is a normal mode of asexual reproduction in
(a) starfish and *Hydra*
(b) *Hydra* and sponges
(c) tapeworm and *Hydra*
(d) sponge and starfish. *(1993)*

136. Tracheae of cockroach and mammal are similar in having
(a) paried nature
(b) noncollapsible walls
(c) ciliated inner lining
(d) origin from head. *(1993)*

137. A larval stage occurs in the life history of all members of the group
(a) frog, lizard and cockroach
(b) *Ascaris*, housefly and frog
(c) housefly, earthworm and mosquito
(d) butterfly, frog and mosquito. *(1993)*

138. Gorilla, chimpanzee, monkeys and humans belong to the same
(a) species (b) genus
(c) family (d) order. *(1993)*

139. What is common in whale, bat and rat?
(a) Absence of neck
(b) Muscular diaphragm between thorax and abdomen
(c) Extra-abdominal testes to avoid high temperature of body
(d) Presence of external ears *(1993)*

140. Bullfrog of India is
(a) *Rana tigrina* (b) *R. sylvatica*
(c) *R. ecutesbeiana* (d) *R. esculenta*. *(1992)*

141. Aristotle's lantern occurs in Class
(a) Echinoidea (b) Asteroidea
(c) Holothuroidea (d) Ophiuroidea. *(1992)*

142. Starfish belongs to
(a) asteriodea (b) ophiuroidea
(c) holothuroidea (d) crinodiea. *(1992)*

143. Eye of the molluscan group that resembles vertebrate eye is
(a) bivalvia (b) gastropoda
(c) pelecypoda (d) cephalopoda. *(1992)*

144. Adult *Culex* and *Anopheles* can be distinguished with the help of
(a) mouth parts/colour (b) sitting posture
(c) antennae/wings (d) feeding habits. *(1992)*

145. Sound box of birds is called
(a) pygostyle (b) larynx
(c) syrinx (d) synsacrum. *(1992)*

146. **Assertion (A) :** *Periplaneta americana* is nocturnal, omnivorous, household pest.
Reason (R) : It is because it acts as scavenger.
(a) A is true but R is false.
(b) A is false but R is true.
(c) Both A and R are true and R is correct explanation of A.
(d) Both A and R are true but R is not correct explanation of A. *(1992)*

147. *Ascaris* larva is called
(a) cysticercus (b) rhabditiform
(c) hexacanth (d) onchosphere. *(1992)*

148. What is correct about *Taenia*?
(a) Male organs occur in posterior proglottides.
(b) Male organs occur in anterior proglottides.
(c) Female organs occur in anterior proglottides.
(d) Mature proglottides contain both male and female organs. *(1992)*

149. The simplest type of canal system in Porifera is
(a) ascon type (b) leucon type
(c) sycon type (d) radial type. *(1992)*

150. An egg laying mammal is
(a) kangaroo (b) platypus
(c) koala (d) whale. *(1992)*

151. Kidney of adult rabbit is
(a) pronephros (b) metanephros
(c) mesonephros (d) opisthonephros. *(1992)*

152. Homeostasis is
(a) tendency to charge with change in environment
(b) tendency to resist change
(c) disturbance in regulatory control
(d) plants and animal extracts used in homeopathy. *(1991)*

153. Which one occurs in echinodermata?
(a) Bilateral symmetry (b) Radial symmetry
(c) Porous body (d) Soft skin *(1991)*

154. An insect regarded as greatest mechanical carrier of diseases is
(a) *Pediculus* (b) *Cimex*
(c) *Musca* (d) *Xenopsylla*. *(1991)*

155. Metamorphosis of insects is regulated through hormone
(a) pheromone (b) thyroxine
(c) ecdysone (d) all of these. *(1991)*

156. Classification of Porifera is based on
(a) branching (b) spicules
(c) reproduction (d) symmetry. *(1991)*

157. The excretory structures of flatworms/ *Taenia* are
(a) flame cells (b) protonephridia
(c) malpighian tubules (d) green glands. *(1991)*

158. Bladderworm/cysticercus is the larval stage of
(a) tapeworm (b) roundworm
(c) pinworm (d) liver fluke. *(1991)*

159. Ecdysis is shedding of
(a) stratum corneum (b) epidermis
(c) dermis (d) stratum malpighi. *(1990)*

160. Penguin occurs in
(a) Australia (b) Antarctica
(c) Africa (d) America. *(1990)*

161. Kala-azar and Oriental Sore are spread by
(a) housefly (b) bed bug
(c) sand fly (d) fruit fly. *(1990)*

162. Malpighian tubules are
(a) excretory organs of insects
(b) excretory organs of annelids
(c) respiratory organs of insects
(d) respiratory organs of annelids. *(1990)*

163. *Taenia saginata* differs from *Taenia solium* in
(a) absence of scolex hooks
(b) absence of scolex hooks and uterine branching
(c) absence of scolex hooks and presence of both male and female reproductive organs
(d) presence of scolex hooks. *(1990)*

164. Onchosphere occurs in
(a) *Ascaris* (b) *Fasciola*
(c) *Taenia* (d) *Planaria*. *(1990)*

165. Eutherians are characterised by
(a) hairy skin (b) true placentation
(c) ovoviviparity (d) glandular skin. *(1989)*

166. Wish bone of birds is from
(a) pelvic girdle
(b) skull
(c) hind limbs
(d) pectoral girdle/clavicles. *(1989)*

167. Flight muscles of bird are attached to
(a) clavicle (b) keel of sternum
(c) scapula (d) coracoid. *(1989)*

168. A chordate character is
(a) gills
(b) spiracles
(c) post-anal tail
(d) chitinous exoskeleton. *(1989)*

169. Earthworms are
(a) useful
(b) harmful
(c) more useful than harmful
(d) more harmful. *(1989)*

170. Transfer of *Taenia* to secondary host occurs as
(a) oncosphere (b) cysticercus
(c) morula (d) egg. *(1989)*

171. Jelly fish belongs to Class
(a) Hydrozoa (b) Scyphozoa
(c) Anthozoa (d) none of these. *(1989)*

172. Fish which can be used in biological control of mosquitoes/larvicidal fish is
(a) *Eel* (b) carp
(c) cat fish (d) *Gambusia*. *(1989)*

173. Hair occur in all mammals except those of
(a) rodentia (b) chiroptera
(c) primata (d) cetacea. *(1988)*

174. Bird vertebrae are
(a) acoelous (b) heterocoelous
(c) amphicoelous (d) procoelous. *(1988)*

175. Feet of kingfisher are modified for
(a) wading (b) perching
(c) running (d) catching. *(1988)*

176. Both male and female pigeons secrete milk through
(a) salivary glands
(b) modified sweat glands
(c) crop
(d) gizzard. *(1988)*

177. *Typhlops* is
(a) sea snake (b) glass snake
(c) blind snake (d) grass snake. *(1988)*

178. *Necturus* is
(a) hell bender (b) congo eel
(c) mud puppy (d) blind worm. *(1988)*

179. Fire bellied toad is
(a) *Amphiuma* (b) *Bombina*
(c) *Necturus* (d) *Salamandra*. *(1988)*

180. Which is not a true amphibian animal?
(a) Salamander (b) Toad
(c) Tortoise (d) Frog *(1988)*

181. A wood boring mollusc/shipworm is
(a) *Chiton* (b) *Teredo*
(c) *Limax* (d) *Patella*. *(1988)*

182. Silk thread is obtained from silk moth during
(a) pupal stage (b) larval stage
(c) nymph stage (d) adult stage. *(1988)*

183. Organ Pipe Coral is
(a) *Tubipora* (b) *Astraea*
(c) *Helipora* (d) *Fungia*. *(1988)*

Answer Key

1.	(b)	**2.**	(b)	**3.**	(a)	**4.**	(b)	**5.**	(b)	**6.**	(a)	**7.**	(c)	**8.**	(a)	**9.**	(d)	**10.**	(d)
11.	(b)	**12.**	(a)	**13.**	(*)	**14.**	(a)	**15.**	(a)	**16.**	(d)	**17.**	(b)	**18.**	(b)	**19.**	(b)	**20.**	(a)
21.	(a)	**22.**	(c)	**23.**	(d)	**24.**	(d)	**25.**	(d)	**26.**	(d)	**27.**	(d)	**28.**	(a)	**29.**	(b)	**30.**	(a)
31.	(d)	**32.**	(b)	**33.**	(d)	**34.**	(c)	**35.**	(*)	**36.**	(c)	**37.**	(*)	**38.**	(d)	**39.**	(d)	**40.**	(d)
41.	(c)	**42.**	(a)	**43.**	(a)	**44.**	(b)	**45.**	(d)	**46.**	(a)	**47.**	(a)	**48.**	(b)	**49.**	(c)	**50.**	(d)
51.	(a)	**52.**	(a)	**53.**	(c)	**54.**	(a)	**55.**	(d)	**56.**	(a)	**57.**	(d)	**58.**	(a)	**59.**	(c)	**60.**	(c)
61.	(a)	**62.**	(d)	**63.**	(d)	**64.**	(d)	**65.**	(d)	**66.**	(b)	**67.**	(a)	**68.**	(a)	**69.**	(c)	**70.**	(c)
71.	(a)	**72.**	(d)	**73.**	(d)	**74.**	(c)	**75.**	(b)	**76.**	(d)	**77.**	(c)	**78.**	(a)	**79.**	(c)	**80.**	(b)
81.	(d)	**82.**	(a)	**83.**	(b)	**84.**	(b)	**85.**	(d)	**86.**	(d)	**87.**	(a)	**88.**	(a)	**89.**	(d)	**90.**	(d)
91.	(c)	**92.**	(b)	**93.**	(b)	**94.**	(a)	**95.**	(a)	**96.**	(a)	**97.**	(a)	**98.**	(b)	**99.**	(a)	**100.**	(b)
101.	(d)	**102.**	(c)	**103.**	(b)	**104.**	(c)	**105.**	(a)	**106.**	(c)	**107.**	(c)	**108.**	(b)	**109.**	(b)	**110.**	(d)
111.	(c)	**112.**	(c)	**113.**	(b)	**114.**	(a)	**115.**	(d)	**116.**	(a)	**117.**	(d)	**118.**	(a)	**119.**	(c)	**120.**	(c)
121.	(b)	**122.**	(d)	**123.**	(d)	**124.**	(a)	**125.**	(b)	**126.**	(c)	**127.**	(a)	**128.**	(a)	**129.**	(d)	**130.**	(a)
131.	(c)	**132.**	(d)	**133.**	(c)	**134.**	(a)	**135.**	(b)	**136.**	(b)	**137.**	(d)	**138.**	(d)	**139.**	(b)	**140.**	(a)
141.	(a)	**142.**	(a)	**143.**	(d)	**144.**	(b)	**145.**	(c)	**146.**	(d)	**147.**	(b)	**148.**	(d)	**149.**	(a)	**150.**	(b)
151.	(b)	**152.**	(b)	**153.**	(b)	**154.**	(c)	**155.**	(c)	**156.**	(b)	**157.**	(a)	**158.**	(a)	**159.**	(a)	**160.**	(b)
161.	(c)	**162.**	(a)	**163.**	(a)	**164.**	(c)	**165.**	(b)	**166.**	(d)	**167.**	(b)	**168.**	(c)	**169.**	(a)	**170.**	(a)
171.	(b)	**172.**	(d)	**173.**	(d)	**174.**	(b)	**175.**	(a)	**176.**	(c)	**177.**	(c)	**178.**	(c)	**179.**	(b)	**180.**	(c)
181.	(b)	**182.**	(a)	**183.**	(a)														

(*) *None of these.*

EXPLANATIONS

1. (b) : An important characteristics that hemichordates and chorddates share is presence of pharyngeal gill slits. Gill slits are dorsal in position in hemichordates whereas they are lateral in chordates. A true unotochord does not occur in hemichordates. Nervous system is distinctly of vertebrate type being intraepidermal in position and having a ventral nerve cord.

2. (b) : Whales, dolphin and seals are examples of aquatic mammals. *Trygon* and sharks are cartilaginous fishes.

3. (a) : Perissodactyla represents the order of horse. Equidae is the family, *caballus* is the subspecies whereas *E. ferus* is the species of horse.

4. (b) : Spongocoel is the central body cavity of the sponges. It is lined by highly specialised flagellated cells called choanocytes.

5. (b) : *Ornithorhynchus* and *Tachyglossus* are oviparous mammals. Crocodile is a reptile which possesses four chambered heart. In cartilaginous fish (except *Chimaera*) gills are not covered by an operculum.

6. (a) : All birds are oviparous while all mammals except *Ornithorhyncus* (duck billed platypus) and *Echidna* or *Tachyglossus* (spiny anteater) are viviparous.

7. (c) : Phylum Chordata includes both jawless vertebrates (Agnatha) and jawed vertebrates (Gnathostomata). Crocodile of Class Reptilia has four chambered heart with two auricles and two ventricles. Duck billed platypus and spiny anteater are oviparous mammals.

8. (a) : Parapodia are flattened, fleshy, vertical flap-like outgrowths of body wall found in annelids on lateral sides of trunk segments. These are hollow structures enclosing coelom which is continuous with that of trunk segments. These serve the dual purpose of locomotion and respiration.

9. (d) : Phylum Porifera (the sponges) has cellular level of body organisation, with inner cellular layer consisting of highly specialised flagellated cells called choanocytes (or collar cells). The development in this phylum is indirect as it includes a free swimming larva called amphiblastula or parenchymula for dispersal of the species.

10. (d) : An alternation of generation between asexual and sexual phases of an organism is referred to as metagenesis. *E.g.* in *Obelia* (a coelenterate), polyps reproduce asexually and medusae reproduce sexually.

11. (b) : *Petromyzon* (Lamprey) belongs to the Class-Cyclostomata of Phylum-Chordata. It is a jawless fish which lays eggs in fresh water. The eggs hatch in about 3 weeks into minute transparent larvae called ammocoetes. After metamorphosis, the young lampreys swim down to the sea where they remain for 3 or 4 years before reaching maturity, when they once again migrate to streams or rivers to spawn and die. Gonads become mature at that time when adults return to rivers for spawning.

12. (a) : *Trichinella spiralis* is a minute nematode parasite that shows viviparity *i.e.*, produces live youngs (larvae) not eggs. The adults of *T. spiralis* live in the human small intestine, where the females release large numbers of larvae. These larvae bore through the intestine and can cause trichinosis or trichiniasis which has symptoms like diarrohea, nausea, vertigo, pain in limbs and fever etc.
Humans get infected after eating imperfectly cooked meat infected with the parasite's larval cysts.

13. None of the options is correct.
Cyclostomes do not have paired appendages. Skin in Aves is neither moist nor glandular. Only preen gland is present at the base of tail. Chondrichthyes members have gills without operculum, except *Chimaera*. Prototherian mammals do not have ear pinnae and aquatic mammals lack hindlimbs (like whales and dolphins).

14. (a) : Duck-billed platypus is an egg laying mammal. It is found in the rivers in eastern Australia and Tasmania. It is a beaver like monotreme about 50-60 cm long and well adapted to live in water. Usually, two eggs are laid at a time. The female curls around them for incubation and remains inactive for about two weeks. Newly hatched young ones are very immature, naked, blind and each is 2.5 cm long.

15. (a) : Exoskeleton made of cuticle has enabled insects to live on land and to diversify to almost all the possible habitats. It gives them protection, support and also helps to prevent desiccation.

16. (d) : Cnidarians are the sac-like animals which are aquatic, mostly marine except a few like *Hydra*,

are fresh water. They are the simplest organisms that have attained a tissue level of organization. Members of Ctenophora, Cephalochordata and Echinodermata are exclusively marine.

17. (b) : *Gorgonia* (sea fan) is an animal belonging to phylum Coelenterata. All animals lack cell wall.

18. (b) : *Planaria* possesses high degree of regeneration. Both epimorphosis, in which the missing parts are formed and morphallaxis, in which the whole body can be regenerated from a fragment of the body, occurs.

19. (b): *Torpedo* is a bottom-living marine fish, discharging electricity which is sufficient to stun preys such as small fishes, etc. A pair of electric organs are situated on the dorsal side of the trunk region. Infact the electric organs are the modified lateral muscle-plates innervated by the cranial nerves.

20. (a) : Spiny anteater (*Echidna*) is a prototherian mammal whereas, sea urchins and sea cucumber are echinoderms. Silver fish (*Lepisma*) is an insect, Cuttle fish (*Sepia*) is a mollusc and flying fish (*Exocoetus*) is a bony fish. Centipede is class chilopoda, Millipede is class diplopoda and Scorpion and Spider are class arachnida of Phylum Arthropoda.

21. (a) : Prawn, Scorpion and *Locusta* belong to the phylum Arthropoda. All other animals categories are given below:

Sponge	→	Porifera
Sea anemone	→	Coelenterata
Starfish	→	Echinodermata
Malarial parasite, *Amoeba*	→	Protozoa
Mosquito	→	Arthropoda
Earthworm	→	Annelida
Pinworm	→	Aschelminthes
Tapeworm	→	Platyhelminthes

22. (c)

23. (d) : Phylum Arthropoda is the largest phylum of Animalia which includes insects. Examples include *Apis*, silkworm, *Laccifer*, silver fish (*Lepisma*), locust, etc. Puffer fish and flying fish (*Exocoetus*) are examples of superclass Pisces, while cuttle fish (*Sepia*) belongs to Mollusca.

24. (d) : Reptiles represent the first class of vertebrates fully adapted for life in dry places on land. The characters of reptiles are in fact a combination of characters that are found in fish and amphibians on one hand and birds and mammals on the other. Their exoskeleton is of horny epidermal scales, shields, plates and scutes. The skin is dry, cornified and devoid of glands. Reptiles lack external ears and have immovable eyelids.

25. (d) : In ctenophores, asexual reproduction is absent. They are monoecious and fertilization is generally external. In cnidaria, asexual reproduction (budding) is found in the polyps and sexual reproduction is found in the medusa form. Both asexual and sexual reproduction occur in porifera (sponges). Asexual reproduction occurs by budding and gemmules. In protozoa, asexual reproduction takes place by binary fission, budding etc. and sexual reproduction takes place by syngamy and conjugation.

26. (d) : Duckbilled platypus is oviparous and belongs to class Mammalia. Millipede belongs to class Diplopoda. Sea anemone has two germ layers, *i.e.*, diploblastic. Silverfish (*Lepisma*) belongs to nonchordata. It is an insect.

27. (d) : Sharks and dogfishes have cylindrical body while skates and rays have both of their pectoral fins fused. It gives a wing-like appearance and are not distinct from body.

28. (a) : The respiratory system is well developed in a cockroach in order to compensate the poorly developed circulatory system. It consists of tracheae, tracheoles and spiracles. The main tracheal trunks open to the exterior on body surface through 10 pairs of segmentally arranged apertures termed spiracles or stigmata. Two pairs of spiracles are thoracic, one between pro and mesothorax and the other between meso and metathorax. Haemocoel contains a network of elastic, closed and branching air tubes or tracheae. The ultimate finer branches of tracheae are called tracheoles which come in contact with the individual body cells. The elaborate tracheal system carries oxygen directly to all the body cells.

29. (b) : *Pheretima* (earthworm) and related organisms feed upon the decaying organic matter found in the soil. They also feed on the bits of plants and animal matter. Thus, they are omnivorous.

30. (a) : *Pila* belongs to phylum mollusca. The body of molluscs (soft bodied animals) is unsegmented, with a distinct head, muscular foot and visceral hump. Radula is found in mouth of *Pila*.

31. (d) : Sea horse (*Hippocampus*) and flying fish (*Exocoetus*) belong to class osteichthyes of super class pisces. They have two chambered heart (one auricle and one ventricle) and are cold blooded animals.

32. (b) : Heart is generally 3-chambered in reptiles but in crocodile, it is 4-chambered. Sponges are generally marine and have collared cells but few fresh water forms can also be seen like *Spongilla*. All mammals are viviparous (giving birth to young ones) with an exception, *Ornithorhynchus* (platypus), which is oviparous (egg laying).

33. (d) : Tail end is straight in female *Ascaris*, while tail end is curved ventral words in male *Ascaris*. Anal cerci is present in both male and female cockroach, while anal style is present only in the male cockroach. The forelimbs in both frogs (male and female) bear small articular pads dorsally at the joints of digit, but the males possess a special nuptial, copulatory pad on ventral side of the first finger of each forelimb. Copulatory pad appears merely as rough patches, but during breeding season, these become thick and sticky. In copulation, the male strongly grips a female under her armpits by means of these pads. Claspers are modified inner edges of pelvic fins in male sharks.

34. (c)

35. None of the options is correct.

Ascaris is member of phylum Nematoda, which are round worms. They do not have segmented body. In ascaris female is longer than male.

Salamandra is member of amphibia. Salamanders do not have tympanum, although they have greatly reduced middle ears and fertilization is usually internal in them.

Pteropus is member of class mammalia. They are viviparous A mantle of golden hair covers the head, neck and shoulders in *Pteropus*.

Aurelia is member of coelenterata, which has tissue level of organization. Its epidermis contain cnidoblasts (stinging cells) for defence and offence purpose.

36. (c) : Humans are mammals which are chordates. Phylum chordata includes animals which possess a notochord either throughout or during early embryonic life. In *Ascidia* (urochordata), notochord is present only in larval tail while in *Amphioxus* (cephalochordata), it extends from head to tail region and is persistent throughout their life. It is replaced by a vertebral column in adult frog.

37. None of the options is correct.

Frog respires in three different manners; cutaneous or skin respiration; buccopharyngeal respiration; pulmonary or lung respiration. Lungs are poorly developed in frog, the inadequate supply of O_2 obtained through lungs is supplemented through moist skin and buccal cavity. Hence, first statement is false. Heart of frog has three chambers, two atria and one ventricle. Hence, second statement is false. The frog excretes urea and thus is a ureotelic animal. The elimination of nitrogenous wastes is carried out by a well developed excretory system. The excretory system consists of a pair of kidneys, ureters, cloaca and urinary bladder. Frog do not change into uricotelic animal in any condition. Hence, third statement is false. In frog, fertilization is external and takes place in water. Within two weeks, fertilized eggs or zygotes develop into free-swimming aquatic larvae, called tadpoles, which undergo metamorphosis to become adult terrestrial frogs.

38. (d) : The animals which possess true coelom are called eucoelomates or coelomates. The true coelom is a body cavity which arises as a cavity in embryonic mesoderm. True coelom is of two types; schizocoelom (schizocoel) and enterocoelom (enterocoel). Schizocoelom develops as a split in the mesoderm sheet. It is found in annelids, arthropods, molluscs. In enterocoelom, mesoderm arises from the wall of the embryonic cut of enteron as hollow outgrowths. It occurs in echinoderms and chordates.

39. (d) : In male frogs, two ureters act as urinogenital duct which open into the cloaca. They run backwards from the kidneys and open into the cloaca. In female ureters carry urine alone, while in male both sperms and urine are carried. Hence, are called urinogenital ducts.

40. (d) : In *Fasciola* (flatworms) the body has a single cavity with one opening to the outside. The single opening functions as both mouth for ingestion (intake of food) and anus for egestion (undigested food is passed out). It is called blind sac plan. Other examples are coelenterates.

41. (c) : *Spongilla* is a common, widely distributed fresh water sponge belonging to phylum porifera. Canal system in *Spongilla* is essentially of rhagon type with choanocytes restricted to small rounded chambers. It is not found in leech, dolphin and penguin.

42. (a) : Triploblastic is a condition which describes an animal having a body composed of three embryonic germ layers : the ectoderm, mesoderm and endoderm. Most multicellular animals belonging to phylum platyhelminthes to phylum chordata are triploblastic. Ctenophores, sponges and corals are diploblastic.

43. (a) : Acoelomates are animals having no body cavity or coelom. Examples are poriferans coelenterates, ctenophora, platyhelminthes and nemertinea. In pseudocoelomates, body space is pseudocoelom or false coelom. Examples are ectoprocta, aschelminthes. In coelomates, body space is a true coelom enclosed by mesoderm on both sides. Remaining phyla of bilateria, from annelida to arthropoda are coelomates. Molluses and insects are coelomates while flatworms are acoelomates.

44. (b) : Nephridia is the excretory organ of the earthworm. Earthworms have three types of nephridial structures called as septal, integumentary and pharyngeal nephridia. These three nephridial structures are present on different positions in the body and also vary in structures. Septal and pharyngeal nephridia are both enteronephric *i.e.*, nitrogen products are expelled in gut. Integumentary nephridia is exonephric *i.e.*, nitrogen waste products are directly discharged outside.

45. (d) : Animals belonging to Phylum Chordata are fundamentally characterised by the presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal gill slits. Crocodile, penguin, whale and dogfish are all chordates. All of them have gill slits or have had it during embryonic development. Thus, paired gill slits are present in these animal at some stage of life.

46. (a) : Aschelminthes is a superphylum consisting of pseudocoelomates. These are mostly aquatic, free living or parasitic. Their body is slender, bilaterally symmetrical and triploblastic.

47. (a) : Coelom or body cavity of earthworm is filled with coelomic fluid. It lies between body wall and alimentary canal. So if a live earthworm is pricked with a needle on its outer surface without damaging the gut then only coelomic fluid will come out.

48. (b) : Agnatha is subphylum or superclass of marine and fresh water vertebrates that lack jaws. They are fish-like animals with cartilaginous skeletons and well-developed sucking mouthparts with horny teeth. The only living agnathans are lampreys and hagfishes (Class Cyclostomata), which are parasites or scavengers.

49. (c) : Birds have originated from some ancestral reptilian stalk. These two classes have so many features in common that link the two groups. The evidence of reptilian ancestry of birds is furnished by their comparative anatomy, embryology and palaeontology. One of the features is that all birds have horny epidermal scales confined to the lower parts of their legs and feet, which are exactly like the epidermal scales of the reptiles.

50. (d) : *Ascaris* belong to the Phylum Nematoda of Superphylum Aschelminthes. They have a cylindrical body without showing any metamerism, a pseudocoel (false coelom) and a complete digestive tract lined by endodermal epithelium. The cuticle covering the body surface bears minute transverse striations giving a pseudosegmented appearance to the worm.

51. (a) : Scorpion, spider and cockroach belong to Phylum Arthropoda and are invertebrates. They possess ventral solid central nervous system which consists of a dorsal brain connected with a nerve ring to a double ventral nerve cord.

52. (a) : Nephridia are excretory organs of earthworm which consist of a simple or branched tube formed by the ingrowth of ectoderm with cilia at the inner end. Excretory products diffuse into the nephridium and are wafted to the exterior by ciliary action. Malpighian tubules are the organs that are involved in the excretion of nitrogenous wastes in cockroach. It open into the intestine; selectively extract from the blood uric acid, which-together with water and salts – is deposited into the hindgut and excreted in the faeces.

53. (c) : Arthropods are the largest phylum of Kingdom Animalia that characteristically possesses an outer body layer – the cuticle. The body is composed of segments usually forming distinct specialized body regions, *i.e.*, head, thorax and abdomen. In them the trachea or windpipe or book lungs are the respiratory organs found in terrestrial forms, which help in respiration.

54. (a) : Phylum Annelida comprises invertebrates, which are segmented worms having cylindrical soft bodies showing metameric segmentation. These are triploblastic animals showing bilateral symmetry. A true coelom is present which is filled with coelomic fluid containing cells. Annelids are perhaps the first animals to have a true schizocoelic coelom.

55. (d) : Reptiles have two auricles and a partly divided ventricle except crocodiles which have four-chambered heart. *Obelia* shows metagenesis *i.e.,* alternation of generations which may be defined as a phenomenon in which diploid asexual phase alternates with haploid sexual phase. Lemur has a thecodent teeth *i.e.*, the teeth are embedded in the sockets of the jaw bone.

56. (a)

57. (d) : Homoiothermy is the maintenance by an animal of its internal body temperature at a relatively constant value by using metabolic processes to counteract fluctuations in the temperature of the environment. Homoiothermy occurs in birds and mammals, which are described as endotherms. The heat produced by their tissue metabolism and the heat lost to the environment are balanced by various means to keep body temperature constant: 36-38ºC in mammals and 38-40ºC in birds. The hypothalamus

in the brain monitors blood temperature and controls thermoregulation by both nervous and hormonal means. Thus parrot (bird) and platypus and kangaroo (mammals) are homoiothermic animals.

58. (a) : *Nereis*, scorpion, cockroach and silver fish are all invertebrates and thus possess dorsal heart. *Nereis* is a marine animal while other animals mentioned in the question are terrestrial. *Nereis* belongs to Phylum Annelida while rest of the animals belong to Phylum Arthropoda. Jointed appendages are present in scorpion, cockroach and silver fish.

59. (c) : Ctenophora is a small phylum of exclusively marine, invertebrate animals. *Ctenoplana* and *Beroe* are examples of ctenophora. They have biradial symmetry (a combination of radial and bilateral symmetries).

They lack the specialized stinging cells (nematocysts) found in coelenterates, but one species (*Haeckelia rubra*) incorporates those of its jellyfish prey for its own defense.

60. (c) : Centipede, cockroach, and crab all belong to phylum arthropoda which are characterized by jointed legs and chitinous exoskeleton. Arthropods have bilaterally symmetrical and metamerically segmented body with haemocoel and open blood vascular system.

61. (a) : Kangaroo, hedgehog, dolphin and *Loris* are mammals and thus give brith to young ones. Ostrich and kiwi are brids that lay eggs. *Platypus* is a most primitive living mammal that lays eggs. Other animals in the options are mammals and give birth to young ones.

62. (d) : Living fossil is a term for any living species (or clade) of organism which closely resembles species otherwise only known from fossils and has no close living relatives. These species have all survived major extinction events, and generally retain low taxonomic diversities.

Some examples of living fossils in animals are – coelocanth, coral (polyp), crocodylia (crocodiles, gavials and alligators), horseshoe crab (*Limulus polyphemus*), monotremes (*Platypus* and *Echidna*), snout-nosed frog (*Nasikabatrachus sahyadrensis*). *Archaeopteryx* is the earliest and most primitive known bird to date. It lived in the Jurassic Period around 150-155 million years ago. It has feathers and wings but it also had teeth and a skeleton similar to a small carnivorous dinosaur, therefore, it had both bird and theropod dinosour features. *Archaeopteryx* is a powerful piece of evidence that shows that birds have evolved from dinosaurs.

63. (d) : Migration is the seasonal movement of complete populations of animals to a more favourable environment. It is common in mammals (*e.g.* porpoises), fish (*e.g.* eels and salmon) and some insects but is most marked in birds. The arctic tern, for example, migrates annually from its breeding ground in the Arctic circle to the Antarctic. Salmon usually migrate from marine to fresh water to spawn. The siberian crane, breeds in arctic Russia in Ykutia and western Siberia. It is a long distant migrant. Salamander is an amphibian with slender body, short legs and long tail. Outside the breeding season they are seldom seen as they spend most of their time underground.

64. (d) : The term metamerism refers to a linear repetition of parts in an animal body. It occurs in three highly organized phyla : Annelida, Arthropoda and Chordata. Each segment is called a metamere, or somite. Segmentation often affects both external and internal structures. Such a condition is called metameric segmentation. In chordates, the segmentation is apparent only in the embryonic stage. In the adult chordates, segmentation is visible in the internal structures, such as vertebrae, ribs, nerves and blood vessels. Other animals have unsegmented bodies.

65. (d) : Mollusca includes those animals which have soft bodies, usually furnished with a shell. The body is often divided into a head, with eyes or tentacles, a muscular foot and a visceral mass housing the organs. *Loligo* (squid or sea arrow), *Teredo* (shipworm), *Octopus* are some of their examples.

In option (a) *Spongilla* and *Euplectella* belong to porifera but *Pennatula* (the sea pen or sea feather) belongs to coelenterata. In option (b) *Physalia* and *Aurelia* belong to cnidaria but *Bonellia* belongs to Phylum Annelida. In option (c) *Planaria* and *Schistosoma* belong to platyhelminthes but *Enterobius* (Pinworm) belongs to aschelminthes.

66. (b) : Protista is the kingdom of unicellular eukaryotes. The protists include heterotrophs, autotrophs, and some organisms that can vary their nutritional mode depending upon environmental conditions. Protists occur in freshwater, saltwater, soil, and as symbionts within other organisms. *Trypanosoma*, *Noctiluca*, *Monocystis* and *Giardia* are all unicellular protists.

67. (a) : Platyhelminthes do not have body cavity so they are acoelomates. In annelids, the body cavity is true and schizocoelous. Both annelids and platyhelminthes have bilateral symmertry.

68. (a) : Prawn has one pair of antennae, one on either side, just below the antennules. They are sensory, excretory and balancing in function. Antennules are attached on either side, below the bases of eye stalks. They are tactile in function. Nematocysts are present in cnidoblasts that act as organs of offence and defence. Millipedes belong to class myriapoda. They are called thousand leggers because of possession of numerous walking legs. Body is made up of small head and 40 trunk segments, each with two pairs of jointed legs. Animals belonging to phylum porifera are mostly marine and a few are freshwater.

69. (c)

70. (c) : Mammals have twelve pair of cranial nerves. Ten pairs of cranial nerves are present in fish and amphibians. Reptiles and birds also have 12 pairs of cranial nerves.

71. (a) : Body in arthropoda is segmented. Segments are grouped into 3 forms - head, thorax and abdomen. When head and thorax are fused then they are referred to as cephalothorax. Class Insecta of Phylum Arthropoda have body divided into head, thorax and abdomen.

72. (d) : Echinoderms are triploblastic animals with organ system level of organisation. Larval forms possess bilateral symmetry while adults have radial symmetry.

73. (d) : It is universally accepted that amphibians (frogs) have originated from fishes. Resemblance of amphibia to fish is seen in most systems of the body. Both are cold blooded. Fish respire by gills and also tadpole of frog respires by gills. To prevent dessication in air, both usually lay eggs in water.

74. (c) : Uricotelism means excretion of uric acid. Uric acid excretion occurs in organisms which develop in an enclosed egg (where water is severely limited) or which normally experience very dry terrestrial environment as adult organisms. Uric acid is discharged as thick paste or as solid pellet: Examples: terrestrial reptiles, birds, insects, gastropod mollusc, etc.

75. (b) : The unique feature of mammals is the presence of diaphragm. It is a membrane that separates thoracic cavity from abdominal cavity. The cavity of other animals is not divided into thoracic and abdominal cavities. Homeothermy, four chambered heart and rib cage are the characters of mammals as well as some other animals also.

76. (d) : *Amoeba* is a fresh water protozoan containing contractile vacuole that is meant for osmoregulation. When *Amoeba* is placed in a marine water, then the water from the contractile vacuole will move out resulting in decrease in size of it. Contractile vacuole will increase in size if it is placed in hypotonic solution. Water will enter into contractile vacuole, thus increasing its size and ultimately it will burst and disappear.

77. (c) : Bartholin's glands are situated on either side of vagina in human females. These glands secrete a fluid that lubricates the vulva during copulation.

78. (a) : *Amoeba* forms a cyst and reproduces by multiple fission, during adverse environmental conditions. The animal secretes a three-layered, protective, chitinous cyst around it and becomes inactive. Inside the cyst, the nucleus repeatedly divides to form several daughter nuclei, which arrange themselves near the periphery. Each daughter nucleus becomes enveloped by a small amount of cytoplasm, thus forming a daughter amoeba, called amoebula or pseudopodiospore. When favourable conditions arrive, the cyst breaks off liberating the young pseudopodiospores, each with fine pseudopodia. They feed and grow rapidly to become adults and lead an independent life.

79. (c) : Systemic heart refers to the entire heart of lower vertebrates. This heart pumps blood to body parts and not the lungs.

80. (b) : *Sycon,* belonging to the Phylum Porifera, are multicellular organisms with cellular level of body organisation. The constituent cells perform their functions more or less independently. No distinct tissue or organs are present in it.

81. (d) : Life cycle of *F.hepatica* is complete and completed in two hosts. Primary host, in which the adult fluke lives, is sheep. While the intermediate host, in which numerous larval stages are passed, is a snail (*Lymnaea*, *Planorbis*, etc.). This type of life cycle, involving two different kinds of hosts, is termed digenetic.

Miracidium larva is the larval stage involved in life cycle. When suitable conditions become available, the encapsulated embryo, in 4-15 days, differentiates into a miracidium larva. It hatches out and swims in water. Metacercaria develops into adult fluke only inside its definitive host or sheep. The latter gets infection by grazing on leaves and grass blades to which the cysts are attached. Metacercaria survives action of host's gastric juice as its cyst is insoluble in it. Cyst wall finally dissolves in proximal part of intestine and liberates the larva.

82. (a) : In cockroach, the compound eyes are a pair of large, black, kidney-shaped organs situated dorsolaterally on the head, one on either side. Their surface is marked by a large number of hexagonal areas, the facets. Each facet represents a visual unit named ommatidium. The eyes are the organs of sight (photoreception).

83. (b) : In *Musca*, development is indirect with complete metamorphosis (holometaboly) including four stages as follows - egg, larva, pupa and adult.

In complete metamorphosis, larva after hatching, moults several times to become a fully grown one. It later becomes a pupa within a secreted case, called the puparium. Pupa differentiates into the young adult that breaks the puparium open and emerges outside. Then it grows to a mature form.

84. (b) : Silver fish is an insect in which respiration occurs by tracheae. These communicate with the exterior by paired apertures, called spiracles. Respiratory system of scorpion consists of 4 pairs of book lungs that communicate with the outer air through stigma. In sea squirt, respiration occurs through pharyngeal slits. In dolphin, respiration occurs by lungs.

85. (d) : *Hydra* which belongs to the phylum coelenterata has nerve cells but no brain. Its nervous system consists of nerve cells and their processes. Sensory cells are also present. Sponges do not have nerve cells, they lack nervous system. Earthworm (annelida) has nervous system consisting of a circumenteric nerve ring and a solid, double, midventral nerve cord with ganglia. Cockroach (arthropoda) has the nervous system as that of earthworm.

86. (d) : Dimorphic nucleus means two types of nuclei are present in *P. caudatum* – large macronucleus and small micronucleus. The macronucleus is roughly kidney-shaped and with inconspicuous nuclear membrane. Macronucleus is the somatic or vegetative nucleus and controls the day-to-day metabolic activities of the cell. The micronucleus is lodged in a depression on the surface of the macronucleus. It is usually spherical, with a nuclear membrane and with diploid number of chromosomes. It controls the reproductive activities of the organism. *Amoeba*, *Trypanosoma* and *Plasmodium* have only one nucleus.

87. (a) : Chordates are the animals that have notochord, a skeletal rod present at some stage in life cycle. In lower vertebrates, notochord persists throughout life while in higher vertebrates it is replaced by vertebral column in adults. Nonchordates never develop notochord, not even in embryonic stage.

88. (a) : The function of contractile vacuole is osmoregulatory. Water in freshwater protozoa enters the organism by endosmosis and during feeding. If the organism does not possess a mechanism to get rid of this excess water, it will swell to the point of rupture and dissolution. The mechanism which is assumed to effect water regulation is the contractile vacuole. The vacuole periodically increases in volume (diastole) to get filled with water and contracts (systole) to discharge its water content to the surrounding environment.

89. (d) : In molluscs, blood often has a copper-containing, blue respiratory pigment called haemocyanin. In insects, the blood called haemolymph is colourless. In echinodermates, blood is colourless as it has no respiratory pigment. In annelids, the blood is red with haemoglobin dissolved in plasma.

90. (d) : Snakes are limbless reptiles with elongated cylindrical body, covered with overlapping scales differentiated into shields and plates and have post anal tail which is long.

91. (c) : In *Hydra* indigestible residues are egested through mouth, for there is no anus. Egestion occurs by a sudden squirt due to muscular contraction of body, so that the debris is thrown at a distance. *Hydra* has neither blood and blood vessels, nor organs of excretion. Due to thinness of body wall and circulation of water in gastrovascular cavity, most cells of body remain freely exposed to the surrounding water. Therefore, excretion of waste nitrogenous matter (chiefly ammonia) occurs directly by diffusion through cell membranes in the outside world.

92. (b) : Cleavage in mammals is holoblastic unequal. Mammals have microlecithal eggs so they have holoblastic cleavage in which the segmentation lines pass through the entire egg, dividing it completely. As the eggs are microlecithal so one would expect that first cleavage will produce two equal blastomeres. But, this is not the case. The two blastomeres produced are unequal which divide further to form 4 unequal blastomeres and this process continues to form a ball of cells called morula. Superficial cleavage occurs in insects and discoidal cleavage occurs in birds.

93. (b) : *Hydra*, has tissue level of organization. Its body is multicellular and the cells occur in 2 distinct layers or tissues of specialized cells. Sponges have cellular level of organization. Liver fluke and *Ascaris* have organ-system level of organization.

94. (a) : Sexual dimorphism is the difference in the form of individuals of different sexes but of same species. Sexes in *Ascaris* are separate and sexual dimorphism is well defined. Males are smaller than females. They possess a recurved tail with pre and post anal papillae, a cloaca, and a pair of spicules or penial setae. In *Anopheles*, the ends of maxillary palps in males are club-shaped while in females they are not.

95. (a) : Main component of bone is collagen which is a complex combination of amino acids. When frog's bone is treated with HCl, these compounds are broken down and the bone becomes flexible.

96. (a) : Diaphragm is a membrane that separates thoracic cavity from abdominal cavity. It is present only in mammals. All other chordates do not have diaphragm as their body cavity is not divided into thoracic and abdominal cavities. Chordates are coelomate animals having a true coelom, entercoelic and shizocoelic in origin. Pharyngeal gill slits are present at some stage, may or may not be functional. Nerve cord is dorsal and tubular.

97. (a) : Mammals are viviparous *i.e.*, they give birth to young ones. Protherians (*e.g.*, *Platypus*) are primitive mammals and lay eggs, so they are oviparous.

98. (b) : The waste material of aquatic reptiles chiefly consists of urea, so they are ureotelic. Land forms are uricotelic *i.e.*, their water material consists of uric acid.

99. (a) : Poikilothermic animals are those whose body temperature varies with the temperature of the environment. All animals except birds and mammals are poikilothermic. Although unable to maintain a constant body temperature, they can respond to compensate for very low or very high temperatures. For example, the tissue composition (especially cell osmotic pressure) can change to regulate the blood flow to peripheral tissues (and thus increase heat loss or heat absorption), and the animals can actively seek sun or shade.
Homoiothermic animals are those whose body temperature remains constant irrespective of the variations in the temperature of the environment.

100. (b)

101. (d) : Forelimbs are absent in birds as they are modified into wings for flight. They are attached high on the back, to the anterior or thoracic region of the trunk, and are very powerful when compared with the size and strength of the bird. Each wing is elongated, flattened and distally pointed with its longitudinal axis at right angles to that of the trunk. Hindlimb is made of three parts - thigh, shank and foot. Pectoral girdle on each side consists of three bones - a large coracoid, scapula and clavicle. Pelvic girdle consists of ilium, ischium and pubis.

102. (c) : Aves are the animals that fly so their body weight should be less and for this their bones are hollow and connected by air passages. Reptilia, land vertebrates and mammals do not have hollow bones.

103. (b) : Solenocytes are also called flame cells. It is a cup shaped cell, which contains group of cilia and this is the main excretory organ of platyhelminthes.

104. (c) : *Obelia* belongs to the Phylum Coelenterata. In *Obelia*, life-cycle includes two clearly defined phases : a fixed polypoid phase (hydroid colony) and a pelagic medusoid phase. Hydroid colony has no gonads and reproduces by asexual budding to give rise to medusae. On the other hand, medusae reproduce exclusively by sexual method (ova and sperms) to give rise to new hydroid colonies. This fact apparently seems to have given rise to the idea of alternation of generations, also called metagenesis.

105. (a) : Dentary is a membrane bone, present in the lower jaw of the vertebrates, that supports the teeth. In mammals the dentary is the sole bone of the lower jaw. The dentary bone is relativley short comma shaped bone.

106. (c) : The connective tissue in between the seminiferous tubules of the testis contains special interstitial cells or cells of Leydig. They secrete the male sex hormones (androgens) such as testosterone. It stimulates secondary sexual characteristics of the male such as the enlargement of the external genitals and accessory glands.

107. (c) : Silver fish, scorpion, crab and honey bee all have compound eyes. These are present on each lateral side of the head and are convex. This eye consists of numerous visual units, the ommatidia. Each ommatidium consists of an outer cuticle covering a lens, beneath which are 6-8 retinal cells surrounding a light sensitive rhabdom. Adjacent ommatidia are separated by pigment cells.

108. (b) : The embryonated egg of *Ascaris* represents an egg with a juvenile. In case of *Ascaris*, the eggs containing the second stage of juvenile are called embryonated egg. These are infective to human host. In suitable conditions of temperature and moisture these eggs can survive for 5 to 6 years in the soil.

109. (b) : Sponges may have calcareous or siliceous spicules. All sponges are not marine, some are freshwater living also. Sponges may be asymmetrical or bilaterally symmetrical, besides being radially symmetrical. So, these characters are with exception. The character without exception is the regenerative power of sponges.

All sponges have a good power of regeneration. They can regrow any part of the body lost or cut off. Small fragments can grow into a complete sponge.

110. (d) : Gynandromorph (hermaphrodite) is an animal that possesses both male and female characteristics. For example, earthworm.

111. (c) : Coelom is a fluid-filled cavity that forms the main body cavity of vertebrate and most invertebrate animals. It is found between mesoderm and body wall (endoderm).

112. (c) : Pneumatic bone is present in pigeon to keep the bones light weight because the pigeon has to fly. Pneumatic bone has a hollow cavity, which makes it light.

113. (b) : Analogous organs are organs of very disparate organisms and are superficially similar but have evolved from vastly different origins. They have same function but different structure. The nephridia in earthworm are analogous to flame cells of *Planaria* since both of them have excretory functions. Nematoblasts of *Hydra* are organs of locomotion, food capture and anchorage. Gills and trachea are organs of respiration in prawn and insects respectively.

114. (a) : Mammals do not undergo moulting. Moulting is usually exhibited by invertebrates. In many vertebrate species, cervical vertebrae are variable in number, however almost all mammals have seven cervical vertebrae including those with short neck such as elephants or whales and those with very long necks, such as giraffes. But there are a few exceptional cases in which there are nine cervical vertebrae in mammals. All the mammals are not carnivorous, they may be herbivorous, carnivorous and omnivorous also. Mammals have dorsal nerve cord.

115. (d) : The body wall of sponges encloses a large cavity, the spongocoel and in most cases also contains in its thickness numerous small cavities, the canals. Either the spongocoel or certain canals are lined by choanocytes with flagella. The ceaseless beating of flagella maintains a steady current of water through the canals in the sponge body. The current of water enters through small pores, the dermal ostia, perforating the porocytes and, after passing through various canals, enters the spongocoel, and finally leaves through a larger aperture, the osculum, or apertures, the oscula.

All the cavities in a sponge body are inter-communicating, and are collectively referred to as the canal system. The current of water that flows through the canal system brings in food and oxygen, and carries away carbon dioxide and nitrogenous waste materials. Thus, the canal system helps the sponge in nutrition, respiration and excretion.

116. (a) : *Euglena* possesses the characteristics of both plant and animal. It has chlorophyll, thus it is autotrophic like plants. In contrast to this, it has flagellated locomotion like animals.

117. (d) : *Refer to answer 64.*

118. (a) : *Refer to answer 88.*

119. (c) : The organisms attached to the substratum possess radial symmetry in all vertical planes. All the animals belonging to cnidaria (*e.g.* jellyfish) and echinodermata (*e.g.* starfish) are radially symmetrical and typically sessile in their adult form. In radial symmetry the parts in an organ or organism when cut through the centre in any direction produces two halves that are mirror images of each other.

120. (c) : Sympathetic nervous system forms a part of autonomic nervous system that consists of nerves which connect the visceral receptors and effectors with the central nervous system through the crania and spinal nerves. Sympathetic nerves arise from thoracolumbar nerves.

121. (b) : Oestrous cycle comprises cyclic changes in female reproductive system of non-primate mammals like cows, dogs, etc. The oestrous cycle consists of a short period of oestrous or 'heat' (*e.g.*, 18 hours in cow) followed by the rest of period of anoestrous or 'passive'. During oestrous, the female receives the male for copulation. During anoestrus, the female becomes passive and does not receive the male. Although the break down of tissues takes place in the female reproductive tract at the end of an oestrous cycle, yet there is no menstruation.

122. (d) : The sub-phylum vertebrata or craniata have a well developed central nervous system that is differentiated into brain and spinal cord. Brain is protected by a brain box called cranium, so they are also called as craniata.

123. (d) : The cells characteristic of the coelenterates include stinging cells (cnidocytes or cnidoblasts or nematoblasts) for offence and defence. The stinging cells, when discharged, give out from a sac, the cnide or cnidocyst or nematocyst, a long thread-tube that may coil around the prey, or attach to it, or inject a toxin, called hypnotoxin, into it to paralyse it.

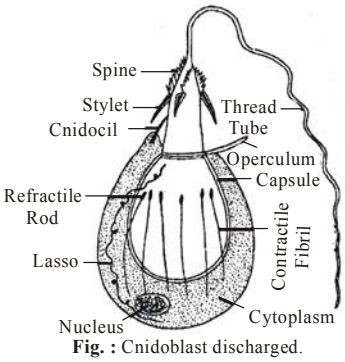


Fig. : Cnidoblast discharged.

124. (a) : *Refer to answer 119.*

125. (b) : Platyhelminthes have soft and dorsoventrally flattened body with bilateral symmetry. *Plasmodium* and *Trypanosoma* belong to Phylum Protozoa while *Wuchereria* belongs to Phylum Aschelminthes.

126. (c) : Sea anemone is completely non-parasitic form. It shows the example of mutualism. Sea-anemone attaches itself to shell used by a hermit crab. The anemone obtains nourishment from the scraps of food left by the crab, and is transported from place to place when the crab moves. The crab is protected by the stinging cells in the tentacles of sea anemone. Mosquito and leech are parasites of animals and feed on their blood. Tapeworm is a human gut parasite.

127. (a) : Starfish belongs to the phylum echinodermata who have developed tube feet for locomotion. The tube feet generally protrude out through special radial areas called ambulacra. They are extended and retracted by variations in hydraulic pressure of fluid in them and by contractions of their muscles.

Cuttle fish belongs to the Phylum Mollusca and it swims. Crayfish belongs to the Phylum Arthropoda in which locomotion occurs by jointed appendages. Jelly fish belongs to the Phylum Cnidaria and it swims.

128. (a) : Birds and lizards are uricotelic. Uricotelic animals are those that excrete nitrogenous waste in the form of uric acid. It is being insoluble in water, does not require water for its elimination. Frogs and cartilaginous fish are ureotelic, that is they excrete nitrogenous waste in the form of urea. The main excretory matter of insects is uric acid and of bony fish is ammonia (ammoniotelic). Molluscs may be ammoniotelic or uricotelic. Mammals are ureotelic (excretory matter is urea).

129. (d) : Air passes from the external nares into the nasal cavity where the dust particles are trapped. From nasal cavity, the air moves into pharynx which is a short, vertical tube. It further leads into two tubes, trachea and oesophagus. Larynx is the upper part of trachea. Besides forming a part of the respiratory tract, it also serves as the voice box. Trachea is a thin walled tube that extends downward through the neck. It divides into two primary bronchi which on entering the lungs divide into fine branches called bronchioles which enter the alveoli. Exchange of gases occur in alveoli.

130. (a) : In the open circulatory system, the blood is not confined to the blood vessels, but it flows in the open spaces. Prawn, *Chelifer* and cockroach have open circulatory system. Frog's tadpole has closed circulatory system, that is the blood flows in the blood vessels.

131. (c) : The ostrich is a flightless bird native to Africa. It is the only living species of its family. It is distinctive in its appearance, with a long neck and legs and the ability to run at speeds of about 65 km/h (40 mph), the top land speed of any bird. Penguins are a group of aquatic, flightless birds living almost exclusively in the Southern Hemisphere. A kiwi is any of the species of small flightless birds endemic to New Zealand.

132. (d) : The looping or crawling movement in *Hirudinaria* is performed with the help of muscles and suckers which serve for attachment.

133. (c) : The beef tapeworm *Taenia saginata* is similar to the pork tapeworm *Taenia solium*, in structure and life history. It is the commonest tapeworm of man with a much greater incidence than that of *T. solium*. Scolex bears four strong, rounded, adhesive suckers but lacks hooks and rostellum.

134. (a) : *Hydra* possesses a very primitive type of nervous system. It includes bipolar and multipolar nerve cells or neurones lying immediately above the muscle processes and forming an irregular and discontinuous nerve net or nerve plexus.

Neighbouring nerve cells are not fused together, but their processes or neurites form synaptic junctions. Such a nerve net is called a synaptic nerve net. Nerve cells are numerous around mouth and on pedal disc but show no groupings in the form of a nerve controlling centre like brain or nerve ring. A difference from higher animals is that the nerve net of *Hydra* is unpolarized so that impulses can pass in all directions (diffuse transmission). In brief, nerve net shows diffuse unpolarized transmission, autonomy of parts and paucity of reflexes.

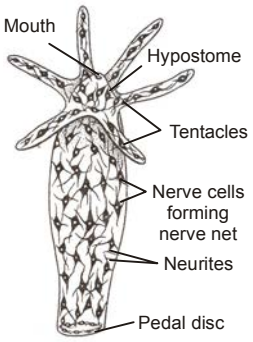


Fig. : Nerve net in *Hydra*.

135. (b) : Budding is an asexual mode of reproduction in *Hydra* and sponges. Bud is formed as an outgrowth on the body surface, then detached to form new animal.

136.(b) : Tracheae act as passage of air during respiration in both cockroach and mammals. In cockroach, the cuticular lining is spirally thickened forming taenidia which prevents the tracheal tubes from collapsing. In mammals, cartilaginous rings supporting the walls of the tracheae prevent their collapsing.

137. (d) : In butterfly, the larval stage is known as catterpillar, in frog is known as tadpole and in mosquito is known as wriggler.

138. (d) : Gorilla, chimpanzee, monkeys and humans belong to the same order *i.e.*, primates. They have well developed brain, flat nails on fingers and toes. First digit is usually opposable, an adaptation for grasping. Eyes are typically large and turned forward.

139. (b) : Whale, bat and rat are mammals. Diaphragm is present in mammals. The diaphragm separates the thoracic cavity (with lung and heart) from the abdominal cavity (with digestive system and urogenital system). In its relaxed state, the diaphragm is shaped like a dome. It is controlled by the phrenic nerve.

140. (a) : The common Indian bull frog *Rana tigrina* lives in or near permanent freshwater lakes, ponds and streams. It is in the water most of the time. It lives near water mainly for two reasons : (i) To keep skin moist to carry on cutaneous respiration, and (ii) To immediately jump or slip into water to escape from enemies.

141. (a) : Aristotle's lantern occurs in the Class Echinoidea. Five teeth surrounding the mouth are attached to a masticatory apparatus, called Aristotle's lantern, after its discoverer and because of its resemblance to an ancient Greek ship-lantern. It is situated within the test and projects slightly through the mouth. It consists of five large calcareous plates, called pyramids or alveoli. By means of special protractor and retractor muscles the lantern can be partially protracted and retracted through the mouth. Aristotle's lantern is used in feeding.

142. (a) : Starfishes belong to Class Asteroidea, characterized by the presence of five or more arms not sharply set off from a central disc. They are free-living marine animals that occur on sandy or muddy bottoms or crawl about over rocks and shells. All are carnivorous, feeding mainly on crustaceans, polychaetes and molluscs. They also feed on detritus and plankton. They are in general, exhibit remarkable powers of autotomy and regeneration.

143. (d) : In cephalopoda paired eyes are large, efficient and bulge from the dorso-lateral sides of the head. They bear striking resemblance to those of a vertebrate in that a cornea, iris, lens and retina are present. Lens projects an inverted image on the retina, as in the vertebrate eye. External muscle attachments enable limited movements of the eye. But the embryological development of the cephalopod eye is entirely different from that of the vertebrate eye, so that homologically they are different, for the vertebrate eye is formed as an outgrowth of the brain, while the cephalopod eye is formed by an ectodermal invagination.

144. (b) : Two common mosquito genera, *Anopheles* and *Culex* can be easily identified by their sitting postures. When sitting, the abdomen of *Anopheles* is always held at an angle to the surface while that of *Culex* is held parallel to the surface.

145. (c) : At the posterior end or base of the trachea, at its junction with the bronchi, is found a special structure, the syrinx or voice box, concerned with sound production. It is characteristic of birds as it does not occur in other vertebrates.

146. (d) : Cockroaches are found in places where there is warmth, dampness and plenty of organic food to devour. Indoors, they are a common pest in kitchens, latrines, hotels, restaurants, godowns, storerooms, board ships, etc.

Cockroaches are nocturnal creatures. During daytime, they remain inactive and hiding. During night, they show much activity and run here and there in search of food. Being omnivorous and scavengerous in diet, they devour any animal or vegetable substance and even non-living materials like leather, paper, cloth, etc., causing great loss.

147. (b) : In *Ascaris*, rhabditiform larva of first stage is not infective. In a week's time, it moults within the egg shell and becomes the second stage rhabditoid, which is capable of infecting the host. Cysticercus, hexacanth and onchosphere are the larval stages of *Taenia*.

148. (d) : There are about 450 mature proglottids forming the middle part of strobila. These are large and squarish in outline. The anterior 100 to 150 proglottids contain only male reproductive organs, while the posterior 250 mature proglottids develop both male and female reproductive organs making them hermaphrodite.

149. (a) : Sponges belong to the Phylum Porifera. Ostia, spongocoel and osculum together form a canal system which is characteristic of all sponges. Canal system of *Leucosolenia* is of ascon type. It is the simplest type of canal system found in sponges. Water enters directly through ostia into the central spongocoel, which is lined by choanocytes, and leaves through osculum. Sycon type of canal system is found *Sycon* and Leucon type is found in *Spongilla*. There is no canal system named as radial type.

150. (b) : *Refer to answer 14.*

151. (b) : Kidney of adult rabbit is metanephros. It is formed from the posterior end of the nephrogenic mesoderm which is displaced somewhat anteriorly and laterally.

152. (b) : Homoeostasis is the regulation by an organism of the chemical composition of its body fluids and other aspects of its internal environment so that physiological processes can proceed at optimum rates. It involves monitoring changes in the external and internal environment by means of receptors and adjusting the composition of the body fluids accordingly; excretion and osmoregulation are important in this process. Example of homeostatic regulation are the maintenance of the acid-base balance and body temperature.

153. (b) : Radial symmetry is the arrangement of parts in an organ or organism such that cutting through the centre of the structure in any direction produces two halves that are mirror images of each other. All animals belonging to the cnidaria (*e.g.,* jellyfish) and echinodermata (*e.g*., starfish) are radially symmetrical.

154. (c) : *Musca* is the zoological name of house fly which is regarded as mechanical carrier of many diseases. It is very active and keeps on visiting on dirty things and eatables as well.

155. (c) : Ecdysone is a steroid hormone, secreted by a pair of prothoracic glands in the thorax of insects and by Y-organs in crustaceans, that stimulates moulting and metamorphosis. In insects its release is stimulated by prothoracicotropic hormone.

156. (b) : The Phylum Porifera is divided into three classes : calcarea or calcispongiae, hexactinellida or hyalospongiae and demospongiae or sclerospongiae, on the basis of spicules (skeleton). Class Calcarea have calcareous spicules, Class Hexactinellida have siliceous spicules and Class Demospongiae have siliceous spicules or spongin fibres or both.

157. (a) : Flame cells are scattered throughout parenchyma from which they remove metabolic wastes. A flame cell is of irregular shape, with granular cytoplasm and a nucleus. Bundle of cilia, or flame, arises from basal granules near nucleus. Cilia are enclosed into a funnel-shaped lumen formed by the terminal blind end of a capillary. Protonephridia are found in flatworms, Malpighian tubules in insects and green glands in crustaceans.

158. (a) : Cysticercus is the larval stage of tapeworm which is characterised by a large vesicle and one scolex. Cysticercus develops in adult tapeworm only when ingested by the human host. In pig's body it leads quite an inactive life and remains viable for several years, after which it dies and becomes calcified. Pork (pig's flesh) containing viable cysticerci is called measly pork for its spotted appearance.

159. (a) : The stratum corneum ("the horny layer") is the outermost layer of the epidermis (the outermost layer of the skin). It is composed mainly off dead cells that lack nuclei. In reptiles, the stratum corneum is permanent, and is only replaced during times of rapid growth, in a process called ecdysis or moulting. During ecdysis, small fragments of this layer are periodically shed of from the body. The new layer is regularly formed by underlying stratum germinativum.

160. (b) : Penguins are a group of aquatic, flightless birds living almost exclusively in Antarctica. All penguins are countershaded - that is, they have a white underside and a dark (mostly black) upperside. This is for camouflage.

161. (c) : Visceral leishmaniasis, also known as kala-azar and black fever, is the most severe form of leishmaniasis, a disease caused by parasites of the *Leishmania* genus.It is transmitted by sand fly. The adult female sand fly is a bloodsucker, usually feeding at night on sleeping prey. When the fly bites an animal infected with *L. donovani*, the pathogen is ingested along with the prey's blood.

Leishmania tropica produces skin ulcers known as oriental sore or Delhi sore. The disease is spread by sand flies. The parasite lives in the endothelial cells of skin capillaries. It leads to ulcerated wounds with raised edges. They do not cause much pain.

162. (a) : In insects Malpighian tubules are attached to the alimentary canal at the extreme anterior end of hindgut. These are fine, long, unbranched, yellowish and blind tubules lying freely in the haemolymph. These are between 60 to 150 in number and are arranged in 6-8 bundles. These excrete out nitrogenous wastes from the body in the form of uric acid.

163. (a) : The beef tapeworm *Taenia saginata* is similar to the pork tapeworm *Taenia solium*, in structure and life history. It is the commonest tapeworm of man with a much greater incidence than that of *T. solium*. Its intermediate hosts are cattle and buffaloes. It is longer than *T.solium*, usually attaining a length upto 12 meters or more. Scolex bears four strong, rounded, adhesive suckers but lacks hooks. Strobila comprises up to 2,000 proglottids. A gravid proglottid contains about 100,000 eggs. Uterus of gravid proglottids has 15 to 35 branches on either side.

164. (c)

165. (b) : Eutheria is a taxon containing the placental mammals, such as humans. Nevertheless, all Eutherians are placental mammals. This means that a Eutherian foetus is nourished during gestation by a placenta. Eutherians are also viviparous, meaning that the offspring are carried in the mother's womb until fully developed.

166. (d) : The wishbone, known in anatomy as the furcula, is a sternum bone found in birds which is shaped like the letter Y. It is used as an attachment point for the wing muscles. It is so named because of a tradition: Two people pull on each side of such a bone, and when it breaks, the one who gets the larger part is said to have a wish granted. Two clavicles fused with inter clavicle to form a fork shaped bone called wish bone.

167. (b) : In birds, the pectoral and supracoracoideus muscles that power the wings are anchored to a large bony keel along the midline of the sternum.

168. (c) : The diagnostic characters of chordates are notochord, dorsal hollow nerve cord, pharyngeal slits and post anal tail. Tail is the part of the body behind the cloacal or anal opening. It contains skeletal elements, muscles, blood vessels and nerves but no viscera. It provides much of propulsive force in aquatic species. The tail is reduced or absent in the adults of some chordates.

169. (a) : Earthworms are very useful. All over the world they are used as bait for fishing. Earthworms are in general beneficial to agriculture. Their habit of burrowing and swallowing earth increases fertility of soil in many ways. Their burrows permit penetration of air and moisture in porous soil, improve drainage, and make easier the downward growth of roots. Excretory wastes and other secretions of worms also enrich soil by adding nitrogenous matters that form important plant food. Earthworms were used variously as medicines in the past. Earthworms were used to cure stones in bladder, yellowness of jaundice, pyorrhoea, piles, rheumatism or gout, diarrhoea. Earthworms are easily obtained and are of convenient size for dissections. They are, therefore, universally employed for class studies and for investigations in general and comparative physiology.

170. (a) : Eggs of *Taenia* undergo cleavage to form morula. Morula, at its morphologically posterior end, develops three pairs of chitinous hooks secreted by differentiated cells, called onchoblasts. This six-hooked embryo, called hexacanth, possesses a pair of large penetration glands. It is surrounded by two hexacanth membranes. The hexacanth, together with all the membranes surrounding it, is known as onchosphere. The secondary or intermediate host acquires infection by ingesting the onchospheres. Pig, which regularly feeds on human excreta is the usual secondary host, but dog, monkey and sheep are also known to get the infection. Man himself may serve as the secondary host by ingesting onchospheres with inadequately cooked or raw vegetables.

171. (b) : Jelly fish belongs to the Class Scyphozoa of the Phylum Cnidaria. Its genus is *Aurelia*. *Aurelia* is found in the coastal waters of the tropical and temperate seas. *Aurelia* may float passively or swim

actively, singly or in shoals. It is carnivorous and unisexual. It has a soft, gelatinous, saucer-like body. Its margin bears numerous short tentacles and 8 sense organs, called rhopalia, in notches of the margin. Each sense organ is enclosed by a pair of leaf-like lappets. At the centre of the lower (subumbrellar) surface is the squarish mouth surrounded by 4 long oral arms.

172. (d) : *Gambusia* is a species of freshwater fish. It is remarkably hardy, surviving in waters of very low oxygen saturations, high salinities and high temperatures. For these reasons, this species may now be the most widespread freshwater fish in the world, having being introduced as a biocontrol in certain countries to control mosquitoes. It feeds on larval and pupal stages of mosquitoes.

173. (d) : Order Cetacea includes whales, dolphins and porpoises. These are the most highly modified mammals. They have a fish-like body with smooth, hairless skin devoid of sweat and oil glands, far posterior nares, small eyes, minute ear openings without pinnae, paddle-like forelimbs, no hindlimbs, abdominal testes and flattened tail ending in two horizontal flaps or flukes.

174. (b) : Bird vertebrae are heterocoelous *i.e.*, the centra of vertebrae have saddle - shaped ends. Acoelous refers to vertebrae that are flat on both ends (mammals). Amphicoelous means both ends of the centrum are concave (fish). Procoelous means concave in front and convex in back (anurans and reptiles).

175. (a) : Hindlimbs are variously modified for various functions like perching, grasping etc. In the kingfisher they are modified for wading. The legs and toes are exceptionally long and slender and serve to walk over aquatic vegetation or marshes.

176. (c) : Pigeons are noted for their unique ability to produce "pigeon's milk", a soft, cheesy and nourishing secretion, especially during the breeding season. It is formed by the degeneration of the epithelial cells lining the crop. It is regurgitated into the mouth of the young birds until they are old enough to manage a grain-diet like their parents. The pigeon's milk includes water, fat, protein (casein) and lactose. The milk is produced by both sexes and contains 35 per cent of fat.

177. (c) : *Typhlops* is a genus of blind snakes (non-poisonous snake) found in Europe, Africa, Asia and Central and South America. Sea snake is a poisonous snake while grass snake is a non-poisonous snake. Glass snake is a lizard.

178. (c) : *Necturus* is a mud puppy belonging to the Order Urodela of Class Amphibia. Hell bender is a large salamander. *Amphiuma* is a Congo Eel and *Ichthyophis* is a blind worm.

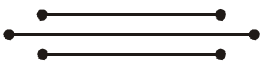
179. (b) : The fire-bellied toads is a group of eight species of small toads belonging to the genus *Bombina*. They are found across much of Europe and Asia, staying in water or near the shore. Their name derives from the brightly coloured red or yellow and black patterns on their ventral region, which act as warning to its predators. *Amphiuma* is a Congo-eel. *Necturus* is a mud puppy and *Salamandra* is a salamander.

180. (c) : Tortoise belongs to the Class Reptilia. Its body is protected by a shell consisting of a dorsal carapace and ventral plastron.

181. (b) : The common name of *Teredo* is shipworm which belongs to the class bivalvia of the Phylum Mollusca. In it, head is absent and foot is wedge - shaped for burrowing. Shell consists of two valves. The common name of *Chiton* is the coat of mail shell (Class Amphineura), *Limax* is the grey slug (Class Gastropoda) and *Patella* is true limpet (Class Gastropoda).

182. (a) : The mulberry silk moth has been the most commercially important beneficial insect. The silk is obtained by killing the pupa inside the hot water.Then, the silk thread is wound.

183. (a) : The common name of *Tubipora* is Organ Pipe Coral. It is a marine animal of the Class Anthozoa (Phylum Cnidaria). It occurs on reefs in shallow waters of the Indian and Pacific oceans and is characterized by long, parallel upright polyps or stalks, supported by a skeleton of rigid tubes of calcium carbonate.



Chapter

5

Morphology of Flowering Plants

1. Coconut fruit is a
(a) berry (b) nut
(c) capsule (d) drupe.
(NEET 2017)

2. In *Bougainvillea*, thorns are the modifications of
(a) adventitious root (b) stem
(c) leaf (d) stipules.
(NEET 2017)

3. The morphological nature of the edible part of coconut is
(a) cotyledon (b) endosperm
(c) pericarp (d) perisperm.
(NEET 2017)

4. The term 'polyadelphous' is related to
(a) gynoecium (b) androecium
(c) corolla (d) calyx.
(NEET-II 2016)

5. How many plants among *Indigofera, Sesbania, Salvia, Allium, Aloe*, mustard, groundnut, radish, gram and turnip have stamens with different lengths in their flowers?
(a) Three (b) Four
(c) Five (d) Six
(NEET-II 2016)

6. Radial symmetry is found in the flowers of
(a) *Brassica* (b) *Trifolium*
(c) *Pisum* (d) *Cassia*.
(NEET-II 2016)

7. Free-central placentation is found in
(a) *Dianthus* (b) *Argemone*
(c) *Brassica* (d) *Citrus*.
(NEET-II 2016)

8. Which of the following is not a stem modification?
(a) Tendrils of cucumber
(b) Flattened structures of *Opuntia*
(c) Pitcher of *Nepenthes*
(d) Thorns of citrus *(NEET-I 2016)*

9. Stems modified into flat green organs performing the functions of leaves are known as
(a) phylloclades (b) scales
(c) cladodes (d) phyllodes.
(NEET-I 2016)

10. Cotyledon of maize grain is called
(a) coleoptile (b) scutellum
(c) plumule (d) coleorhiza.
(NEET-I 2016)

11. Tricarpellary, syncarpous gynoecium is found in flowers of
(a) Fabaceae (b) Poaceae
(c) Liliaceae (d) Solanaceae
(NEET-I 2016)

12. The standard petal of a papilionaceous corolla is also called
(a) vexillum (b) corona
(c) carina (d) pappus.
(NEET-I 2016)

13. The wheat grain has an embryo with one large, shield shaped cotyledon known as
(a) scutellum (b) coleoptile
(c) epiblast (d) coleorhiza.
(2015)

14. Among China rose, mustard, brinjal, potato, guava, cucumber, onion and tulip, how many plants have superior ovary?
(a) Three (b) Four
(c) Five (d) Six
(2015)

15. Axile placentation is present in
(a) pea (b) *Argemone*
(c) *Dianthus* (d) lemon.
(2015)

16. Roots play insignificant role in absorption of water in
(a) pea (b) wheat
(c) sunflower (d) *Pistia*.
(2015)

17. $\oplus$ ⚥ $K_{(5)}\overset{\frown}{C_{(5)}A_5}\underline{G}_{(2)}$ is the floral formula of

(a) *Petunia* (b) *Brassica*
(c) *Allium* (d) *Sesbania*.
(2015 Cancelled)

18. Perigynous flowers are found in

(a) China rose (b) rose
(c) guava (d) cucumber.
(2015 Cancelled)

19. Keel is the characteristic feature of flower of

(a) *Aloe* (b) tomato
(c) tulip (d) *Indigofera*.
(2015 Cancelled)

20. Leaves become modified into spines in

(a) onion (b) silk cotton
(c) *Opuntia* (d) pea.
(2015 Cancelled)

21. Placenta and pericarp are both edible portions in

(a) apple (b) banana
(c) tomato (d) potato.
(2014)

22. When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as

(a) vexillary (b) imbricate
(c) twisted (d) valvate.
(2014)

23. Which one of the following statements is correct?

(a) The seed in grasses is not endospermic.
(b) Mango is a parthenocarpic fruit.
(c) A proteinaceous aleurone layer is present in maize grain.
(d) A sterile pistil is called a staminode.
(2014)

24. An example of edible underground stem is

(a) carrot (b) groundnut
(c) sweet potato (d) potato.
(2014)

25. Among bitter gourd, mustard, brinjal, pumpkin, china rose, lupin, cucumber, sunhemp, gram, guava, bean, chilli, plum, petunia, tomato, rose, *Withania*, potato, onion, aloe and tulip how many plants have hypogynous flower?

(a) Fifteen (b) Eighteen
(c) Six (d) Ten
(NEET 2013)

26. In China rose the flowers are

(a) zygomorphic, hypogynous with imbricate aestivation
(b) zygomorphic, epigynous with twisted aestivation
(c) actinomorphic, hypogynous with twisted aestivation
(d) actinomorphic, epigynous with valvate aestivation *(NEET 2013)*

27. Among flowers of *Calotropis*, tulip, *Sesbania*, *Asparagus*, *Colchicum*, sweet pea, *Petunia*, *Indigofera*, mustard, soybean, tobacco and groundnut, how many plants have corolla with valvate aestivation?

(a) Six (b) Seven
(c) Eight (d) Five
(Karnataka NEET 2013)

28. Inflorescence is racemose in

(a) brinjal (b) tulip
(c) aloe (d) soybean.
(Karnataka NEET 2013)

29. In a cymose inflorescence the main axis

(a) has unlimited growth
(b) bears a solitary flower
(c) has unlimited growth but lateral branches end in flowers
(d) terminates in a flower.
(Karnataka NEET 2013)

30. How many plants among China rose, *Ocimum*, sunflower, mustard, *Alstonia*, guava, *Calotropis* and *Nerium* (oleander) have opposite phyllotaxy?

(a) Three (b) Four
(c) Five (d) Two
(Karnataka NEET 2013)

31. Placentation in tomato and lemon is

(a) parietal (b) free central
(c) marginal (d) axile. *(2012)*

32. Cymose inflorescence is present in

(a) *Solanum* (b) *Sesbania*
(c) *Trifolium* (d) *Brassica*. *(2012)*

33. Phyllode is present in

(a) *Asparagus* (b) *Euphorbia*
(c) Australian *Acacia* (d) *Opuntia*.
(2012)

34. The gynoecium consists of many free pistils in flowers of

(a) *Aloe* (b) tomato
(c) *Papaver* (d) *Michelia*.
(2012)

35. How many plants in the list given below have composite fruits that develop from an inflorescence?
Walnut, poppy, radish, fig, pineapple, apple, tomato, mulberry.
(a) Four (b) Five
(c) Two (d) Three
(2012)

36. The coconut water and the edible part of coconut are equivalent to
(a) endosperm (b) endocarp
(c) mesocarp (d) embryo.
(2012)

37. Vexillary aestivation is characteristic of the family
(a) Fabaceae (b) Asteraceae
(c) Solanaceae (d) Brassicaceae.
(2012)

38. Which one of the following organisms is correctly matched with its three characteristics?
(a) Pea: C_3 pathway, endospermic seed, vexillary aestivation
(b) Tomato: twisted aestivation, axile placentation, berry
(c) Onion: bulb, imbricate aestivation, axile placentation
(d) Maize: C_3 pathway, closed vascular bundles, scutellum
(Mains 2012)

39. How many plants in the list given below have marginal placentation?
Mustard, Gram, Tulip, *Asparagus*, Arhar, Sun hemp, Chilli, *Colchicum*, Onion, Moong, Pea, Tobacco, Lupin
(a) Four (b) Five
(c) Six (d) Three
(Mains 2012)

40. Which one of the following statements is correct?
(a) In tomato, fruit is a capsule.
(b) Seeds of orchids have oil-rich endosperm.
(c) Placentation in primose is basal.
(d) Flower of tulip is a modified shoot.
(2011)

41. The correct floral formula of chilli is
(a) $\oplus\ \female\!\!\male\ K_{(5)}\ C_5\ A_5\ \underline{G}_{(2)}$
(b) $\oplus\ \female\!\!\male\ K_{(5)}\ \overbrace{C_{(5)}\ A_5}\ \underline{G}_{(2)}$
(c) $\oplus\ \female\!\!\male\ K_{(5)}\ C_{(5)}\ A_{(5)}\ \underline{G}_2$
(d) $\oplus\ \female\!\!\male\ K_5\ \overbrace{C_5\ A_{(5)}}\ \underline{G}_2$. *(2011)*

42. Flowers are zygomorphic in
(a) mustard (b) gulmohur
(c) tomato (d) *Datura.*
(2011)

43. The ovary is half inferior in flowers of
(a) peach (b) cucumber
(c) cotton (d) guava.
(2011)

44. A drupe develops in
(a) mango (b) wheat
(c) pea (d) tomato.
(2011)

45. Which one of the following pairs is wrongly matched while the remaining three are correct?
(a) *Penicillium* – conidia
(b) Water hyacinth – runner
(c) *Bryophyllum* – leaf buds
(d) *Agave* – bulbils
(Mains 2011)

46. Which one of the following figures represents the placentation in *Dianthus*?
(a)  (b) 
(c)  (d) 
(Mains 2011)

47. Whorled, simple leaves with reticulate venation are present in
(a) *Calotropis* (b) neem
(c) China rose (d) *Alstonia.*
(Mains 2011)

48. Sweet potato is homologous to
(a) potato (b) *Colocasia*
(c) ginger (d) turnip.
(Mains 2011)

49. In unilocular ovary with a single ovule, the placentation is
(a) marginal (b) basal
(c) free central (d) axile.
(2010)

50. Keel is characteristic of the flowers of
(a) gulmohur (b) *Cassia*
(c) *Calotropis* (d) bean.
(2010)

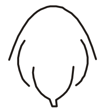
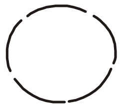
51. Ovary is half-inferior in the flowers of
(a) guava (b) plum
(c) brinjal (d) cucumber.
(2010)

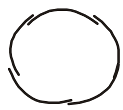
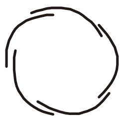
52. The technical term used for the androecium in a flower of China rose (*Hibiscus rosa sinensis*) is
(a) monadelphous (b) diadelphous
(c) polyandrous (d) polyadelphous.
(2010)

53. The scutellum observed in a grain of wheat or maize is comparable to which part of the seed in other monocotyledons?
(a) Cotyledon (b) Endosperm
(c) Aleurone layer (d) Plumule
(2010)

54. Which one of the following is a xerophytic plant in which the stem is modified into the flat green and succulent structure?
(a) *Opuntia* (b) *Casuarina*
(c) *Hydrilla* (d) *Acacia*
(Mains 2010)

55. Aestivation of petals in the flower of cotton is correctly shown in

(a)  (b) 

(c)  (d) 

(Mains 2010)

56. The correct floral formula of soyabean is
(a) % ⚥ $K_{(5)}\ C_{1+(2)+2}\ A_{(9)+1}\underline{G}_1$
(b) % ⚥ $K_5\ C_{1+(2)+2}\ A_{(9)+1}\underline{G}_1$
(c) % ⚥ $K_{(5)}\ C_{1+2+(2)}\ A_{(9)+1}\underline{G}_1$
(d) % ⚥ $K_{(5)}\ C_{1+2+(2)}\ A_{1+(9)}\underline{G}_1$ *(Mains 2010)*

57. Consider the following four statements (i), (ii), (iii) and (iv) and select the right option for two correct statements.

Statements :
(i) In vexillary aestivation, the large posterior petal is called-standard, two lateral ones are wings and two small anterior petals are termed keel.
(ii) The floral formula for Liliaceae is
⊕⚥ $P_{3+3}\ A_{3+3} + \underline{G}_3$.
(iii) In pea flower the stamens are monadelphous.
(iv) The floral formula for Solanaceae is
⊕⚥ $K_{(3)}\ C_{(3)}\ A_{(4)} + \underline{G}_{(2)}$.
The correct statements are
(a) (i) and (iii) (b) (i) and (ii)
(c) (ii) and (iii) (d) (iii) and (iv).
(Mains 2010)

58. The floral formula ⊕⚥ $K_{(5)}\ \overset{\frown}{C_{(5)}\ A_5}\ \underline{G}_{(2)}$ is that of
(a) soybean (b) sunhemp
(c) tobacco (d) tulip.
(2009)

59. A fruit developed from hypanthodium inflorescence is called
(a) sorosis (b) syconus
(c) caryopsis (d) hesperidium.
(2009)

60. An example of axile placentation is
(a) *Dianthus* (b) lemon
(c) marigold (d) *Argemone.*
(2009)

61. Cotyledons and testa respectively are edible parts in
(a) walnut and tamarind
(b) french bean and coconut
(c) cashew nut and litchi
(d) groundnut and pomegranate.
(2009)

62. An example of a seed with endosperm, perisperm, and caruncle is
(a) coffee (b) lily
(c) castor (d) cotton.
(2009)

63. The fleshy receptacle of syconus of fig encloses a number of
(a) berries (b) mericarps
(c) achenes (d) samaras.
(2008)

64. Dry indehiscent single-seeded fruit formed from bicarpellary syncarpous inferior ovary is
(a) berry (b) cremocarp
(c) caryopsis (d) cypsella.
(2008)

65. Replum is present in the ovary of flower of
(a) sun flower (b) pea
(c) lemon (d) mustard.
(2008)

66. The fruit is chambered, developed from inferior ovary and has seeds with succulent testa in
(a) guava (b) cucumber
(c) pomegranate (d) orange.
(2008)

67. Endosperm is consumed by developing embryo in the seed of
(a) pea (b) maize
(c) coconut (d) castor.
(2008)

68. Which of the following is a flowering plant with nodules containing filamentous nitrogen-fixing micro-organism?
(a) *Crotalaria juncea*
(b) *Cycas revoluta*
(c) *Cicer arietinum*
(d) *Casuarina equisetifolia* *(2007)*

69. Pentamerous actinomorphic flowers, bicarpellary ovary with oblique septa, and fruit capsule or berry, are characteristic features of
(a) Liliaceae (b) Asteraceae
(c) Brassicaceae (d) Solanaceae.
(2006)

70. Pineapple (ananas) fruit develops from
(a) a multilocular monocarpellary flower
(b) a unilocular polycarpellary flower
(c) a multipistillate syncarpous flower
(d) a cluster of compactly borne flowers on a common axis. *(2006)*

71. In which of the following fruits, the edible part is the aril ?
(a) Litchi (b) Custard apple
(c) Pomegranate (d) Orange *(2006)*

72. Long filamentous threads protruding at the end of a young cob of maize are
(a) hairs (b) anthers
(c) styles (d) ovaries. *(2006)*

73. Why is vivipary an undesirable character for annual crop plants?
(a) It reduces the vigour of the plant.
(b) It adversely affects the fertility of the plant.
(c) The seeds exhibit long dormancy.
(d) The seeds cannot be stored under normal conditions for the next season. *(2005)*

74. Which of the following represents the edible part of the fruit of litchi?
(a) Mesocarp (b) Endocarp
(c) Pericarp (d) Juicy aril *(2005)*

75. Edible part of mango is
(a) endocarp (b) receptacle
(c) epicarp (d) mesocarp. *(2004)*

76. Juicy hair-like structures observed in the lemon fruit develop from
(a) exocarp
(b) mesocarp
(c) endocarp
(d) mesocarp and endocarp. *(2003)*

77. Geocarpic fruit is
(a) potato (b) peanut
(c) onion (d) garlic. *(2002)*

78. Edible part in mango is
(a) mesocarp (b) epicarp
(c) endocarp (d) epidermis.
(2002)

79. Bicarpellary gynoecium and oblique ovary occurs in
(a) mustard (b) banana
(c) *Pisum* (d) brinjal. *(2001)*

80. Tetradynamous conditions occur in
(a) Cruciferae (b) Malvaceae
(c) Solanaceae (d) Lilliaceae.
(2001)

81. In which of the following plant sunken stomata are found?
(a) *Nerium* (b) *Hydrilla*
(c) Mango (d) Guava *(2001)*

82. What is the eye of potato?
(a) Axillary bud (b) Accessory bud
(c) Adventitious bud (d) Apical bud
(2001)

83. Edible part of banana is
(a) epicarp
(b) mesocarp and less developed endocarp
(c) endocarp and less developed mesocarp
(d) epicarp and mesocarp. *(2001)*

84. Which is correct pair for edible part?
(a) Tomato-thalamus
(b) Maize-cotyledons
(c) Guava-mesocarp
(d) Date palm-mesocarp *(2001)*

85. Which is expressing right appropriate pairing?
(a) Brassicaceae - sunflower
(b) Malvaceae - cotton
(c) Papilionaceae - catechu
(d) Liliaceae - wheat *(2000)*

86. Pneumatophores are found in
(a) the vegetation which is found in marshy and saline lake
(b) the vegetation which found in acidic soil
(c) xerophytes
(d) epiphytes. *(2000)*

87. Hair found in the inflorescence of *Zea mays* are the modification of
(a) style (b) stigma
(c) spathe (d) filaments. *(2000)*

88. Geocarpic fruits is
(a) carrot (b) radish
(c) ground nut (d) turnip. *(2000)*

89. Angiosperm, to which the largest flowers belong, is
(a) total root parasite
(b) partial root parasite
(c) total stem parasite
(d) partial stem parasite. *(1999)*

90. The plant, which bears clinging roots, is
(a) screw pine (b) *Podostemon*
(c) *Trapa* (d) orchid. *(1999)*

91. Floral features are chiefly used in angiosperms identification because
(a) flowers can be safely pressed
(b) reproductive parts are more stable and conservative than vegetative parts
(c) flowers are nice to work with
(d) flowers are of various colours. *(1998)*

92. Which plant will lose its economic value, if its fruits are produced by induced parthenocarpy?
(a) Orange (b) Banana
(c) Grape (d) Pomegranate *(1997)*

93. Which of the following is a 'true fruit'?
(a) Banana (b) Fig
(c) Apple (d) Pear *(1996)*

94. A plant bears fruit, has a column of vascular tissue and a tap root system. This plant is a
(a) angiosperm and dicot
(b) gymnosperm and dicot
(c) angiosperm and monocot
(d) gymnosperm and monocot. *(1994)*

95. Hypanthodium is a specialized type of
(a) fruit (b) inflorescence
(c) thalamus (d) ovary. *(1994)*

96. Pulses are obtained from
(a) Fabaceae (b) Asteraceae
(c) Poaceae (d) Solanaceae. *(1993)*

97. Epipetalous stamens with free filaments and fused anthers occur in
(a) Asteraceae (b) Solanaceae
(c) Liliaceae (d) Poaceae. *(1992)*

98. Floral formula of tomato/tobacco is
(a) $\oplus \male\!\female K_{4-5}A_{10}G_{(2)}$ (b) $\oplus \male\!\female K_{2+2}C_4A_{2+4}G_1$
(c) $\oplus \male\!\female P_2A_3G_1$ (d) $\oplus \male\!\female K_{(5)}\overset{\frown}{C_{(5)}}A_5\underline{G}_{(2)}$. *(1992, 1989)*

99. Botanical name of cauliflower is
(a) *Brassica oleracea var. capitata*
(b) *Brassica compesteris*
(c) *Brassica oleracea var. botrytis*
(d) *Brassica oleracea var. gemmifera*. *(1991)*

100. $\oplus \male\!\female K_{(5)}\overset{\frown}{C_{(5)}}A_{(5)}\underline{G}_{(2)}$ is floral formula of
(a) Liliaccae (b) Solanaceae
(c) Asteraceae (d) Fabaceae. *(1991)*

101. Epipetalous and syngenesious stamens occur in
(a) Solanaceae (b) Brassicaceae
(c) Fabaceae (d) Asteraceae. *(1991)*

102. Fruit of *Mangifera indica* is
(a) berry (b) drupe
(c) capsule (d) siliqua. *(1991)*

103. A family delimited by type of inflorescence is
(a) Fabaceae (b) Asteraceae
(c) Solanaceae (d) Liliaceae. *(1991)*

104. Syngenesious condition is found in
(a) Asteraceae (b) Labiatae
(c) Solanaceae (d) Fabaceae.
(1991)

105. Vegetative reproduction of *Agave* occurs through
(a) rhizome (b) stolon
(c) bulbils (d) sucker.
(1991)

106. Velamen is found in
(a) roots of screwpine
(b) aerial and terrestrial roots of orchids
(c) leaves of *Ficus elastica*
(d) aerial roots of orchids.
(1991)

107. In groundnut the food/oil reserve is present in
(a) epicarp (b) mesocarp
(c) endosperm (d) cotyledons.
(1990)

108. Tegmen develops from
(a) funiculus
(b) chalaza
(c) inner integument
(d) outer integument. *(1990)*

109. Oil reserve of groundnut is present in
(a) embryo
(b) cotyledons
(c) endosperm
(d) underground tubers. *(1990)*

110. New banana plants develop from
(a) rhizome (b) sucker
(c) stolon (d) seed. *(1990)*

111. Mango juice is obtained from
(a) epicarp
(b) mesocarp
(c) endocarp
(d) pericarp and thalamus. *(1989)*

112. Which one yields fibres?
(a) Coconut (b) Oak
(c) Teak (d) Sisso *(1988)*

113. Micropyle of seed is involved in the passage of
(a) male gamete (b) pollen tube
(c) water (d) gases. *(1988)*

114. Fruit of groundnut is
(a) legume (b) caryopsis
(c) berry (d) nut. *(1988)*

Answer Key

1.	(d)	**2.**	(b)	**3.**	(b)	**4.**	(b)	**5.**	(b)	**6.**	(a)	**7.**	(a)	**8.**	(c)	**9.**	(a)	**10.**	(b)
11.	(c)	**12.**	(a)	**13.**	(a)	**14.**	(d)	**15.**	(d)	**16.**	(d)	**17.**	(a)	**18.**	(b)	**19.**	(d)	**20.**	(c)
21.	(c)	**22.**	(b)	**23.**	(c)	**24.**	(d)	**25.**	(a)	**26.**	(c)	**27.**	(b)	**28.**	(d)	**29.**	(d)	**30.**	(a)
31.	(d)	**32.**	(a)	**33.**	(c)	**34.**	(d)	**35.**	(d)	**36.**	(a)	**37.**	(a)	**38.**	(c)	**39.**	(c)	**40.**	(d)
41.	(b)	**42.**	(b)	**43.**	(a)	**44.**	(a)	**45.**	(b)	**46.**	(b)	**47.**	(d)	**48.**	(d)	**49.**	(b)	**50.**	(d)
51.	(b)	**52.**	(a)	**53.**	(a)	**54.**	(a)	**55.**	(d)	**56.**	(c)	**57.**	(b)	**58.**	(c)	**59.**	(b)	**60.**	(c)
61.	(d)	**62.**	(c)	**63.**	(c)	**64.**	(d)	**65.**	(d)	**66.**	(c)	**67.**	(a)	**68.**	(d)	**69.**	(d)	**70.**	(d)
71.	(a)	**72.**	(c)	**73.**	(d)	**74.**	(d)	**75.**	(d)	**76.**	(c)	**77.**	(b)	**78.**	(a)	**79.**	(d)	**80.**	(a)
81.	(a)	**82.**	(a)	**83.**	(c)	**84.**	(d)	**85.**	(b)	**86.**	(a)	**87.**	(a)	**88.**	(c)	**89.**	(a)	**90.**	(d)
91.	(b)	**92.**	(d)	**93.**	(a)	**94.**	(a)	**95.**	(b)	**96.**	(a)	**97.**	(a)	**98.**	(d)	**99.**	(a)	**100.**	(b)
101.	(d)	**102.**	(b)	**103.**	(b)	**104.**	(a)	**105.**	(c)	**106.**	(d)	**107.**	(d)	**108.**	(c)	**109.**	(b)	**110.**	(b)
111.	(b)	**112.**	(a)	**113.**	(c)	**114.**	(a)												

EXPLANATIONS

1. (d) : Coconut fruit is fibrous drupe with a fibrous mesocarp.

2. (b) **3. (b)**

4. (b) : Polyadelphous condition represents cohesion of stamens. In this condition stamens of a flower are fused by their filaments only to form many groups, *e.g., Citrus*.

5. (b)

6. (a) : The flowers of *Brassica* are radially symmetrical whereas flowers of *Trifolium*, *Pisum* and *Cassia* are zygomorphic.

7. (a) : Free central placentation is found in *Dianthus*. Parietal placentation is present in *Argemone* and *Brassica* whereas *Citrus* has axile placentation in ovary.

8. (c) : Pitcher of *Nepenthes* is a modification of leaf. In *Nepenthes*, the pitchers are meant for catching and digesting insects. The lamina is modified into pitcher. The leaf apex gives rise to a coloured lid for attracting the insects.

9. (a) : Phylloclades are flattened green stems which have taken over the function of photosynthesis while cladodes are only the branches of stem that are modified to take over the function of leaves. Cladodes may not be flattened as in *Ruscus aculeatus*, cladodes are leaf-like with spiny tip whereas in *Asparagus*, they are slightly flattened, fleshy, straight or curved pointed structures which develop in clusters in the axil of scale leaves.

10. (b)

11. (c) : Members of Liliaceae possess tricarpellary, syncarpous gynoecium with superior ovary. The ovary is trilocular with two to many ovules in each loculus.

12. (a) : The posterior large bilobed petal of a papilionaceous corolla is called standard or vexillum. It overlaps the two smaller lateral petals known as wings or alae.

13. (a) : The seeds of monocotyledonous plants have only one cotyledon. In family Poaceae (*e.g.*, wheat, maize etc.), this cotyledon is called scutellum, situated towards lateral side of embryonal axis. It provides nourishment to the developing embryo.

14. (d) : China rose, mustard, brinjal, potato, onion and tulip are the plants that have superior ovary whereas in guava and cucumber, ovary is inferior.

15. (d) : Axile placentation occurs in syncarpous pistils. The ovary is partitioned into two or more chambers. Placentae occur in the central region where the septa meet so that an axile column bearing ovules is formed *e.g.*, shoe flower (pentalocular), lemon (multilocular), etc.

16. (d) : *Pistia* (water lettuce) is a floating aquatic plant. In aquatic plants, roots are generally poorly developed and do not take part in absorption of water. Water is absorbed by the general body surface in these plants.

17. (a) : The given floral formula is of Family Solanaceae. Among the given options, only *Petunia* belongs to Family Solanaceae. *Allium* is a member of Family Liliaceae, *Sesbania* is of Family Leguminosae and *Brassica* is a member of Family Brassicaceae or Cruciferae.

18. (b) : If gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level, it is called perigynous. The ovary here is said to be half inferior, *e.g.*, plum, rose, peach.

19. (d) : The flowers of Family Papilionaceae have butterfly shaped corolla (papilionaceous corolla). Posterior or outermost petal is the largest and is called standard or vexillum, two lateral petals are similar and generally clawed, are called wings or alae and the two anterior petals called keel are fused enclosing stamens and carpels. This type of petal arrangement is found in bean, gram, pea, *Indigofera* etc.

20. (c) : In xerophytic plants, the leaves modify into sharp, pointed spines *e.g. Aloe, Solanum surattense, Opuntia, Asparagus* etc. This modification is either for protection of plant or to lessen transpiration, or for both.

21. (c) : A true fruit consists of a pericarp (fruit wall) formed from ovary wall and seeds formed from ovules. Pericarp is divisible into epicarp, mesocarp and endocarp. Tomato is a berry fruit derived from bicarpellary, syncarpous, bi-to tetralocular ovary with swollen placentae. Berry consists of a membranous skin represented by epicarp. Mesocarp is the middle fleshy part. Endocarp, septa and placentae are pulpy and edible. All parts of the fruit, except the small seeds, are edible.

22. (b) : Aestivation is the arrangements of accessory floral organs (sepals or petals) in relation to one another in floral bud. It may be of open, valvate, twisted or imbricate type. In imbricate aestivation there is an irregular overlapping of petals by one another. It has three subtypes besides imbricate proper

i.e., quincuncial, ascending imbricate and descending imbricate or vexillary. *Cassia*, *Pisum,* etc., show imbricate aestivation.

23. (c) : Grass seeds are endospermic. Mango is a seeded fruit. A sterile pistil is called pistillode and a sterile stamen is called staminode. Maize grains consist of fruit wall, seed coat, endosperm and embryo. The endosperm occupies most of the grains interior and consists of two parts, horny aleurone layer and mainly storage layers. The aleurone layer lies immediately below the grain covering and is 1-3 cell thick. Aleurone cells are thick walled with cytoplasm filled with aleurone grains which produce enzymes during seed germination to mobilise stored nutrients.

24. (d) : Carrot and sweet potato are root modifications while edible part of groundnut is seeds. Potato is an edible underground stem.

25. (a) : In the hypogynous flower the gynoecium occupies the highest position while the other parts are situated below it. The ovary in such flowers is said to be superior, *e.g.*, mustard, China rose and brinjal. All the given plants except bitter gourd, pumpkin, cucumber, guava, plum and rose have hypogynous flower.

26. (c) : In China rose the flowers are actinomorphic *i.e.*, it can be divided into two equal radial halves in any radial plane passing through the centre; they are hypogynous, *i.e.*, the gynoecium occupies the highest position, while the other parts are situated below it; they have twisted aestivation *i.e.*, one margin of petal overlaps that of the next one and so on.

27. (b) : The mode of arrangement of the sepals or petals with respect to one another in the floral bud is termed as aestivation. Aestivation is of different types - valvate, twisted or contorted, imbricate, quincuncial, vexillary, convolute, and plicate. In valvate aestivation, sepals or petals or tepals just touch each other without any overlapping. *Calotropis*, tulip, *Asparagus*, *Colchicum*, *Petunia*, mustard and tobacco have valvate aestivation.

28. (d) : Racemose inflorescence is also called indefinite and indeterminate type. Growth of the peduncle is indefinite. Here the terminal bud will not modify into a flower. Flowers develop in acropetal succession *i.e.*, mature flowers are towards the base and the younger ones towards the tip of the peduncle. Flowers open in centripetal succession *i.e.*, opening of flowers proceeds from the periphery to the centre of the inflorescence. Peduncle may be unbranched or branched. Soybean belongs to family Fabaceae which has racemose inflorescence.

29. (d) : Cymose inflorescence is also called definite or determinate inflorescence. Growth of the peduncle is definite. Here, the terminal bud is modified into a flower. Flowers develop in basipetal succession, *i.e.*, mature flowers are towards the apex and young flower buds are towards the base. Flowers open in centrifugal sequence, *i.e.*, flowers open from centre to the periphery of the inflorescence *e.g.*, *Solanum*, *Ranunculus, Datura*, *Gossypium*, etc.

30. (a) : In opposite phyllotaxy, two leaves are borne on the opposite sides of a single node. It is of two types; (a) opposite and superposed, (b) opposite and decussate. *Ocimum*, guava and *Calotropis* have opposite decussate phyllotaxy.

31. (d) : Placentation is the arrangement of ovules within the ovary. It is of different types namely, marginal (pea), parietal (mustard, *Argemone*), axile (China rose, tomato, lemon) and free central (*Dianthus*, *Primrose*).

32. (a) : *Refer to answer 29.*

33. (c) : In several species of *Acacia* found in the deserts of Australia the bipinnate lamina is absent. Instead petiole and part of the rachis become flattened into sickle-shaped structure for performing the function of food synthesis. Such a flattened petiole which carries out the functions of the lamina is called phyllode. Formation of phyllode is a mechanism to reduce transpiration because (i) it is vertically placed and (ii) has fewer stomata.

34. (d) : Gynoecium is the female reproductive organ of a flower. It may be apocarpous (pistils separated) *e.g.*, *Michelia* or syncarpous (fused) *e.g.*, tomato.

35. (d) : A composite or multiple fruit is a group of fruitlets which develop from the different flowers of an inflorescence. It is of two main types, sorosis (*e.g.*, mulberry, pineapple, jack fruit) and syconus (*e.g.,* peepal, banyan, fig, etc.)

36. (a) : Coconut fruit is a drupe. It has a membranous epicarp, fibrous mesocarp and stony endocarp. The endocarp encloses a single seed with brown testa that contains a small embryo and a white oily endosperm (edible part) with watery fluid called coconut water.

37. (a) : Vexillary or descending imbricate aestivation is a characteristic of family Fabaceae. In it, the posterior largest petal (standard) overlaps two lateral petals (wings) which in turn overlap two anterior petals (keel). It is also called pailionaceous corolla.

38. (c)

39. (c) : Gram, arhar, sunhemp, moong, pea and lupin belong to Family Fabaceae which is characterized by marginal placentation.

40. (d) : Tulip is the common name for any member of the thousands of varieties and about 100 species of bulbous perennial plants comprising the genus *Tulipa* of the flowering plant Family Liliaceae. A bulb is an underground vertical shoot that has modified shoot (or thickened leaf bases). As flower is regarded as a modified stem with shortened internodes and bearing at its nodes and structures that may be highly modified leaves. A flower structure forms on a modified shoot or axis with an apical meristem that does not grow continuously.

41. (b) : Chilli is the member of Solanaceae, in which flowers are bisexual (φ), actinomorphic ($\oplus$); calyx – 5 and gamosepalous, corolla – 5 and gamopetalous ; androecium – 5, free, epipetalous basifixed, inferior; gynoecium – bicarpellary, syncarpous and ovary superior.

So, floral formula of chilli is $\oplus \varphi \; K_{(5)}\overset{\frown}{C_{(5)}}\,A_5\,\underline{G}_{(2)}$.

42. (b) : Flowers of gulmohur have bilateral symmetry. So, they are called zygomorphic. *Datura*, mustard and tomato have actinomorphic flowers.

43. (a) : If gynoecium is situated in the centre and other parts of the flower are located on the rim of the thalamus almost at the same level, it is called perigynous. The ovary here is said to be half inferior, *e.g.*, plum, rose, peach.

44. (a) : Drupe is a fleshy fruit that develops from either one or several fused carpels and contains one or many seeds. The seeds are enclosed by the hard protective endocarp (pericarp) of the fruit, *e.g.*, mango. In mango the pericarp is well differentiated into an outer thin epicarp, a middle fleshy edible mesocarp and an inner stony hard endocarp.

45. (b) : The examples of runners are doob grass, *Oxalis, Centella* etc. These plants have long and thin internodes and branches creep over the surface of soil. Such plants develop adventitious roots at nodes on lower side. When long branches breakup by any method they form new plants.

Water hyacinth (*Eichhornia*) is the example of offset. This is sub aerial modification of stem. It is like runner but internodes are thick and short.

46. (b) : The figure given in option (b) represents the free central placentation. In free central placentation, ovary is unilocular and ovules are borne on the axis in the center of the ovary and septa are absent. It is seen in *Dianthus* and *Primrose*.

47. (d) : In *Alstonia*, five or more leaves arises from each node, so it shows whorled phyllotaxy. The leaves are leathery, sessile, simple which are elliptical or ovate or wedge shaped at the base. It is used in traditional medicines.

48. (d) : Sweet potato is homologous to turnip as both are having same origin *i.e.,* both are root but modified for different functions. Sweet potato is a modified root for storage and vegetative propagation while turnip is modified for storage only.

49. (b) : In basal type of placentation the ovary is unilocular and ovules and generally reduced to one borne at the base of the ovary, *e.g.*, compositae.

50. (d) : *Refer to answer 19.*

51. (b) : *Refer to answer 43.*

52. (a) : China rose of Family Malvaceae possess numerous stamens. The filaments of stamens are united in one group thus forming a staminal tube around the style. Such stamens are called monadelphous.

53. (a) : Scutellum is the tissue in a grass or wheat or maize seed that lies between the embryo and the endosperm. It is the modified cotyledon, being specialized for the digestion and absorption of the endospserm.

54. (a) : *Opuntia* is a xerophytic plant which lives in dry habitat. The plant has fleshy organs where water and mucilage are stored. The stem is modified into flat green structure, therefore, *Opuntia* is also called as phylloclades.

55. (d) : In cotton, china rose and lady's finger margins of sepals or petals overlap that of the next one this mode of arrangement (aestivation) is called twisted.

56. (c) : The plants belonging to the Family Fabaceae such as soyabean, pea, sem, moong, gram, etc have the floral formula

$\% \varphi K_{(5)}\, C_{1+2+(2)}\, A_{(9)+1}\, \underline{G}_1$.

57. (b) : Flowers in pea have diadelphous stamens. The floral formula for Solanaceae is

$\oplus \varphi K_{(5)}\overset{\frown}{C_{(5)}}\,A_5\,\underline{G}_{(2)}$.

58. (c) : The floral formula of tobacco is $\oplus \varphi K_{(5)}\overset{\frown}{C_{(5)}}\,A_5\,\underline{G}_{(2)}$. It belongs to the family Solanaceae. The flower is actinomorphic, bisexual, 5 sepals gamosepalous, 5 gamopetalous corolla, 5 epipetalous stamens and 2 carpels syncarpous having superior ovary.

59. (b) : Syconous fruit develops from a hypanthodium inflorescence, *e.g.*, *Ficus*. Hypanthodium is a box like inflorescence where the box is formed by the flesly receptacle. It opens to exterior by a single pore called ostiole. The hollow pear shaped fleshy receptacle encloses a number of minute male and female flowers, it becomes fleshy and forms the fruit.

60. (c) : In marigold of Asteraceae the ovary is superior, 2 or 3 locular, placentation is axile,ovules 1 to many per locule, style 1, stigma 2 or 3 lobed.

61. (d) : Groundnut is dry, one chambered, one seeded fruit developing from a superior bi or poly carpellary ovary. The edible part is cotyledons and embryo lobe. Pomegranate is balausta type of fruit. The fruits develop from multilocular syncarpous inferior ovary. Testa is fleshy & edible.

62. (c) : In castor seed testa and tegmen are united together. Seed coat is tough and bright due to scleroprotein. Over narrower end a brownish pad is found which is called caruncle. Caruncle is carbohydrate in nature. This protects micropyle and develops as an integumental outgrowth after fertilization.Below seed coat a very thin membrane is found over kernel and called perisperm (the persistant nucellus).Below perisperm there is a large, white, swollen and oily mass called endsoperm.

63. (c) : Syconus develop from hypanthodium type of inflorescence. The flask shaped fleshy receptacle encloses female flower which produces small achene like fruitlets and has a small pore protected by scale leaves. Example : syconus of fig (*Ficus carica*).

64. (d) : Cypsella is a dry, one chambered, one seeded fruit developing from an inferior, bicarpellary ovary, *e.g.*, sunflower, marigold, cosmos, etc. *Caryopsis* or grain is a small, dry one seeded fruit developing from superior monocarpellary ovary. Pericarp fused with the seed coat, *e.g.*, rice, wheat, maize, etc. Cremocarp is a bilocular, two seeded fruit developing from an inferior bicarpellary ovary. It is characteristic fruit of umbelliferae, *e.g.*, Coriander, *Cuminum*, etc. Berry or bacca develops from mono or multicarpellary superior or inferior syncarpous ovary with axile or parietal placentation, *e.g.*, tomato, banana, brinjal, guava, grapes etc.

65. (d) : Replum is a false septum formed due to the ingrowth of parietal placenta. This makes the ovary bilocular. It is mainly seen in the ovary of flowers of Brassicaceae (Cruciferae) Family *e.g.*, mustard, candytuft etc.

66. (c) : In pomegranate, the whole fruit is covered by a hard rind made up of exocarp and a part of mesocarp. It develops from multilocular syncarpous inferior ovary. Mesocarp forms plate like infolding (*i.e.* chambered) and the seeds are covered by endocarp and contain bright red succulent testa.

67. (a) : During the process of the development of the embryo, the food stored up in the endosperm is continuously drawn up by the developing embryo and thus completely exhausted. Such seeds are known as exalbuminous or non-endospermic. The common examples are : exalbuminous – gram, pea, bean, tamarind, orchid, etc.

68. (d) : Casuarinaceae is the family of dicotyledonous flowering plants placed in the order Fagales. *Casuarina* is a member of the family, characterized by drooping equisteoid twigs, are evergreen, and monoecious or dioecious. The roots have nitrogen fixing nodules that contain the soil actinomycetes called *Frankia* which is filamentous bacteria.

69. (d) : A pentamerous actinomorphic flower is one where the floral parts are in multiples of five and the flower can be divided into two equal halves in more than one plane. Gynoecium is bicarpellary, syncarpous, forming a superior bilocular ovary. Each locule has many ovule on axile placentation. Members of solanaceae are characterised by the presence of an obliquely placed septum in the ovary and highly swollen placentae.

70. (d) : Pineapple is a sorosis type of fruit that develops from spike or spadix inflorescence. Here the flowers fuse by their succulent tepals and axis bearing the flowers becomes fleshy or woody, thus forming a compact mass. These are composite or multiple fruits. In pineapple fleshy axis, bracts, fused perianth and pericarp are edible.

71. (a) : In litchi, aril forms the edible part in fruit. It is a collar like out growth from the base of the ovule forming a kind of third integument. Aril is also found in *Asphodelus*, *Trianthema* and *Ulmus*.

Litchi is a nut. In litchi, the epicarp and mesocarp (layers of pericarp) together become leathery and the endocarp is membranous.

72. (c) : In maize the male inflorescence occupies the terminal position on the main axis, whereas the female inflorescence (ear or cob) is borne on modified lateral branches in the axils of leaves. The ear producing branch has short intenodes and bears a female spike at its apex. Each spikelet has a pair of small membranous glumes and two florets. The

feathery styles of the female florets are long and emerge out of the cobs to expose stigma for wind pollination.

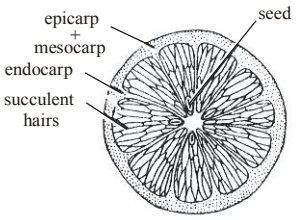
73. (d) : An annual plant is one that completes its life cycle in a single season *i.e.*, a seed germinates and the mature plant so produced dies, having produced seeds, within the season. Vivipary on the other hand is the phenomenon of germination of seed or spore in situ on mature plant even before it release.

It is not possible for annual plants because in these plants, the mature plant cannot store seeds as it dies after producing seeds.

74. (d) : *Refer to answer 71.*

75. (d) : Mango (*Mangifera indica*) of Family Anacardiaceae is a drupe. The edible part in mango is mesocarp.

76. (c) : Lemon is a hesperidium type of fruit. It is many chambered fleshy fruit developing from a multicarpellary, syncarpous, multilocular, superior ovary bearing seeds on axile placentation. The leathery epicarp of hesperidium has many glands of aromatic oil. The mesocarp, represented by white fibres, is fused to the epicarp. The epicarp and mesocarp together form the rind. The endocarp is thin and papery. It projects inwards and forms many compartments. The inner wall of endocarp gives out many juicy succulent hairs which form the edible part of the fruit. Hesperidium is a characteristic fruit of the rutaceae; *e.g.*, *Citrus aurantifolia* (lemon), *Citrus reticulata* (orange). etc.



Hesperidium of lemon

77. (b) : Peanut is geocarpic fruit.

78. (a) : *Refer to answer 75.*

79. (d) : Brinjal or *Solanum melongena* belongs to family solanaceae. The fruits are rich in iodine. They are used in the form of vegetable. Gynoecium is bicarpellary, syncarpous, forming a superior bilocular ovary. Each locule has many ovule on axile placentation. Members of Solanaceae are characterised by the presence of an obliquely placed septum in the ovary and highly swollen placentae. The oblique septum is probably due to shifting in the position of the ovary.

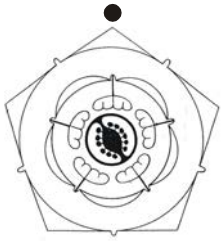


Fig. : Floral diagram of S*olanum nigrum.*

80. (a) : In tetradynamous condition there are six stamens, 4 are long and 2 are short *i.e.*, 4 + 2 arrangement of stamens. It is characterstic feature of Cruciferae members. In Liliaceae 6 stamens are arranged in whorls of 3 each (3 + 3). In Solanaceae there are 5 stamens they are epipetallous and polyandrous. In Malvaceae there are numerous stamens that are monadelphous.

81. (a) : Usually the stomata are placed at the same level as the adjoining epidermal cells (*e.g.*, *Helianthus*, *Mangifera*). In xerophytes the stomata are sunken as they are located in a cup-shaped depression (*e.g.*, *Nerium*). It is an adaptation to reduce the loss of water in xerophytic plants.

82. (a) : A tuber is the swollen tip of the underground branch. Tubers are round or oval in shape. Each tuber has many notches on the surface called 'eyes'. These are in fact axillary buds which grow into new plants during favourable conditions. Unlike other underground stems, tubers do not give off adventitious roots; *e.g.*, *Solanum tuberosum* (potato).

83. (c) : Banana is a berry. It develops from monocarpellary or multicarpellary syncarpous ovary. Epicarp makes the rind of the fruit, mesocarp is fleshy and endocarp is thin and membranous. The edible portion of banana is endocarp and less developed mesocarp.

84. (d)

85. (b) : Malvaceae is also known as cotton family or mallow family. The plants of this family are cosmopolitan in distribution, although more common in tropical (warm) regions. *Gossypium* (cotton) is an important genera of this family.

Sunflower belongs to family Compositae. Wheat belong to family Poaceae. Catechu belongs to family Mimosaceae.

86. (a) : These special roots, called pneumatophores or knees, develop in mangrove plants, *i.e.*, plants growing in saline marshes. These roots grow vertically

upward and are negatively geotropic. Air enters these roots through minute breathing pores called pneumathodes, present on the tips of vertical roots. These plants include *Rhizophora*, *Heritiera*, *Avicinnia*, etc., and are found in Sundarbans of West Bengal.

87. (a) : In maize style is very long. It comes out of the cob to expose stigma for wind pollination. These are collectively known as silk.

88. (c) : Groundnut is geocarpic fruit.

89. (a) : *Rafflesia* is a specialised total root parasite as the vegetative parts of its body are reduced and the whole body is within the host root and only structure which is visible outside, is the biggest flower. The diameter of the flower is one meter and its weight is about 10 kg. Its pollination is done by elephant. The flowers are fleshy white and they emit smell, which resembles the smell of decaying meat.

90. (d) : Clinging roots arise from the nodes of stem and penetrate the stem of the host plant. It helps in fixing the plant to the host. It is found in orchids. Orchids bear three types of roots - clinging roots for fixation, absorbing roots for absorbing mineral salts and water and epiphytic roots for absorbing moisture from air.

91. (b) : Floral features are used to identify because reproductive parts are more stable and conservative than vegetative parts.

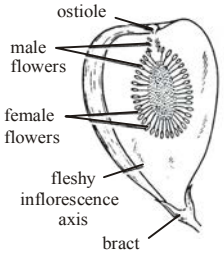
92. (d) : Development of fruits without fertilization is called parthenocarpy and such fruits are called parthenocarpic fruits.

Since in pomegranate juicy testa is the edible part and parthenocarpy will make the fruit seedless and hence they will be useless.

93. (a) : A fruit is a ripened ovary. On the basis of the formation of fruits, they are classified into two types - true fruits and false fruits. True fruits are developed from the ovary only. Banana is a fleshy fruit - berry. It develops from multicarpellary syncarpous superior or inferior ovary. The pericarp of berries is differentiated into epicarp, mesocarp and endocarp (like drupes) but the endocarp is not stony as in drupes. Apple and pear are pome. Pome is a false fruit in which the edible part is thalamus where the true fruit remains embedded. Fig is a composite fruit. These fruits are the products of the whole inflorescence together with its component parts.

94. (a) : In angiosperms, seeds are produced inside the ripened ovary called fruit. However in gymnosperms the seeds are not produced inside a fruit. In angiosperms vascular tissue includes both tracheids and vessels and in gymnosperms the vascular tissue contains only tracheids and not vessels. Tap root is the primary root that develops from the radicle. It forms lateral branches which are further branched to form tertiary roots. These are generally found in dicotyledons. In monocotyledons, primary root is short lived, tap root is absent and adventitious roots are found. The given description is about angiospermic dicot.

95. (b) : Inflorescence is the cluster of flowers or arrangement of flowers on the floral axis. Hypanthodium is the characterstic inflorescence of *Ficus* (Family Moraceae). Here a cup-shaped cavity with an apical opening or ostiole is formed by a fleshy receptacle, which is guarded by inwardly projecting hairs and bear flowers on the iner wall of the cavity, *i.e.*, female (♀) flowers at the base and male (♂) flowers above.



Hypanthodium (longitudinal section)

96. (a) : Pulses are obtained from Fabaceae. Pulses are very economically as well as nutritionally very important for human beings.

97. (a) : Epipetalous stamens with free filaments and fused anthers occur in Asteraceae. Asteraceae possess five stamens with free filaments. This family shows syngenesious condition in which anthers are united forming a tube around the style.

98. (d) : *Refer to answer 58.*

99. (a) : Botanical name of cauliflower is *Brassica oleracea* belongs to variety capitata. Family of cauliflower is Cruciferae.

100. (b) : *Refer to answer 57.*

101. (d) : Syngenesious condition is found in Asteraceae. It is the condition when stamens are united by their anthers (filaments free). Epipetalous condition is also seen here.

102. (b) : *Refer to answer 64.*

103. (b) : A family delimited by type of inflorescence is Asteraceae. Asteraceae possess head or capitulum inflorescence, which is racemose and is surrounded by an involucre of bracts.

104. (a) : *Refer to answer 98.*

105. (c) : Vegetative reproduction in *Agave* occurs through bulbils. Bulbils are the specialised buds vegetative or floral that modify into a swollen structure. It seperates from the parent plant and on approach of favourable condition gives rise to new plant.

106. (d) : Velamen is found in aerial roots of orchids. In many epiphytic orchids, the aerial roots are covered by a hygroscopic velamen tissue. They absorb water from the atmosphere.

107. (d) : In groundnut the food/oil reserve is present in cotyledons. It is very important commercial crop of Leguminosae.

108. (c) : Outer protective covering of seed is called seed coat which develops from integuments of ovules. The seeds developing from bitegmic ovule have two layers. The outer layer is called testa and inner layer or tegmen develops from inner integuments.

109. (b) : *Refer to answer 107.*

110. (b) : Suckers are the sub-aerial modification of stem. They grow obliquely upward from the main stem producing roots from the underground nodes. The sucker like structures in banana are also called sword suckers, which give rise to new leafy trunk.

111. (b) : *Refer to answer 75.*

112. (a) : Coconut (*Cocos nucifera*) is commercial fibres yielding crop. Fibres originate from the upper epidermal surface of seed.

113. (c) : Micropyle of seed is involved in the passage of water. Micropyle plays an very important role in absorbing water during the time of germination.

114. (a) : Fruit of groundnut is legume. It is developed from monocarpellary ovary but dehisces by both sutures from apex downward.

Chapter 6

Anatomy of Flowering Plants

1. The vascular cambium normally gives rise to
(a) primary phloem (b) secondary xylem
(c) periderm (d) phelloderm.
(NEET 2017)

2. Root hair develop from the region of
(a) elongation (b) root cap
(c) meristematic activity
(d) maturation. *(NEET 2017)*

3. Which of the following is made up of dead cells?
(a) Collenchyma (b) Phellem
(c) Phloem
(d) Xylem parenchyma *(NEET 2017)*

4. Identify the wrong statement in context of heartwood.
(a) It is highly durable.
(b) It conducts water and minerals efficiently.
(c) It comprises dead elements with highly lignified walls.
(d) Organic compounds are deposited in it.
(NEET 2017)

5. Cortex is the region found between
(a) epidermis and stele
(b) pericycle and endodermis
(c) endodermis and pith
(d) endodermis and vascular bundle.
(NEET-II 2016)

6. The balloon-shaped structures called tyloses
(a) originate in the lumen of vessels
(b) characterise the sapwood
(c) are extensions of xylem parenchyma cells into vessels
(d) are linked to the ascent of sap through xylem vessels. *(NEET-II 2016)*

7. Specialised epidermal cells surrounding the guard cells are called
(a) bulliform cells
(b) lenticels
(c) complementary cells
(d) subsidiary cells. *(NEET-I 2016)*

8. Read the different components from (i) to (iv) in the list given below and tell the correct order of the components with reference to their arrangement from outer side to inner side in a woody dicot stem.
(i) Secondary cortex (ii) Wood
(iii) Secondary phloem (iv) Phellem
The correct order is
(a) (iv), (i), (iii), (ii) (b) (iv), (iii), (i), (ii)
(c) (iii), (iv), (ii), (i) (d) (i), (ii), (iv), (iii).
(2015)

9. A major characteristic of monocot root is the presence of
(a) vasculature without cambium
(b) cambium sandwiched between phloem and xylem along the radius
(c) open vascular bundles
(d) scattered vascular bundles.
(2015 Cancelled)

10. Vascular bundles in monocotyledons are considered closed because
(a) there are no vessels with perforations
(b) xylem is surrounded all around by phloem
(c) a bundle sheath surrounds each bundle
(d) cambium is absent.
(2015 Cancelled)

11. You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will you use to distinguish between the two?
(a) Secondary xylem
(b) Secondary phloem
(c) Protoxylem
(d) Cortical cells *(2014)*

12. Tracheids differ from other tracheary elements in
(a) having casparian strips
(b) being imperforate
(c) lacking nucleus
(d) being lignified. *(2014)*

13. Lenticels are involved in
(a) food transport (b) photosynthesis
(c) transpiration (d) gaseous exchange.
(NEET 2013)

14. Age of a tree can be estimated by
(a) number of annual rings
(b) diameter of its heartwood
(c) its height and girth
(d) biomass. *(NEET 2013)*

15. Interfascicular cambium develops from the cells of
(a) endodermis
(b) pericycle
(c) medullary rays
(d) xylem parenchyma. *(NEET 2013)*

16. Meristematic tissue responsible for increase in girth of tree trunk is
(a) intercalary meristem
(b) lateral meristem
(c) phellogen
(d) apical meristem.
(Karnataka NEET 2013)

17. Bundle sheath cells
(a) are rich in PEP carboxylase
(b) lack RuBisCO
(c) lack both RuBisCO and PEP carboxylase
(d) are rich in RuBisCO.
(Karnataka NEET 2013)

18. Which of the following statements is not true for stomatal apparatus?
(a) Guard cells invariably possess chloroplasts and mitochondria.
(b) Guard cells are always surrounded by subsidiary cells.
(c) Stomata are involved in gaseous exchange.
(d) Inner wall of guard cells are thick.
(Karnataka NEET 2013)

19. Gymnosperms are also called soft wood spermatophytes because they lack
(a) cambium
(b) phloem fibres
(c) thick-walled tracheids
(d) xylem fibres. *(2012)*

20. Water containing cavities in vascular bundles are found in
(a) sunflower (b) maize
(c) *Cycas* (d) *Pinus*. *(2012)*

21. Closed vascular bundles lack
(a) ground tissue
(b) conjunctive tissue
(c) cambium
(d) pith. *(2012)*

22. Companion cells are closely associated with
(a) sieve elements (b) vessel elements
(c) trichomes (d) guard cells.
(2012)

23. The common bottle cork is a product of
(a) dermatogen
(b) phellogen
(c) xylem
(d) vascular cambium. *(2012)*

24. As compared to a dicot root, a monocot root has
(a) more abundant secondary xylem
(b) many xylem bundles
(c) inconspicuous annual rings
(d) relatively thicker periderm. *(Mains 2012)*

25. The cork cambium, cork and secondary cortex are collectively called
(a) phelloderm (b) phellogen
(c) periderm (d) phellem.
(2011)

26. Ground tissue includes
(a) all tissues external to endodermis
(b) all tissues except epidermis and vascular bundles
(c) epidermis and cortex
(d) all tissues internal to endodermis.
(2011)

27. Some vascular bundles are described as open because these
(a) are surrounded by pericycle but no endodermis
(b) are capable of producing secondary xylem and phloem
(c) possess conjunctive tissue between xylem and phloem
(d) are not surrounded by pericycle.
(Mains 2011)

28. Function of companion cells is
(a) providing energy to sieve elements for active transport
(b) providing water to phloem
(c) loading of sucrose into sieve elements by passive transport
(d) loading of sucrose into sieve elements.
(Mains 2011)

29. Heartwood differs from sapwood in
(a) presence of rays and fibres
(b) absence of vessels and parenchyma
(c) having dead and non-conducting elements
(d) being susceptible to pests and pathogens.
(2010)

30. Which one of the following is not a lateral meristem?
(a) Intrafascicular cambium
(b) Interfascicular cambium
(c) Phellogen
(d) Intercalary meristem *(2010)*

31. The chief water conducting elements of xylem in gymnosperms are
(a) vessels
(b) fibres
(c) transfusion tissue
(d) tracheids. *(2010)*

32. Transport of food material in higher plants takes place through
(a) companion cells (b) transfusion tissue
(c) tracheids (d) sieve elements.
(Mains 2010)

33. In barley stem vascular bundles are
(a) closed and scattered
(b) open and in a ring
(c) closed and radial
(d) open and scattered. *(2009)*

34. Palisade parenchyma is absent in leaves of
(a) mustard (b) soybean
(c) gram (d) *Sorghum*.
(2009)

35. The annular and spirally thickened conducting elements generally develop in the protoxylem when the root or stem is
(a) elongating (b) widening
(c) differentiating (d) maturing.
(2009)

36. Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by
(a) absence of secondary phloem
(b) presence of cortex
(c) position of protoxylem
(d) absence of secondary xylem.
(2009)

37. Vascular tissues in flowering plants develop from
(a) periblem (b) dermatogen
(c) phellogen (d) plerome.
(2008)

38. The length of different internodes in a culm of sugarcane is variable because of
(a) size of leaf lamina at the node below each internode
(b) intercalary meristem
(c) shoot apical meristem
(d) position of axillary buds. *(2008)*

39. Passage cells are thin walled cells found in
(a) phloem elements that serve as entry points for substance for transport to other plant parts
(b) testa of seeds to enable emergence of growing embryonic axis during seed germination
(c) central region of style through which the pollen tube grows towards the ovary
(d) endodermis of roots facilitating rapid transport of water from cortex to pericycle.
(2007)

40. For a critical study of secondary growth in plants, which one of the following pairs is suitable?
(a) Teak and pine
(b) Deodar and fern
(c) Wheat and maiden hair fern
(d) Sugarcane and sunflower *(2007)*

41. A common structural feature of vessel elements and sieve tube elements is
(a) enucleate condition
(b) thick secondary walls
(c) pores on lateral walls
(d) presence of P-protein. *(2006)*

42. In a woody dicotyledonous tree, which of the following parts will mainly consist of primary tissues?
(a) All parts
(b) Stem and root
(c) Flowers, fruits and leaves
(d) Shoot tips and root tips *(2005)*

43. In a longitudinal section of a root, starting from the tip upward, the four zones occur in the following order:
(a) root cap, cell division, cell enlargement, cell maturation
(b) root cap, cell division, cell maturation, cell enlargement

(c) cell division, cell enlargement, cell maturation, root cap
(d) cell division, cell maturation, cell enlargement, root cap *(2004)*

44. The apical meristem of the root is present
(a) only in radicals
(b) only in tap roots
(c) only in adventitious roots
(d) in all the roots. *(2003)*

45. In which one of the following is nitrogen not a constituent ?
(a) Idioblast
(b) Bacteriochlorophyll
(c) Invertase
(d) Pepsin *(2003)*

46. The aleurone layer in maize grain is specially rich in
(a) proteins (b) starch
(c) lipids (d) auxins. *(2003)*

47. Chlorenchyma is known to develop in the
(a) cytoplasm of *Chlorella*
(b) mycelium of a green mould such as *Aspergillus*
(c) spore capsule of a moss
(d) pollen tube of *Pinus*. *(2003)*

48. Diffuse porous woods are characteristic of plants growing in
(a) alpine region
(b) cold winter regions
(c) temperature climate
(d) tropics. *(2003)*

49. The cells of the quiescent centre are characterised by
(a) having dense cytoplasm and prominent nuclei
(b) having light cytoplasm and small nuclei
(c) dividing regularly to add to the corpus
(d) dividing regularly to add to tunica. *(2003)*

50. Which of the following statements is true?
(a) Vessels are multicellular with wide lumen.
(b) Tracheids are multicellular with narrow lumen.
(c) Vessels are unicellular with narrow lumen.
(d) Tracheids are unicellular with wide lumen. *(2002)*

51. Axillary bud and terminal bud derived from the activity of
(a) lateral meristem
(b) intercalary meristem
(c) apical meristem
(d) parenchyma. *(2002)*

52. Four radial vascular bundle are found in
(a) dicot root (b) monocot root
(c) dicot stem (d) monocot stem. *(2002)*

53. Vessels are found in
(a) all angiosperms and some gymnosperm
(b) most of angiosperms and few gymnosperms
(c) all angiosperms, all gymnosperms and some pteridophyta
(d) all pteridophyta. *(2002)*

54. In plants inulin and pectin are
(a) reserved material
(b) wastes
(c) excretory material
(d) insect attracting material. *(2001)*

55. What happens in plants during vascularisation?
(a) Differentiation of procambium, formation of primary phloem followed by formation of primary xylem
(b) Differentiation of procambium followed by the formation of primary phloem and xylem simultaneously
(c) Formation of procambium, primary phloem and xylem simultaneously
(d) Differentiation of procambium followed by the formation of secondary xylem *(2000)*

56. Casparian strips are found in
(a) epidermis (b) hypodermis
(c) periderm (d) endodermis. *(1999)*

57. Which of the following meristems is responsible for extrastelar secondary growth in dicotyledonous stem?
(a) Interfascicular cambium
(b) Intercalary meristem
(c) Phellogen
(d) Intrafascicular cambium *(1998)*

58. The periderm includes
(a) secondary phloem (b) cork
(c) cambium (d) all of these. *(1998)*

59. At maturity, which of the following is non-nucleated?
(a) Palisade cell (b) Cortical cell
(c) Sieve cell (d) Companion cell *(1997)*

60. Which of the following is not true about 'sclereids'?
(a) These are groups of living cells.
(b) These are found in nut shells, guava pulp, pear.
(c) These are also called stone cells.
(d) These are form of sclerenchyma with fibres. *(1996)*

61. Casparian strip occurs in a
(a) endodermis (b) exodermis
(c) pericycle (d) epidermis. *(1994)*

62. As a tree grows older, which of the following increases more rapidly in thickness?
(a) Heart wood (b) Sap wood
(c) Phloem (d) Cortex *(1994)*

63. Where do the casparian bands occur?
(a) Epidermis (b) Endodermis
(c) Pericycle (d) Phloem *(1994, 1990)*

64. Which of the following plant cells will show totipotency?
(a) Sieve tubes (b) Xylem vessels
(c) Meristem (d) Cork cells *(1993)*

65. Periderm is produced by
(a) vascular cambium
(b) fascicular cambium
(c) phellogen
(d) intrafascicular cambium. *(1993)*

66. A narrow layer of thin walled cells found between phloem/bark and wood of a dicot is
(a) cork cambium
(b) vascular cambium
(c) endodermis
(d) pericycle. *(1993)*

67. Which exposed wood will decay faster?
(a) Sapwood
(b) Softwood
(c) Wood with lot of fibres
(d) Heartwood *(1993)*

68. Abnormal/anomalous secondary growth occurs in
(a) *Dracaena* (b) ginger
(c) wheat (d) sunflower. *(1993)*

69. Bordered pits are found in
(a) sieve cells (b) vessel wall
(c) companion cells (d) sieve tube wall. *(1993)*

70. A bicollateral vascular bundle is characterised by
(a) phloem being sandwitched between xylem
(b) transverse splitting of vascular bundle
(c) longitudinal splitting of vascular bundle
(d) xylem being sandwitched between phloem. *(1992)*

71. Vascular cambium produces
(a) primary xylem and primary phloem
(b) secondary xylem and secondary phloem
(c) primary xylem and secondary phloem
(d) secondary xylem and primary phloem. *(1992, 1990)*

72. What is true about a monocot leaf?
(a) Reticulate venation
(b) Absence of bulliform cells from epidermis
(c) Mesophyll not differentiated into palisade and spongy tissues
(d) Well differentiated mesophyll *(1992, 1990)*

73. Which is correct about transport of conduction of substances?
(a) Organic food moves up through phloem
(b) Organic food moves up through xylem
(c) Inorganic food moves upwardly and downwardly through xylem
(d) Organic food moves upwardly and downwardly through phloem *(1991)*

74. An organised and differentiated cellular structure having cytoplasm but no nucleus is
(a) vessels
(b) xylem parenchyma
(c) sieve tubes
(d) tracheids. *(1991)*

75. Angular collenchyma occurs in
(a) *Cucurbita* (b) *Helianthus*
(c) *Althaea* (d) *Salvia*. *(1991)*

76. For union between stock and scion in grafting which one is the first to occur
(a) formation of callus
(b) production of plasmodesmata
(c) differentiation of new vascular tissues
(d) regeneration of cortex and epidermis. *(1990)*

77. Pericycle of roots produces
(a) mechanical support
(b) lateral roots
(c) vascular bundles
(d) adventitious buds. *(1990)*

78. Collenchyma occurs is
(a) herbaceous climbers
(b) woody climbers
(c) climbing stems
(d) water plants. *(1990)*

79. Collenchyma occurs in the stem and petioles of
(a) xerophytes (b) monocots
(c) dicot herbs (d) hydrophytes. *(1990)*

80. Monocot leaves possess
(a) intercalary meristem
(b) lateral meristem
(c) apical meristem
(d) mass meristem. *(1990)*

81. Cork cambium and vascular cambium are
(a) parts of secondary xylem and phloem
(b) parts of pericycle
(c) lateral meristem
(d) apical meristem. *(1990)*

82. Out of diffuse porous and ring porous woods, which is correct?
(a) Ring porous wood carries more water for short period.
(b) Diffuse porous wood carries more water.
(c) Ring porous wood carries more water when need is higher.
(d) Diffuse porous wood is less specialised but conducts water rapidly throughout. *(1989)*

83. Sieve tubes are suited for translocation of food because they possess
(a) bordered pits
(b) no ends walls
(c) broader lumen and perforated cross walls
(d) no protoplasm. *(1989)*

84. Death of protoplasm is a pre-requisite for a vital function like
(a) transport of sap
(b) transport of food
(c) absorption of water
(d) gaseous exchange. *(1989)*

85. Organisation of stem apex into corpus and tunica is determined mainly by
(a) planes of cell division
(b) regions of meristematic activity
(c) rate of cell growth
(d) rate of shoot tip growth. *(1988)*

86. Pith and cortex do not differentiate in
(a) monocot stem (b) dicot stem
(c) monocot root (d) dicot root. *(1988)*

87. Cork is formed from
(a) cork cambium (phellogen)
(b) vascular cambium
(c) phloem
(d) xylem. *(1988)*

88. Which meristem helps in increasing girth?
(a) Lateral meristem
(b) Intercalary meristem
(c) Primary meristem
(d) Apical meristem *(1988)*

89. Tunica corpus theory is connected with
(a) root apex
(b) root cap
(c) shoot apex
(d) secondary growth. *(1988)*

Answer Key

1.	(b)	**2.**	(d)	**3.**	(b)	**4.**	(b)	**5.**	(a)	**6.**	(c)	**7.**	(d)	**8.**	(a)	**9.**	(a)	**10.**	(d)
11.	(c)	**12.**	(b)	**13.**	(d)	**14.**	(a)	**15.**	(c)	**16.**	(b)	**17.**	(d)	**18.**	(b)	**19.**	(d)	**20.**	(b)
21.	(c)	**22.**	(a)	**23.**	(b)	**24.**	(b)	**25.**	(c)	**26.**	(b)	**27.**	(b)	**28.**	(d)	**29.**	(c)	**30.**	(d)
31.	(d)	**32.**	(d)	**33.**	(a)	**34.**	(d)	**35.**	(c)	**36.**	(c)	**37.**	(d)	**38.**	(b)	**39.**	(d)	**40.**	(a)
41.	(a)	**42.**	(c)	**43.**	(a)	**44.**	(d)	**45.**	(a)	**46.**	(a)	**47.**	(c)	**48.**	(d)	**49.**	(b)	**50.**	(d)
51.	(c)	**52.**	(a)	**53.**	(b)	**54.**	(a)	**55.**	(b)	**56.**	(d)	**57.**	(c)	**58.**	(b)	**59.**	(c)	**60.**	(a)
61.	(a)	**62.**	(a)	**63.**	(b)	**64.**	(c)	**65.**	(c)	**66.**	(b)	**67.**	(a)	**68.**	(a)	**69.**	(b)	**70.**	(d)
71.	(b)	**72.**	(c)	**73.**	(d)	**74.**	(c)	**75.**	(a)	**76.**	(a)	**77.**	(b)	**78.**	(c)	**79.**	(c)	**80.**	(a)
81.	(c)	**82.**	(c)	**83.**	(c)	**84.**	(a)	**85.**	(a)	**86.**	(a)	**87.**	(a)	**88.**	(a)	**89.**	(c)		

EXPLANATIONS

1. (b) : Cells of vascular cambium divide periclinally both on the outer and inner sides to form secondary permanent tissues, *i.e.,* secondary xylem and secondary phloem.

2. (d) : Root hair are lateral tubular outgrowths that develop from the outer cells of zone of maturation or root hair zone.

3. (b) : The phellem or cork consists of dead and compactly arranged rectangular cells that possess suberised cell wall.

4. (b) : Heartwood is the non-functional part of secondary xylem, hence, it does not conduct water and minerals.

5. (a)

6. (c) : Tyloses are balloon-like extensions of parenchyma cells that protrudes into the lumen of a neighbouring xylem vessel or tracheid through a pit in the cell wall. Tyloses form most commonly in older woody tissue, possibly in response to injury, they may eventually block the vessels and thus help prevent the spread of fungi and other pathogens within the plant. Tyloses may become filled with tannins, gums, pigments, etc., giving heartwood its dark colour, and their walls can remain thin or become lignified.

7. (d) : The leaf and stem epidermis of plant is covered with pores called stomata. Each stomata is surrounded by a pair of specialised epidermal cells known as guard cells which are in some cases further surrounded by another category of less modified epidermal cells known as subsidiary cells which provide support to the guard cells.

8. (a) : In a woody dicot stem, phellem (cork) forms the outermost layer followed by phellogen and then secondary cortex (phelloderm). Secondary phloem forms a narrow circle on the outer side of vascular cambium whereas secondary xylem occurs on the inner side of vascular cambium.

9. (a) : In monocot root, a large number of vascular bundles are arranged in the form of a ring around the central pith. Vascular bundles are closed because there is no cambium present between the xylem and phloem.

10. (d)

11. (c) : In stems, the protoxylem lies towards the centre (pith) and the metaxylem lies towards the periphery. This type of primary xylem is called endarch. In root, the protoxylem lies towards periphery and metaxylem lies towards the centre, such arrangement is called exarch.

12. (b) : Tracheids are elongated, dead cells with hard lignified walls, wide lumens and narrow walls with spiral, annular, reticulate, scalariform and pitted thickening but without perforated end walls of septa. That is, they have intact end walls unlike vessels. Vessels are long cylindrical tube like structures made of many cells, called vessel members, each with lignified walls and a large central cavity. Vessel members are interconnected through perforation in their common walls.

13. (d) : Lenticels are lens shaped openings formed in bark due to secondary growth. They permit gaseous exchange in woody trees. They also contribute to transpiration but in minute amounts because the suberised complementary cells present beneath the pore prevent excessive water loss.

14. (a) : Two bands of secondary xylem *i.e*., autumn wood and spring wood are produced in one year. These two bands make an annual ring. The age of plant can be determined by counting the annual rings. It is called dendrochronolgy.

15. (c) : In dicot stems, the cells of cambium present between primary xylem and primary phloem is the intrasfascicular cambium. The cells of medullary rays, adjoining these intrafascicular cambium become meristematic and form the interfascicular cambium. Thus, a continuous ring of cambium is formed.

16. (b): Lateral meristems are the meristems which are present along the lateral sides of stem and roots. They divide only in radial direction. Intrastelar or vascular cambium ring formed by intra-fascicular (also called fascicular) and inter-fascicular cambium; and cork cambium (phellogen) are examples of this type of meristem. These meristems are responsible for increase in girth of stem and roots.

17. (d): C_4 plants show kranz type of anatomy. In kranz anatomy, the mesophyll is undifferentiated and its cells occur in concentric layers around vascular bundles. The vascular bundles are surrounded by large sized bundle sheath cells which are arranged in wreath like manner in one to several layers. In C_4 plants there are two carboxylation reactions, first in mesophyll chloroplast and second in bundle sheath chloroplast. RuBP is present in bundle sheath chloroplasts where C_3 cycle takes place.

18. (b) : The epidermal surface of the leaf exhibits 1,000 to 60,000 minute openings called stomata. The stomata are bordered by two specialized epidermal cells - the guard cells which in some cases are accompanied by subsidiary cells. The walls of guard cells are unevenly thickened. Each guard cell has thick, inelastic inner wall and thin, elastic outer wall. Stomatal aperture is present in between the guard cells. Guard cells are not always surrounded by accessory cells or subsidiary cells.

19. (d) **20. (b)**

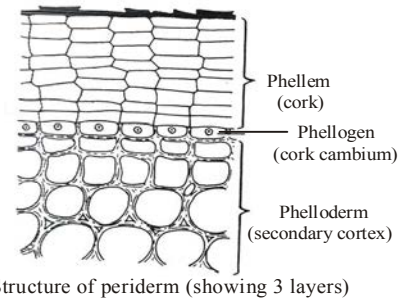
21. (c) : Vascular bundle consists of complex tissues, the phloem and xylem. In dicots, between xylem and phloem, cambium is present which helps in secondary growth. This type of vascular bundle is called open. While in monocots cambium is absent, so these are called closed vascular bundles.

22. (a) : Companion cell is a type of cell found within the phloem of flowering plants. Each companion cell is usually closely associated with a sieve element. They remain connected with sieve cells by plasmodesmata. They help in loading of phloem sieve cells with sugars through active transport.

23. (b) : Cork cambium or phellogen is a type of cambium arising within the outer layer of the stems of woody plants, usually as a complete ring surrounding the inner tissues. The cells of the cork cambium divide to produce an outer corky tissue (cork or phellem) and an inner secondary cortex (phelloderm). The common bottle cork produced from *Quercus suber* is a product of phellogen.

24. (b) : In monocot root, secondary growth is absent and vascular cylinder is in the form of several alternate and radial xylem and phloem bundles. The vascular bundles are arranged in the form of ring around central pith. Their number in maize ranges between 20 – 30 whereas in *Pandanus* and palms, they may be upto 100. Because of the presence of numerous xylem bundles and exarch condition, xylem of monocot root is polyarch. On the other hand, in dicot root, xylem and phloem are equal in number (2 – 6) and alternately arranged *i.e.*, they lie on different radii hence called radial bundles. According to number of ray (equivalent to number of xylem or phloem bundles) the roots may be diarch, triarch, tetrarch, pentarch or hexarch.

25. (c) : In hypodermis or outer cortical cells, a layer becomes meristematic which is known as cork cambium or phellogen. This phellogen also cuts off cells both on its outer side and inner side. The cells cut off on outer side are phellem or cork cells and cells cut off on inner side are phelloderm or secondary cortex. Phellem, phellogen and phelloderm collectively constitute periderm.



Structure of periderm (showing 3 layers)

The function of periderm is protective (because at maturity epidermis ruptures and hence the function is performed by periderm).

26. (b) : Ground tissue can be defined as all the tissues except epidermis and vascular bundles. Ground tissue constitutes the interior of organs except vascular system. It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma. Parenchymatous cells are usually present in cortex, pericycle, pith and medullary rays, in the primary stems and roots. Ground tissue system of the leaves is called mesophyll.

27. (b) : In dicot stem, cambium is present between xylem and phloem, such vascular bundles are called open. In monocot stem, the cambium is absent, such vascular bundles are called closed.
Cambium are the meristematic cells which produces secondary xylem and phloem.

28. (d) : Companion cells move sugar and amino acids into and out of the sieve elements. In "source" tissue such as leaf companion cells use transmembrane proteins to take up sugar and amino acids by active transport. Movement of sugars in the phloem begins at the source, where sugars are loaded (actively transported) into a seive tube. Loading sets up a water potential gradient that facilitates movement of sugar.

29. (c) : In old trees, the greater part of secondary xylem is dark brown due to deposition of organic compounds like tannins, resins, oils, gums, aromatic substances and essential oils in the central or innermost layers of the stem. These substances make it hard, durable and resistant to the attacks of micro-organisms and insects. This region comprises dead elements with highly lignified walls and is called heartwood. The heartwood does not conduct water

but it gives mechanical support to the stem. The peripheral region of the secondary xylem, is higher in colour and is known as the sapwood. It is involved in the conduction of water and minerals from root to leaf.

30. (d) : Meristem is classified on the basis of position in plant bodies into lateral meristem, apical meristem and intercalary meristem. Lateral meristem is present on the lateral sides, *e.g.*, vascular cambium (fascicular and interfascicular cambium) and cork cambium (phellogen).

31. (d) : The chief water conducting elements of xylem in gymnosperms are tracheids. These are elongated cells with tapering ends and are dead because of deposition of lignin. These show scalariform, annular, reticulate or bordered pitted thickening. These are the only water conducting xylem elements in both gymnosperm and pteridophytes. Generally vessels are absent in gymnosperm with exceptions like *Gnetum*, *Welwitschia*, *Ephedra*.

32. (d)

33. (a) : Barley is a monocotyledonous plant. The vascular bundle of stem is conjoint,collateral,exarch and closed (because cambium is absent). It is also scattered throughout the ground tissue.

34. (d) : Palisade parenchyma is absent in leaves of *Sorghum*. It is a monocot plant where the parenchyma tissues of the leaves are not differentiated into palisade and spongy.

35. (c) : The protoxylem differentiates in the parts of the primary body that have not completed their growth and differentiation. In fact in the shoot, the protoxylem matures among actively elongating tissues and is, therefore subjected to stresses. In the root, the protoxylem elements persist longer because here they mature beyond the region of maximum growth. In this differentiation annular and spiral thickening take place.

36. (c) : In dicot root the protoxylem is located near the periphery of the vascular cylinder, the metaxylem farther inward. In roots xylem is exarch or centripetal. In dicot stem the protoxylem is located near the centre of vascular bundle and metaxylem is located near the periphery *i.e.,* the xylem is endarch or centrifugal.

37. (d) : Dermatogen is the region or histogen of single layer of outermost cells formed from the apical meristem. Dermatogen gives rise to epidermis of stem and other aerial parts. Periblem is the middle histogen which forms the cortex of stem and roots. Plerome is the central histogen which forms stele or part of stem and root inner to endodermis. Part of plerome that forms vascular tissues is called procambium. The pericycle layer converts into a secondary meristem called cork cambium or phellogen which divides to form secondary cortex or phelloderm.

38. (b) : Internode is the part of a plant stem, that occurs between two adjacent nodes. Intercalary meristem are internodal in position and is found in the stem of grasses and other monocotyledonous plants. In early stages the internode is wholly or partially meristematic but later on some of its parts become matured more rapidly than the rest so a definite continuous sequence of development is maintained *i.e.*, mature tissue left behind whereas new ones grow which later shows variable length.

39. (d) : Endodermis is a single layered structure which separates cortex from stele. There are both thick walled and thin walled cells in the endodermis. The thin walled cells are known as passage cells or transfusion cells which are opposite the protoxylem groups. These cells help in rapid transport of water from cortex to pericycle.

40. (a) : Secondary growth is observed in dicots and gymnosperm. It is not observed in pteridophytes and rarely observed in monocots. Secondary growth results in increase in girth or diameter of the stem by formation of secondary tissue by the activity of lateral meristem. So for study of secondary growth, teak (angiosperm) and pine (gymnosperm) are best suited.

41. (a) : Xylem is the principal water conducting tissue of the plant. It consists of four types of cells-tracheids, vessels, xylem fibres and xylem parenchyma.

Xylem vessels are hollow, elongated cells with open ends and pitted walls. Cells walls are lignified. At maturity nucleus is absent in vessels.

The constituent cells of the phloem are sieve elements (sieve cells, sieve tubes), companion cells, phloem fibres and phloem parenchyma cells.

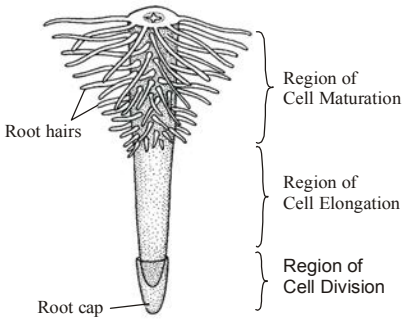
Sieve tube members are long, slender, tube-like cells joined end to end, to form long tubular channels – the sieve tubes. Sieve tube members possess specialized sieve areas on the end walls called sieve plate. Young sieve tube members have abundant cytoplasm but their is no nucleus. The nucleus disintegrates during their development.

42. (c) : The tissues which develop from apical meristem and procambium are known as primary tissues and these constitute the primary structures of the plant body. The development of the primary tissues causes the stem to grow in length and to some extent

in thickness. Stem and root in dicotyledons show secondary growth as they have development of secondary vascular tissues (*i.e.*, secondary xylem and secondary phloem) in them. Flowers, fruits and leaves are primary tissues.

43. (a) : The root system of a plant develops from the hypocotyl of the embryo of a seed.

The root shows following four regions these usually merge into one another, without distinct boundaries between them.



Regions of the root

The zones, successively from the apex to the base are–

(i) Root cap zone : The apex of each root is covered by a cushion of thin walled cells known as root cap.

(ii) Region of cell division : It lies just behind the root cap. It is the main growing region of the root where active cell divisions take place.

(iii) Region of elongation : The region of elongation is responsible for growth in length of the root.

(iv) Region of maturation : Epidermal cells of this region give out small, thin, cylindrical unicellular outgrowths, known as root hairs. These are the main absorbing organs of the root.

44. (d) : Parts of typical root : root cap, meristematic growing region, zone of elongation, root hair zone, zone of meriste-matic cells.

Apical meristem is terminal in position and responsible for terminal growth of the plant. Apical meristem is present at all root tips and shoot tips.

45. (a) : The major storage component of Avocado fruit is oil. It is stored in specialized mesocarp cells called idioblast.

46. (a) : In monocotyledons the seeds are generally endospermous. The internal structure of grain can be studied in a longitudinal section. It shows two distinct regions upper large region, the endosperm and lower smaller region, the embryo. The endosperm is surrounded by a special one cell thick layer, called aleurone layer. It is filled with aleurone grains which are proteinaceous in nature. Other components of this layer are phytin, carbohydrates and small amounts of phospholipids are also present.

47. (c) : Chlorenchyma or assimilatory parenchyma are parenchymatous cells that possess abundant chloroplasts in them. They are capable of photosynthesis. A spore capsule of moss can perform photosynthesis because of the presence of chlorenchyma cells in them.

48. (d) : In most of the gymnosperms, like conifers and cycads, vessels are absent and the wood is made entirely of tracheids. Such wood is known as nonporous.

In angiosperms, on the other hand, the wood consists of both tracheids and vessels. The wide vessels appear as pores between otherwise small sized tracheary elements. Such a wood is known as porous. In porous wood, if vessels have essentially equal diameters and are uniformly distributed throughout the ring, the wood is known as diffuse porous. It is characterstic of plants growing in tropics.

49. (b) : In the apices of some roots, (*e.g.*, *Zea mays* or maize), there is a central region of cells which normally does not divide. This central inactive region was called quiescent centre by F.A.L. Clowes (1959, 1961). The cells of this region have lesser amounts of RNA and DNA so they have small nuclei. These cells also have a lower rate of protein synthesis. Mitochondria and endoplasmic reticulum are less developed. The cells of the quiescent centre are usually inactive. However, if already existing meristematic cells are injured or become inactive due to any other reason, the cells of quiescent centre become active.

50. (d) : Xylem is the principal water conducting tissue of the plant. It consists of four types of cells-tracheids, vessels, xylem fibres and xylem parenchyma. The tracheids and vessels together are known as tracheary elements.

Tracheids are characteristic of all vascular plant. Tracheids originate from single cells. These are single elongated cells with tapering ends. The end walls are without perforations. Their length varies from 1 to 3 mm. Tracheids are devoid of protoplast, hence dead; fairly large cavity of these cells is without any contents. The wall of tracheids is moderately thick and usually lignified.

51. (c) : Apical meristems are situated at the tips of the root and shoot. They take part in initial growth. Plants elongate and increase in height as a result of

divisions in this meristem. Promeristem and primary meristem (root and shoot apices) are included in this type of meristem.

52. (a) : The vascular tissue of the root is characterised by radial arrangement of vascular bundles *i.e.*, xylem and phloem occur in separate patches on alternate radii. The number of xylem and phloem groups vary from two to six. But tetrarch condition (four vascular bundles) is more common. Monocot root generally has more than six vascular bundles (polyarch). Vascular bundles in dicot stems are conjoint, collateral or bicollateral, endarch and open. They are arranged in a ring.

In monocot stems the vascular bundles are conjoint, collateral, endarch and closed. They are scattered in the ground tissue.

53. (b) : Vessels are long tubelike structures ideally suited for the conduction of water and solutes. These are made up of a row of cylindrical cells arranged in longitudinal series. The partition walls of these cells are perforated and as such the entire structure becomes tubelike. The region of the wall where perforations occur is known as perforation plate. Vessels are found in the wood of almost all the angiosperms except certain primitive members of the order ranales (vesseless dicots), *e.g.*, *Trochodendron*, *Tetracentron, Drimys, Pseudowintera,* etc.

Vessels also occur in some pteridophytes, such as *Selaginella* and in the members of order Gnetales of gymnosperms (*e.g.*, *Genetum*, *Ephedra* and *Welwitschia*).

54. (a) : Inulin is a water soluble fructosan. It is a common reserve food in members of family compositae. Pectin in a mucopolysaccharides and occur in plant cell walls. At the time of fruit ripening wall pectins hydrolyse to give constituent sugars.

55. (b) : In plants during vascularisation, differentiation of procambium occurs followed by the formation of primary phloem and xylem simultaneously.

56. (d) : Endodermis is single layered structure which separates cortex from stele. The cells of endodermis are barrel-shaped without intercellular spaces, living and containing starch. The radial and tangential walls of endodermal cells possess thickenings of lignin, suberin and cutin in the form of strips or bands, which are known as casparian bands or casparian strips.

57. (c) : Extrastelar secondary growth means growth in the cortical region, external to stele.

For extrastelar secondary growth the cork cambium or phellogen develops in the region outside the vascular tissue. This gives rise to cork or phellem and secondary cortex or phelloderm. All the three layers (*i.e*, cork, cork cambium and secondary cortex) together constitute periderm. Fascicular and interfascicular cambuim occurs in the stelar regions.

58. (b) : *Refer to answer 25.*

59. (c) : In pteridophytes and gymnosperms, sieve tubes are not arranged in linear rows and hence called sieve cells. Sieve tube elements are the conducting element of phloem. These are arranged end to end in linear rows with septa (sieve plate) between two sieve tube elements. In the sieve plate, there are present sieve pores. Sieve tube elements are living and have thin cellulosic walls in young cells but they become thick walled and are without nuclei at maturity.

60. (a) : Sclereids are a type of sclerenchyma cells. They are short or irregular, their walls are very thick, irergular and the lumen is very narrow. These are dead cells and do not perform any metabolic functions. They show different types of lignin depositions and also have pits. They are present in hard parts like endocarp of coconut, hard seed coats fruit pulps. They are also called stone cells and are different types as brachysclereids, osteoclereids, macrosclereids, asterosclercids and fileform cells.

61. (a) : *Refer to answer 56.*

62. (a) : Heartwood or duramen is the dark coloured wood near the centre of the axis formed after many years of secondary growth of stem. A small outer region, however, remains light coloured. It is known as sap wood or alburnum. The heartwood is formed due to changes in the elements of the secondary xylem. As secondary growth proceeds most of the older elements of secondary xylem lose water and become filled with organic compounds such as oils, gums, resins, tannins, and aromatic and colouring materials. The wood becomes dark coloured due to accumulating of these substances and is also termed as duramen. The sap wood is the light coloured region of the secondary xylem. Cells of this region are functionally active. The elements of the secondary xylem added by cambial activity are those of sap wood. But gradually most of these elements get transformed into heart wood. Thus the amount of heart wood increases as the tree grows older. The amount of sap wood, however, remains almost constant.

63. (b) : The innermost layer of soft cortex is called as endodermis. This uniseriate layer is characterised by the presence of casparian strips. This thickenings was first observed by Caspary, 1865 and hence the name.

64. (c) : Meristems shows the totipotency because xylem vessels and cork cells are dead while sieve tube cells do not possess nuclei.

65. (c) : Periderm is produced by phellogen. The phellogen forms phellem on the outer face and phelloderm on the inner. The three layers *i.e.*, phellem, phellogen and phelloderm jointly constitute the periderm.

66. (b) : A narrow layer of thin walled cells found between phloem/bark and wood of dicot is vascular cambium. Vascular cambium present inside a vascular bundle is called as intrafascicular cambium or fascicular cambium. The vascular cambium is a meristematic tissue.

67. (a) : Sap wood will decay faster. Sap wood is less durable because it is susceptible to attack by pathogen and insects.

68. (a) : Monocot trees such as palms grow in thickness by primary thickening meristem situated at the base of the leaf. Plants like *Dracaena* show secondary growth by a special cambium. It develops in the form of strips just outside the vascular region. This cambial strips produce secondary vascular bundles which is amphivasal in *Dracaena*.

69. (b) : Bordered pits are found in vessel wall. In bordered pits, the thickening material over arches the pit cavity in such a way that a pit chamber opens to the interior by a pit aperture.

70. (d) : A bicollateral vascular bundles is characterised by xylem being sandwiched between phloem. Here there are two cambuim rings *e.g.*, *Cucurbita*.

71. (b) : Vascular cambium produces secondary xylem and secondary phloem. It is develop from the procambium which is an embryonic tissue, hence it is primary in origin. It is secondary in function for it forms the secondary tissues like secondary xylem, secondary phloem and secondary medullary rays. The cambium is a radially one cell thick zone of meristematic cells.

72. (c) : In monocot leaf, mesophyll cells are not differentiated into palisade and spongy tissues. But there is well differentiate mesophyll cells in dicot stem. Also in the upper epidermis, there are some large cells found in groups which are called bulliform cells. The venation pattern in monocot is parallel.

73. (d) : Phloem is the food conducting tissue of plants. The sieve tubes are food conducting elements of the plants. It is proposed that food is translocated by mass flow or by streaming currents of protoplasm.

74. (c) : An organised and differentiated cellular structure having cytoplasm but no nucleus are sieve tubes. The sieve tubes are living cells. Their walls are thicker than surrounding parenchyma cells. Sometimes they have a special, shining nacreous thickening. Cytoplasm occurs in the form of thin lining enclosing a big central vacuole.

75. (a) : Angular collenchyma occurs in, *Cucurbita.* It has thickening at the angles and there are no intercellular spaces. It is generally found in leaf petioles.

76. (a) : Grafting is a techinque in which cambium bearing shoot (scion = graft) of one plant is joined to cambium bearing stump (root system = stock) of a related plant through different unions like tongue grafting, wedge grafting etc. In grafting union between stock and scion produces undifferentiated mass of cells called callus. Therefore, for union between stock and scion in grafting, first to occur is the formation of callus. Callus is more or less corky secondary tissue developed lay woody plants over a wound. It is derived from cambium.

77. (b) : Pericycle of root produces lateral roots. Endodermis is followed by pericycle. Usually it is a continuous layer but in some monocots it is interrupted by xylem and phloem. It is the site of origin of lateral roots and cork cambium. The root branches are, therefore described as endogenous in origin.

78. (c) : Collenchyma occurs in climbing stems. Collenchyma occurs in the stem and petioles of dicot herbs. Due to deposition of pectin, it has high water retaining capacity. Since pectin appears at the angles, it becomes a spongy tissues. The collenchyma is a mechanical tissue which gives tensile strength to the plant.

79. (c) : *Refer to answer 78.*

80. (a) : Monocot leaves possess intercalary meristem. Intercalary meristem are responsible for localised growth. Perhaps they have been separated or detached from the mother meristem *e.g.*, meristem present at the base of leaves in many monocots, in the internode of grasses, at the top of peduncles of *Plantago* and *Taraxacum* etc.

81. (c) : Cork cambium and vascular cambium are lateral meristems. Both are responsible for the secondary growth of stem. It also increases the girth of stem.

82. (c) : Ring porous wood carries more water when need is higher. Ring porous wood provides better translocation when requirement of plant is more. Hence, it is very advanced than diffuse porous wood.

83. (c) : Sieve tubes are suited for translocation of food because they possess broader lumen and perforated cross walls. Sieve tubes are elongated tubular conducting channels of phloem. The end wall possess many small pores and have thin cellulosic wall.

84. (a) : Death of protoplasm is a pre-requisite for a vital functions like transport of sap. Xylem is a dead tissue and do not have protoplasm, xylem performs the function of transport of water or sap inside the plant from roots to leaves.

85. (a) : The tunica corpus concept was given by Schmidt (1924) which was based on plane of divisions of cells. According to this concept there are two portions in shoot apex-tunica and corpus. The tunica shows only anticlinical divisions and thus it is responsible for surface growth. The corpus shows divisions in all plane and thus responsible for volume growth.

86. (a) : Pith and cortex do not differentiate in monocot stem. Since numerous vascular bundles lie scattered, the ground tissue system in a monocot stem is distinguishable into hypodermis and ground parenchyma.

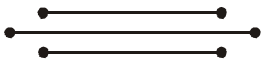
87. (a) : In hypodermis or outer cortical cells, a layer becomes meristematic which is known as cork cambium or phellogen. This phellogen also cuts off cells both on its outer side and inner side. The cells cut off on outer side are phellem or cork cells and cells cut off on inner side are phelloderm or secondary cortex.

The phellem or cork cells are dead and have deposition of a fatty substance called suberin (*i.e.*, cork cells are suberized). Suberin is impervious to water and thus cork cells are buoyant (*i.e.*, float on water).

Phellem, phellogen and phelloderm collectively constitute periderm.

88. (a) : The meristem that helps in increasing girth is lateral meristem. The lateral meristem is responsible for lateral growth of the plant *i.e.*, growth in thickness *e.g.*, cambium and cork cambium. It divides only periclinally or radially and is responsible for increase in girth or diameter.

89. (c) : *Refer to answer 85.*



Chapter 7

Structural Organisation in Animals

1. Select the correct route for the passage of sperms in male frogs.
(a) Testes → Vasa efferentia → Kidney → Seminal vesicle → Urinogenital duct → Cloaca
(b) Testes → Vasa efferentia → Bidder's canal → Ureter → Cloaca
(c) Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca
(d) Testes → Bidder's canal → Kidney → Vasa efferentia → Urinogenital duct → Cloaca
(NEET 2017)

2. Frog's heart when taken out of the body continues to beat for sometime.
Select the best option from the following statements.
(1) Frog is a poikilotherm.
(2) Frog does not have any coronary circulation.
(3) Heart is "myogenic" in nature.
(4) Heart is autoexcitable.
(a) Only (4) (b) (1) and (2)
(c) (3) and (4) (d) Only (3)
(NEET 2017)

3. In male cockroaches, sperms are stored in which part of the reproductive system?
(a) Seminal vesicles
(b) Mushroom glands
(c) Testes
(d) Vas deferens *(NEET-II 2016)*

4. Smooth muscles are
(a) involuntary, fusiform, non-striated
(b) voluntary, multinucleate, cylindrical
(c) involuntary, cylindrical, striated
(d) voluntary, spindle-shaped, uninucleate.
(NEET-II 2016)

5. Which type of tissue correctly matches with its location?

	Tissue	**Location**
(a)	Transitional epithelium	Tip of nose
(b)	Cuboidal epithelium	Lining of stomach
(c)	Smooth muscle	Wall of intestine
(d)	Areolar tissue	Tendons

(NEET-I 2016)

6. Which of the following features is not present in *Periplaneta americana*?
(a) Exoskeleton composed of N-acetylglucosamine
(b) Metamerically segmented body
(c) Schizocoelom as body cavity
(d) Indeterminate and radial cleavage during embryonic development
(NEET-I 2016)

7. The body cells in cockroach discharge their nitrogenous waste in the haemolymph mainly in the form of
(a) urea
(b) calcium carbonate
(c) ammonia
(d) potassium urate. *(2015)*

8. The function of the gap junction is to
(a) separate two cells from each other
(b) stop substance from leaking across a tissue
(c) performing cementing to keep neighbouring cells together
(d) facilitate communication between adjoining cells by connecting the cytoplasm for rapid transfer of ions, small molecules and some large molecules.
(2015)

9. The terga, sterna and pleura of cockroach body are joined by
(a) arthrodial membrane
(b) cartilage
(c) cementing glue
(d) muscular tissue.
(2015 Cancelled)

10. Choose the correctly matched pair.
(a) Tendon - Specialized connective tissue
(b) Adipose tissue - Dense connective tissue
(c) Areolar tissue - Loose connective tissue
(d) Cartilage - Loose connective tissue
(2014)

11. Choose the correctly matched pair.
(a) Inner lining of salivary ducts - Ciliated epithelium
(b) Moist surface of buccal cavity - Glandular epithelium
(c) Tubular parts of nephrons - Cuboidal epithelium
(d) Inner surface of bronchioles - Squamous epithelium
(2014)

12. What external changes are visible after the last moult of a cockroach nymph?
(a) Both forewings and hindwings develop
(b) Labium develops
(c) Mandibles become harder
(d) Anal cerci develop
(NEET 2013)

13. Select the correct option with respect to cockroaches.
(a) Malpighian tubules convert nitrogenous wastes into urea.
(b) Males bear short anal styles not present in females.
(c) Nervous system comprises of a dorsal nerve cord and ten pairs of ganglia.
(d) The forewings are tegmina which are used in flight.
(Karnataka NEET 2013)

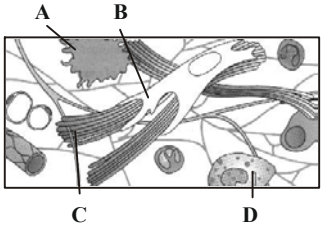
14. Identify the tissue shown in the diagram and match with its characteristics and its location.

(a) Smooth muscles, show branching, found in the wall of the heart
(b) Cardiac muscles, unbranched muscles, found in the walls of the heart
(c) Striated muscles, tapering at both-ends, attached with the bones of the ribs
(d) Skeletal muscles show striations and are closely attached with the bones of the limbs
(Karnataka NEET 2013)

15. Compared to those of humans, the erythrocytes in frog are
(a) without nucleus but with haemoglobin
(b) nucleated and with haemoglobin
(c) very much smaller and fewer
(d) nucleated and without haemoglobin.
(2012)

16. Select the correct statement from the ones given below with respect to *Periplaneta americana*.
(a) Nervous system located dorsally, consists of segmentally arranged ganglia joined by a pair of longitudinal connectives.
(b) Males bear a pair of short thread like anal styles.
(c) There are 16 very long Malpighian tubules present at the junctions of midgut and hindgut.
(d) Grinding of food is carried out only by the mouth parts.
(2012)

17. Given below is the diagrammatic sketch of a certain type of connective tissue. Identify the parts labelled A, B, C and D and select the right option about them.

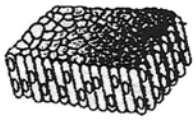


	A	B	C	D
(a)	Macrophage	Fibroblast	Collagen fibres	Mast cell
(b)	Mast cell	Macrophage	Fibroblast	Collagen fibres
(c)	Macrophage	Collagen fibres	Fibroblast	Mast cell
(d)	Mast cell	Collagen fibres	Fibroblast	Macro-phage

(Mains 2012)

18. The supportive skeletal structures in the human external ears and in the nose tip are examples of
(a) ligament (b) areolar tissue
(c) bone (d) cartilage.
(Mains 2012)

19. The four sketches (A, B, C and D) given below, represent four different types of animal tissues. Which one of these is correctly identified in the options given, along with its correct location and function?

(A)  (B) 

(C)  (D) 

	Tissue	Location	Function
(a) (B)	Glandular epithelium	Intestine	Secretion
(b) (C)	Collagen	Cartilage	Attach skeletal muscles fibres to bones
(c) (D)	Smooth muscle tissue	Heart	Heart contraction
(d) (A)	Columnar epithelium	Nephron	Secretion and absorption

(Mains 2012)

20. The ciliated columnar epithelial cells in humans are known to occur in
(a) Eustachian tube and stomach lining
(b) bronchioles and Fallopian tube
(c) bile duct and oesophagus
(d) Fallopian tube and urethra. *(2011)*

21. One very special feature in the earthworm *(Pheretima)* is that
(a) fertilization of eggs occurs inside the body
(b) the typhlosole greatly increases the effective absorption area of the digested food in the intestine
(c) the S-shaped setae embedded in the integument are the defensive weapons used against the enemies
(d) it has a long dorsal tubular heart. *(2011)*

22. Which of the following happens in the common cockroach?
(a) Malpighian tubules are excretory organs projecting out from the colon.
(b) Oxygen is transported by haemoglobin in blood.
(c) Nitrogenous excretory product is urea.
(d) The food is ground by mandibles and gizzard. *(2011)*

23. Frogs differ from humans in possessing
(a) paired cerebral hemispheres
(b) hepatic portal system
(c) nucleated red blood cells
(d) thyroid as well as parathyroid.
(Mains 2011)

24. The cells lining the blood vessels belong to the category of
(a) smooth muscle tissue
(b) squamous epithelium
(c) columnar epithelium
(d) connective tissue. *(Mains 2011, 2010)*

25. Which one of the following structures in *Pheretima* is correctly matched with its function?
(a) Clitellum - Secretes cocoon
(b) Gizzard - Absorbs digested food
(c) Setae - Defence against predators
(d) Typhlosole - Storage of extra nutrients
(Mains 2011)

26. Which one of the following pairs of structures is correctly matched with their corrected description?

Structures	Description
(a) Tibia and fibula	Both form parts of knee joint
(b) Cartilage and cornea	No blood supply but do require oxygen for respiratory need
(c) Shoulder joint and elbow joint	Ball and socket type of joint
(d) Premolars and molars	20 in all and 3 rooted

(Mains 2010)

27. Which one of the following correctly describes the location of some body parts in the earthworm *Pheretima*?

(a) Four pairs of spermathecae in 4^{th}-7^{th} segments
(b) One pair of ovaries attached at intersegmental septum of 14^{th} and 15^{th} segments
(c) Two pairs of testes in 10^{th} and 11^{th} segments
(d) Two pairs of accessory glands in 16^{th}-18^{th} segments *(2009)*

28. Which one of the following is correct pairing of a body part and the kind of muscle tissue that moves it?
(a) Biceps of upper arm – Smooth muscle fibres
(b) Abdominal wall – Smooth muscle
(c) Iris – Involuntary smooth muscle
(d) Heart wall – Involuntary unstriated muscle *(2009)*

29. The epithelial tissue present on the inner surface of bronchioles and Fallopian tubes is
(a) glandular (b) ciliated
(c) squamous (d) cuboidal. *(2009)*

30. The cell junctions called tight, adhering and gap junctions are found in
(a) connective tissue (b) epithelial tissue
(c) neural tissue (d) muscular tissue. *(2009)*

31. The kind of tissue that forms the supportive structure in our pinna (external ears) is also found in
(a) nails (b) ear ossicles
(c) tip of the nose (d) vertebrae. *(2009)*

32. Earthworms have no skeleton but during burrowing, the anterior end becomes turgid and acts as a hydraulic skeleton. It is due to
(a) gut peristalsis (b) setae
(c) coelomic fluid (d) blood. *(2008)*

33. Which one of the following is the true description about an animal concerned?
(a) Rat - Left kidney is slightly higher in position than the right one
(b) Cockroach - 10 pairs of spiracles (2 pairs on thorax and 8 pairs on abdomen)
(c) Earthworm - The alimentary canal consists of a sequence of pharynx, oesophagus, stomach, gizzard and intestine
(d) Frog - Body divisible into three regions - head, neck and trunk *(2008)*

34. Which one of the following pairs of structures distinguishes a nerve cell from other types of cell?
(a) Vacuoles and fibres
(b) Flagellum and medullary sheath
(c) Nucleus and mitochondria
(d) Perikaryon and dendrites *(2007)*

35. In which one of the following preparations are you likely to come across cell junctions most frequently?
(a) Thrombocytes
(b) Tendon
(c) Hyaline cartilage
(d) Ciliated epithelium *(2007)*

36. Areolar connective tissue joins
(a) bones with bones
(b) fat body with muscles
(c) integument with muscles
(d) bones with muscles. *(2006)*

37. Mast cells secrete
(a) haemoglobin (b) hippurin
(c) myoglobin (d) histamine. *(2006)*

38. Earthworms are
(a) ammonotelic when plenty of water is available
(b) ureotelic when plenty of water is available
(c) uricotelic when plenty of water is available
(d) uricotelic under conditions of water scarcity. *(2006)*

39. Four healthy people in their twenties got involved in injuries resulting in damage and death of few cells of the following. Which of the cells are least likely to be replaced by new cells?
(a) Liver cells
(b) Neurons
(c) Malpighian layer of the skin
(d) Osteocytes *(2005)*

40. Mast cells of connective tissue contain
(a) vasopressin and relaxin
(b) heparin and histamine
(c) heparin and calcitonin
(d) serotonin and melanin. *(2004)*

41. Which one of the following contains the largest quantity of extracellular material ?
(a) Striated muscle
(b) Areolar tissue
(c) Stratified epithelium
(d) Myelinated nerve fibres *(2003)*

42. Collagen is
(a) fibrous protein (b) globular protein
(c) lipid (d) carbohydrate. *(2002)*

43. Melanin protects from
(a) UV rays (b) visible rays
(c) infrared rays (d) X-rays. *(2002)*

44. During an injury nasal septum gets damaged and for its recovery which cartilage is preferred?
(a) Elastic cartilage (b) Hyaline cartilage
(c) Calcified cartilage (d) Fibrous cartilage *(2001)*

45. Which cells do not form layer and remains structurally separate?
(a) Epithelial cells (b) Muscle cells
(c) Nerve cells (d) Gland cells *(2001)*

46. Proteoglycan in cartilages which is a part of polysaccharide is
(a) chondroitin (b) ossein
(c) casein (d) cartilagin. *(2000)*

47. Characteristic of simple epithelium is that they
(a) are arranged indiscriminately
(b) make a definite layer
(c) continue to divide and help in organ function
(d) none of the above. *(2000)*

48. Which pair is correct?
(a) Sweat – Temperature regulation
(b) Saliva – Sense of food taste
(c) Sebum – Sexual attraction
(d) Humerus – Hindleg *(2000)*

49. Primary function of enteronephric nephridia of *Pheretima* is
(a) osmoregulation
(b) excretion of nitrogenous wastes
(c) respiration
(d) locomotion. *(2000)*

50. Ligament is a/an
(a) inelastic white fibrous tissue
(b) modified white fibrous tissue
(c) modified yellow elastic fibrous tissue
(d) none of the above. *(1999)*

51. Tendon is made up of
(a) yellow fibrous connective tissue
(b) modified white fibrous tissue
(c) areolar tissue
(d) adipose tissue. *(1999)*

52. In mammals, histamine is secreted by
(a) lymphocytes (b) mast cells
(c) fibroblasts (d) histiocytes. *(1998)*

53. Protein present in cartilage is
(a) cartilagin (b) ossein
(c) chondrin (d) none of these. *(1997)*

54. Basement membrane is made up of
(a) no cell product of epithelial cell
(b) epidermal cell only
(c) endodermal cell
(d) both (b) and (c). *(1997)*

55. Stratum germinativum is an example of which kind of epithelium?
(a) Columnar (b) Squamous
(c) Cuboidal (d) Ciliated *(1997)*

56. The roof of the cranium of frog is formed by
(a) frontoparietal (b) orbitosphenoid
(c) parasphenoid (d) alisphenoid. *(1997)*

57. In frog, the surface of attachment of tongue is
(a) pterygoid (b) hyoid apparatus
(c) parasphenoid (d) palatine. *(1997)*

58. In frog, "fenestra ovalis" is
(a) the communication between the pharynx and the tympanic cavity
(b) the external opening of the tympanic cavity which is covered by the tympanic membrane
(c) the air filled cavity of the middle ear
(d) the opening in the auditory capsule which separates the middle ear from the internal ear. *(1997)*

59. The kidney of an adult frog is
(a) metanephros (b) opisthonephros
(c) pronephros (d) mesonephros. *(1997)*

60. An epithelial tissue which has thin flat cells, arranged edge to edge so as to appear like closely packed tiles, is found to be present at
(a) outer surface of ovary
(b) inner lining of fallopian tube
(c) inner lining of stomach
(d) inner lining of cheeks. *(1994)*

61. Hair present in the skin are
(a) epidermal in origin and made of dead cells
(b) epidermal in origin and made of living cells
(c) dermal in origin and made of living cells
(d) dermal in origin and made of dead cells. *(1993)*

62. The layer of actively dividing cells of skin is termed as
(a) stratum compactum
(b) stratum corneum
(c) stratum malpighii/stratum germinativum
(d) stratum lucidum. *(1993)*

63. Formation of cartilage bones involves
(a) deposition of bony matter by osteoblasts and resorption by chondroclasts
(b) deposition of bony matter by osteoclasts
(c) deposition of bony matter by osteoclasts only
(d) deposition of bony matter by osteoblasts only. *(1993)*

64. Mucus helps frog in forming
(a) thick skin (b) dry skin
(c) smooth skin (d) moist skin. *(1993)*

65. Characteristics of smooth muscle fibres are
(a) spindle-shaped, unbranched, nonstriated, uninucleate and involuntary
(b) spindle-shaped, unbranched, unstriped, multinucleate and involuntary
(c) cylindrical, unbranched, unstriped, multinucleate and involuntary
(d) cylindrical, unbranched, striated, multinucleate and voluntary. *(1992)*

66. Male and female cockroaches can be distinguished externally through
(a) anal styles in male
(b) anal cerci in female
(c) anal style and antennae in females
(d) both (b) and (c). *(1991)*

67. Earthworm possesses hearts
(a) 6 pairs (b) 4 pairs
(c) 2 pairs (d) 1. *(1991)*

68. Blood of *Pheretima* is
(a) blue with haemocyanin in corpuscles
(b) blue with haemocyanin in plasma
(c) red with haemoglobin in corpuscles
(d) red with haemoglobin in plasma. *(1990)*

69. *Pheretima posthuma* is highly useful as
(a) their burrows make the soil loose
(b) they make the soil porous, leave their castings and take organic debris in the soil
(c) they are used as fish meal
(d) they kill the birds due to biomagnification of chlorinated hydrocarbons. *(1990)*

70. Haversian canals occur in
(a) humerus (b) pubis
(c) scapula (d) clavicle. *(1989)*

71. Histamine secreting cells are found in
(a) connective tissues
(b) lungs
(c) muscular tissue
(d) nervous tissue. *(1989)*

72. Mineral found in red pigment of vertebrate blood is
(a) magnesium (b) iron
(c) calcium (d) copper. *(1989)*

73. Photoreceptors of earthworm occur on
(a) clitellum (b) many eyes
(c) dorsal surface (d) lateral sides. *(1989)*

Answer Key

1.	(c)	**2.**	(c)	**3.**	(a)	**4.**	(a)	**5.**	(c)	**6.**	(d)	**7.**	(d)	**8.**	(d)	**9.**	(a)	**10.**	(c)
11.	(c)	**12.**	(a)	**13.**	(b)	**14.**	(d)	**15.**	(b)	**16.**	(b)	**17.**	(a)	**18.**	(d)	**19.**	(a)	**20.**	(b)
21.	(b)	**22.**	(d)	**23.**	(c)	**24.**	(b)	**25.**	(a)	**26.**	(b)	**27.**	(c)	**28.**	(c)	**29.**	(b)	**30.**	(b)
31.	(c)	**32.**	(c)	**33.**	(b)	**34.**	(d)	**35.**	(d)	**36.**	(c)	**37.**	(d)	**38.**	(a)	**39.**	(b)	**40.**	(b)
41.	(b)	**42.**	(a)	**43.**	(a)	**44.**	(b)	**45.**	(c)	**46.**	(a)	**47.**	(b)	**48.**	(a)	**49.**	(a)	**50.**	(c)
51.	(b)	**52.**	(b)	**53.**	(c)	**54.**	(a)	**55.**	(a)	**56.**	(a)	**57.**	(b)	**58.**	(c)	**59.**	(d)	**60.**	(d)
61.	(a)	**62.**	(c)	**63.**	(a)	**64.**	(d)	**65.**	(a)	**66.**	(a)	**67.**	(b)	**68.**	(d)	**69.**	(b)	**70.**	(a)
71.	(a)	**72.**	(b)	**73.**	(c)														

EXPLANATIONS

1. (c) : The correct route for transport of sperms in male frog is
Testes → Vasa efferentia → Kidney → Bidder's canal → Urinogenital duct → Cloaca.

2. (c) : Frog's heart is myogenic, *i.e.*, heartbeat originates from muscles of heart. Hence, it is autorythmic. Wave of contraction originates from sinus venosus and spreads to wall of sinus venosus and both auricles. This compels the heart to beat. Due to this reason, frog's heart will continue to beat as long as it gets supply of ATP.

3. (a) : Seminal vesicles are numerous small sacs present on ventral surface of anterior part of the ejaculatory duct which store sperms.

4. (a) : Smooth muscle fibres are elongated and spindle shaped (fusiform). Each fibre contains a single oval nucleus surrounded by cytoplasm (sarcoplasm). In cytoplasm myofibrils are arranged longitudinally. These fibres lack striations and sarcolemma, however are enclosed by plasma membrane.

5. (c) : Tip of nose has elastic cartilage. Simple columnar epithelium lines the stomach. Tendon is white fibrous connective tissue. Posterior part of intestine has single unit smooth muscle in which all fibres of muscle contract simultaneously as single unit.

6. (d) : In insect cleavage is superficial.

7. (d) : In cockroach, Malpighian tubules extract metabolic wastes like potassium and sodium urate, water and carbon dioxide from the blood. In the Malpighian tubules bicarbonates of potassium and sodium, water and uric acid are formed. A large amount of water and bicarbonates of potassium and sodium are reabsorbed by the cells of Malpighian tubules and then transferred to the blood (haemolymph). Uric acid is carried to the alimentary canal of the insect and is finally passed out through anus.

8. (d) : Most cells in animal tissues (with the exception of a few terminally differentiated cells such as skeletal muscle cells and blood cells) are in communication with their adjoining cells *via* gap junctions. At the place where gap junction is present, membranes of two adjacent cells are separated by a uniform narrow gap of about 2-4 nm. The gap is spanned by channel forming proteins called connexins, which allow inorganic ions and other small water soluble molecules to pass directly from cytoplasm of one cell to cytoplasm of other cell.

9. (a) : Arthrodial membrane is a tough, flexible cuticle that joins the skeletal elements of cockroach and other arthropods. It connects terga, pleura and sterna of cockrocah body.

10. (c) : Areolar tissue is the most widely distributed loose connective tissue in the body. Tendon is a type of dense connective tissue, adipose tissue is a fat-storing loose connective tissue and cartilage is a specialised connective tissue.

11. (c) :

Inner lining of salivary ducts	-	Simple cuboidal epithelium
Moist surface of buccal cavity	-	Non-keratinized stratified squamous epithelium
Inner surface of bronchioles	-	Ciliated columnar epithelium

12. (a) : Cockroach undergoes paurometabolous development. The nymph moults about 6-7 times to reach the adult form. The next to last nymphal stage has wing pads but only adult cockroaches have wings.

13. (b) : Malpighian tubules are the main excretory structures in cockroach. They extract nitrogenous wastes and water from haemolymph and reabsorb certain salts resulting in precipitation of uric acid. So, cockroach is uricotelic. Males have paired anal styles on 9th abdominal sternite which are absent in females.

14. (d) : Locomotion (performed by limbs) in humans depends on the movements of muscle fibres. Skeletal muscles are attached to the bones by tendons and help in the movement of the parts of skeleton. These muscles are under the control of conscious mind and are called voluntary muscles. Under the microscope, these muscles show transverse stripes and hence are designated as striated muscles.

15. (b) : Human erythrocytes are enucleated, discoidal while in frogs erythrocytes are large, oval and biconvex nucleated cells. Erythrocytes are the carriers of haemoglobin.

16. (b) : The posterior segment of cockroaches bear appendages named as anal cerci. These are found in both male and female. But male cockroach can be distinguished by female ones by the presence of an extra pair of accessory appendages named as anal styles. It assists during copulation.

17. (a)

18. (d) : Cartilage is a semi-rigid supportive or skeletal connective tissue in which matrix is solid and made of mucoprotein or proteoglycan called chondrin. It is of four types –hyaline, fibrous, calcified and elastic. Yellow elastic fibrocartilage is found in pinna and external auditory canal of the ear, Eustachian tubes, epiglottis and tip of the nose. Its matrix contains numerous yellow fibres which form a network by uniting with one another. Due to the presence of yellow fibres, the cartilage becomes more flexible. Hence, it provides flexibility to these organs.

19. (a) : Intestine is lined by glandular epithelium which is secretory in function. The glands found in intestine are exocrine and may be unicellular or multicellular. When unicellular glands secrete mucus, they are called mucus cells or goblet cells and are common in the columnar epithelium of intestine. When unicellular glands secrete a clear watery fluid, they are called serous cells which are also present in intestinal glands. On the other hand, multicellular glands consist of a duct and secretory portion, both formed of epithelial cells. They are further of two types: tubular and saccular. In tubular glands secretory portion is tube like for example, Crypts of Lieberkuhn (a type of simple straight tubular glands found in intestine) and Brunner's gland (a type of simple branched tubular glands found in intestine).

20. (b) : The ciliated columnar epithelial cells in humans are present in the nasal passages, oviducts (Fallopian tubes) terminal bronchioles, ventricles of the brain and central canal of the spinal cord of the embryo. Columnar ciliated epithelium consists of columnar cells, which bear cilia on the free surface.

21. (b) : In *Pheretima*, next to stomach is the intestine. It is a long, wide and thin walled tube extending from 15th segment to the last. Second or middle part of the intestine lies between 27^{th} segment upto 23–25 segments in front of anus. This is characterised by the presence of a highly glandular and vascular longitudinal ridge, arising as a median in-growth of the dorsal aspect of the intestinal cavity. This is called the typhlosole. The typhlosole greatly increases the effective absorption area of the digested food in the intestine.

22. (d) : Mouth part of cockroach contain two mandibles, which bears teeth. When both the mandibles work simultaneously in a horizontal plane, the food matter is cut and masticated into fine and smaller pieces. Gizzard is a part of alimentary canal. It bears six muscular folds which are covered by chitinous conical plates, the teeth, used for grinding the food.

23. (c) : Human erythrocytes are enucleated, discoidal while in frogs erythrocytes are large, oval and biconvex nucleated cells. Erythrocytes are the carriers of haemoglobin.

24. (b) : Simple squamous epithelium is composed of large flat cells whose edges fit closely together like the tiles in a floor, hence it is also called pavement epithelium. The nuclei of the cells are flattened and often lie at the centre of the cells and cause bulgings of cells surface. The epithelium lines the blood vessels, lymph vessels, heart, terminal bronchioles, alveoli of the lungs, walls of the Bowman's capsules, descending limbs of loop of Henle. In the blood vessels and heart it is called endothelium.

25. (a) : In a mature earthworm, segments 14^{th}-16^{th} are covered by a prominent dark band of glandular tissues called clitellum which secretes cocoon where fertilization and development takes place. In alimentary canal, muscular gizzard (8^{th}-9^{th} segments) helps in grinding the soil particles and decaying leaves, etc. The characteristic feature of the intestine between 26^{th}-35^{th} segments is the presence of internal median fold of dorsal wall called typhlosole. This increases the effective area of absorption in the intestine. In each body segment, except the first, last and clitellum, there are rows of S-shaped setae, embedded in the epidermal pits in the middle of each segment. Setae can be extended or retracted. Their principal role is in locomotion.

26. (b) : Cartilage is avascular, as the blood vessels innervate only perichondrium through which nutrition diffuses into cartilage cells. Cornea is also avascular.

27. (c) : In *Pheretima* two pairs of testis sac are situated in the tenth and eleventh segments. Each testis sac of the tenth segment encloses a testis and a seminal funnel. Each testis sac of the eleventh segment encloses a testis, a seminal vesicle and a seminal funnel.

28. (c) : Smooth muscles are called as involuntary muscles as action of these muscles is controlled by autonomic nervous system *i.e.* not under the control of animal's will. Iris of eyes consist of smooth involuntary muscles. Abdominal wall also have smooth muscles. Biceps of upper arm is made of skeletal muscles while heart wall consists of cardiac muscles.

29. (b) : *Refer to answer 20.*

30. (b) : Epithelial tissues consist of variously shaped cells closely arranged in one or more layers. The cells are held together by intercellular junctions like tight, adhering and gap junctions.

31. (c) : Yellow elastic fibrocartilage, a type of skeletal tissue, is found in the pinna, Eustachian tubes, epiglottis and tip of the nose. It is a type of cartilage and due to presence of yellow fibres, it becomes more flexible.

32. (c) : Hydraulic skeleton is the system of support found in soft bodied invertebrates, which relies on the incompressibility of fluids contained within the body cavity. In earthworms the coelomic fluid is under pressure within the coelom and therefore provides support for internal organs. Due to hydraulic skeleton, during burrowing, the anterior end becomes turgid and aids in relaxation of longitudinal muscles.

33. (b) : There are 10 pairs of spiracles in cockroach. Two pairs are thoracic in which first pair is known as mesothoracic, lying infront of the mesothorax between the bases of first and second pair of legs and are the largest. The second pair is called metathoracic. Abdominal spiracles are eight pairs. The first pair is dorsal in position and lies on the lateral margins of the first abdominal tergum. The remaining are situated on the sides of their corresponding segments on the pleura between the terga and sterna. Spiracles are meant for intake of fresh air and release of foul air.

34. (d) : Neuron (nerve cell) is one of the basic functional units of the nervous system. Neuron is a cell specialized to transmit electrical nerve impulse and so carry information from one part of the body to another. Each neuron has an enlarged portion, the cell body (perikaryon), containing the nucleus; from the body extend several processes (dendrites) through which impulses enter from their branches. A longer process, the nerve fibre, extends outward and carries impulses away from the cell body. This is normally unbranched except at the nerve ending. The point of contact of one neuron with another is known as a synapse.

35. (d) : From the given four options cell junctions come across most frequently in the preparation of ciliated epithelium. A cell junction is a structure within a tissue of a multicellular organism. Cell junctions are especially abundant in epithelial tissues. They consist of protein complexes and provide contact between neighbouring cells, between a cell and the extracellular matrix, or they built up the paracellular barrier of epithelia and control the paracellular transport. Ciliated epithelium is a region of epithelium consisting of columnar or cuboidal cells bearing hairlike appendages that are capable of beating rapidly. Ciliated epithelium performs the function of moving particles or fluid over the epithelial surface in such structures as the trachea, bronchial tubes, and nasal cavities. It often occurs in the vicinity of mucus-secreting goblet cells.

The other three (thrombocytes, tendon and hyaline cartilage) belongs to connective tissue. Connective tissue is widely distributed and has many functions including support, packing, defence and repair. Thrombocytes or platelets aid the formation of blood clots by releasing various protein substances. Tendon attaches a muscle to a bone and hyaline cartilage consists largely of glycosaminoglycan, giving a shiny glass like appearance and gives flexibility and support at the joints.

36. (c) : Areolar tissue is a loose connective tissue comprised of a semifluid ground substance containing several kinds of loosely arranged fibres. Its function is to attach the skin to the underlying tissues, to fill the spaces between various organs and thus holds them in place, and surrounds and supports the blood vessels. Tendons connect muscles with bone while ligaments connect bone with bone.

37. (d) : Mast cells are granulated wandering cells that are found in connective tissue. Their granules contain histamine which is a vasodilator. It causes running nose, sneezing and itching; and narrows the airways in the lungs. Haemoglobin and myoglobin are the pigments present in the blood and muscles respectively.

38. (a) : Earthworm has excretory organ called nephridia. Ammonia is the chief excretory waste when water is available and hence it is ammonotelic in water and terrestrial earthworm is ureotelic.

39. (b) : Neurons are least likely to be replaced by new cells as they have least regeneration power. Osteocytes are the bone forming cells. Liver cells and Malpighian layer of the skin have regeneration power.

40. (b) : Mast cells are the large cells with densely granular cytoplasm that is found in connective tissues. Their granules contain histamine which is a vasodilator, heparin which is an anticoagulant and serotonin which acts as a mediator of inflammation and allergic reactions. Vasopressin is a hormone secreted by posterior pituitary gland. Calcitonin is a hormone secreted by thyroid gland. Melanin is a pigment produced by specialized epidermal cells called melanocytes. Relaxin is a hormone produced by the corpus luteum and placenta during the terminal stages of pregnancy.

41. (b) : In areolar tissue, there is more intercellular space, so largest quantity of extracellular material is

present in this tissue. It contains all cell types and fibres of connective tissue. There is a thin layer of extracellular fluid in stratified epithelium whereas striated muscle is attached with tendons and there is very less amount of extracellular fluid in myelinated nerve fibre.

42. (a) : Collagen is an insoluble fibrous protein found extensively in the connective tissue of skin, tendons and bone. Collagen accounts for over 30% of the total body protein of mammals. Globular proteins have compact rounded molecules and are usually water soluble. Lipid is a diverse group of organic compounds, that are insoluble in water but soluble in organic solvents. Carbohydrates are compounds of carbon, hydrogen and oxygen.

43. (a) : Melanin is produced by specialized epidermal cells called melanophores (or melanocytes). Their dispersion in these cells is controlled by melanocyte - stimulating hormone and melatonin. Melanin, a pigment present in skin, protects it from harmful effects of UV rays. People living in tropics have more melanin in their skin which is an adaptation to protect themselves from harmful UV rays. Melanin cannot protect from infrared rays and X-rays.

44. (b) : Nasal septum consists of hyaline cartilage. It is bluish-green and translucent in appearance. It has fewer very fine white fibres in the matrix. This type of cartilage gives flexibility and support at the joints. Elastic, calcified and fibrous cartilages occur in other parts of body.

45. (c) : Nerve cells are the highly excitable cells, specialized for impulse conduction. They originate from neural plate of embryonic ectoderm and serve as structural and functional units of nervous tissue.

46. (a) : Proteoglycans consist of polysaccharide attached with a protein chondroitin. It is present in cartilage as well as in extracellular material. Ossein is a protein present in matrix of bone. Casein is a milk protein.

47. (b) : Simple epithelium consists of a single layer of cells resting on a basement membrane. This makes a definite layer.

48. (a) : Sweat is secreted by sweat glands of skin and helps in regulating body temperature. Saliva is secreted by salivary glands and helps in digestion (carbohydrate digestion). Sebum is the waxy secretion secreted by sebaceous glands. Sebum is a fatty mildly antiseptic material that protects, lubricates, and waterproofs the skin and hair and helps prevent desiccation. Humerus is the long bone of the upper arm. It articulates with the scapula at the glenoid cavity and with the ulna and radius at the elbow.

49. (a) : Pharyngeal nephridia and septal nephridia are enteronephric as they discharge excretory matter into the gut. Discharge of waste matter *via* gut is an adaptation to conserve water by its reabsorption in the gut. Integumentary nephridra are exonephric, as they discharge waste matter to the exterior.

50. (c) : Ligament occurs in the form of cords in a modified yellow elastic fibrous tissue and connects bone with a bone. Modified white fibrous tissue is present in the tendons.

51. (b) : White fibrous tissue has two forms : cords and sheets. The white fibres run parallel to form cords, called tendons. Tendon attaches a muscle to a bone. It consists of collagen fibres and are therefore inelastic. They ensure that the force exerted by muscular contraction is transmitted to the relevant part of the body to be moved. Yellow elastic tissue also has two forms : cords and sheets. Here, cords are called ligaments. Adipose tissue is a fat storing loose connective tissue. Areolar tissue is the most widely distributed connective tissue in the body.

52. (b) : Mast cells are found in the matrix of areolar connective tissue and secrete histamine (vasodilator), serotonin (vasoconstrictor) and heparin (anticoagulant). These take part in allergic reactions and also help in a body defence. Fibroblasts and histiocytes are also found in the matrix of areolar tissue. Fibroblasts secrete ground substance while histiocytes engulf the microbes, foreign particles and damaged cells. Lymphocytes are the type of leucocytes present in blood and secrete antibodies.

53. (c) : Chondrin is a protein present in the matrix of cartilage. It forms a constituent of a compound called chondrin sulphate. Chondrin sulphate consists of proteoglycans, that is protein chains bonded to long chains of disaccharide hyaluronic acid. Matrix of bone is made up of a protein called ossein.

54. (a) : Basement membrane (basal lamina) is a thin sheet of fibrous proteins that underlies and supports the cells of an epithelium, separating this from underlying tissue. Basement membranes are components of the extracellular matrix (= the viscous watery fluid that surrounds cells in animal tissue) and help to regulate passage of materials between epithelial cells and adjacent blood vessels. Each consists of a framework of collagen fibrils within which are glycosaminoglycans (mucopolysacc harides) and laminins, which are proteins that bind

the basement membrane to neighbouring cells *via* cell adhesion molecules.

55. (a) : Stratum germinativum (also stratum basale or basal cell layer) is the layer of keratinocytes that lies at the base of the epidermis immediately above the dermis. It consists of a single layer of tall, simple columnar epithelial cells lying on a basement membrane. These cells undergo rapid cell division, mitosis to replenish the regular loss of skin by shedding from the surface. About 25% of the cells are melanocytes, which produce melanin which provides pigmentation for skin and hair.

56. (a) : Fronto-parietals are a pair of long, broad, flattened and membranous bones. They are united along the mid-dorsal line and form the whole roof of cranium. In larval frog, each fronto-parietal occurs into separate frontal and parietal parts, but in adult frog, they become fused to form a single frontoparietal. The entire floor of cranium is covered and strengthened by a large parasphenoid bone.

57. (b) : In adult frog, gills disappear and their skeletal framework is also reduced to form hyoid apparatus. It lies below tongue in the floor of mouth and provides surface of attachment to the tongue.

Pterygoid contributes to the postero-ventral margin of orbit of its side. Palatine connects the anterior side of cranium with the middle of maxilla. Parasphenoid forms floor of the cranium.

58. (c) : The bony partition between tympanic cavity (cavity of middle ear) and auditory capsule (internal ear) is perforated by a small window-like oval aperture, the fenestra ovalis, which remains closed by a membrane and a cartilaginous nodule, the stapedial plate.

59. (d) : Mesonephros kidney is present in both adult as well as embryo of frog. A mesonephros develops from the middle part of intermediate mesoderm, posterior to each pronephros soon after its degeneration.

60. (d) : An epithelial tissue which has thin flat cells, arranged edge to edge so as to appear like closely packed tiles is known as pseudostratified epithelium. It covers moist surfaces where there is little wear and tear by friction such as inner lining of cheeks.

61. (a) : Each hair is present in a tubular pit called hair follicle which is made up by sinking of epidermis. Living cells are present only at the base of hair *i.e.* in hair papilla, rest of the hair is dead and is divisible into outer cuticle, middle cortex and inner medulla.

62. (c) : Stratum malpighii/stratum germinativum is the innermost layer of the skin consisting of one celled thick columnar epithelial cells. It lies on the basement layer. Its cells are active and continuously produce new cells by mitotic division that is why called germinative layer.

63. (a) : Bone is an unusual tissue in that it is continually being reconstructed. The osteoblasts secrete bone matrix, whereas the large, much branched, motile, lysosome-rich, multinucleate cells, called osteoclasts, destroy bone matrix. The twin process of resorption and resconstruction enables a particular bone to remodel its structure to meet any change in the mechanical requirements of the animal during its development.

64. (d) : Mucus helps frog in forming moist skin as skin is its respiratory organ.

65. (a) : The smooth muscle consists of long, narrow unbranched spindle-shaped fibres. Each fibre contains a single oval nucleus in its thick middle part. The cross-striations are absent so that the fibres look smooth, hence the name nonstriated. Its contraction is not under the control of the animal, therefore, also called involuntary muscle.

66. (a) : In male cockroach, 9^{th} sternum bears a pair of short, unjointed thread-like anal styles which are absent in female. Anal cerci and antennae are present in both male and female cockroaches.

67. (b) : In each of the segments 7, 9, 12 and 13 is found a pair of large, thick, muscular and rhythmically contractile vertical vessels, called hearts. They pump blood from dorsal to ventral vessel, while flow in opposite direction is prevented by internal valves. Hearts of 7^{th} and 9^{th} segments connect dorsal and ventral vessels only and are called lateral hearts. Those of 12^{th} and 13^{th} segments connect both dorsal and supra-oesophageal vessels with ventral vessel, and are designated as latero-oesophageal hearts.

68. (d) : Circulatory or blood vascular system of earthworm is a closed system consisting of blood vessels and capillaries which ramify to all parts of the body. Blood is composed of a fluid plasma and colourless corpuscles, physiologically comparable to the leucocytes of the vertebrates. The red respiratory pigment, haemoglobin (or erythrocruorin) occurs dissolved in plasma. It gives a red colour to blood and aids in the transportation of oxygen for respiration.

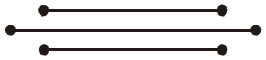
69. (b) : *Pheretima posthuma* is highly useful and beneficial in agriculture. Its habit of burrowing and swallowing earth makes it porous and increases the soil fertility in many ways. Their burrows permit penetration of air and moisture in porous soil and their excretory wastes and other secretions also enrich soil by adding nitrogenous matters to the soil.
Pheretima posthuma is not used as fish meal. Whereas a small white earthworm (*Enchytraeus albidus*) is often grown in soil and used to feed aquarium fish.

70. (a) : Small bones are solid. Long bones, such as the humerus and femur, have a cavity, the marrow cavity, at the centre. The substance of the bone is distinguishable into 3 regions : periosteum, matrix and endosteum. The matrix of bone along with the bone forming cells (osteoblasts) is arranged in concentric layers (lamellae) round the small canals which run parallel to the long axis (shaft) of the bone. These canals, called Haversian canals, are interconnected with one another via Volkmann's canals and contain a blood vessel, a nerve and a lymph vessel. Bone cells remain alive and once they have completely surrounded by the hard bone matrix, they are called osteocytes. The osteocytes are embedded in fluid-filled cavities within the concentric lamellae. These cavities are known as lacunae and occur at regular intervals in these concentric layers of bone tissue. The lacunae are connected to one another and to the Haversian canals by a system of interconnecting canals known as canaliculi. Each Haversian canal, its concentric lamellae, lacunae with osteocytes and canaliculi forms a long cylinder and is called a Haversian system. Separate Haversian systems are joined to each other by means of interstitial lamellae.

71. (a) : *Refer to answer 52.*

72. (b) : Red pigment of vertebrate blood is haemoglobin. Haemoglobin is a conjugated protein. It consists of a basic protein globin joined to a nonprotein group heme, hence the name haemoglobin. Heme is an iron-porphyrin ring. A mammalian haemoglobin molecule is a complex of 4 heme molecules joined with 4 globin molecules.

73. (c) : Photoreceptors restricted only to dorsal surface, are more numerous on prostomium and peristomium of earthworm and gradually reduce in number towards posterior end of body. They are totally absent in clitellum. Each photoreceptor consists of a single ovoid cell, with a nucleus and clear cytoplasm containing a network of neurofibrillae and a small transparent L-shaped lens or optic organelle or phaosome, made up of a hyaline substance. Photoreceptors enable worms to judge the intensity and duration of light.



Chapter

8

Cell - The Unit of Life

1. Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP?
(a) Ribosome (b) Chloroplast
(c) Mitochondrion (d) Lysosome
(NEET 2017)

2. Select the mismatch.
(a) Gas vacuoles – Green bacteria
(b) Large central vacuoles – Animal cells
(c) Protists – Eukaryotes
(d) Methanogens – Prokaryotes
(NEET-II 2016)

3. Select the wrong statement.
(a) Bacterial cell wall is made up of peptidoglycan.
(b) Pili and fimbriae are mainly involved in motility of bacterial cells.
(c) Cyanobacteria lack flagellated cells.
(d) *Mycoplasma* is a wall-less microorganism.
(NEET-II 2016)

4. A cell organelle containing hydrolytic enzymes is
(a) lysosome (b) microsome
(c) ribosome (d) mesosome.
(NEET-II 2016)

5. Mitochondria and chloroplast are
(A) semi-autonomous organelles
(B) formed by division of pre-existing organelles and they contain DNA but lack protein synthesising machinery.
Which one of the following options is correct?
(a) (A) is true but (B) is false.
(b) Both (A) and (B) are false.
(c) Both (A) and (B) are correct.
(d) (B) is true but (A) is false. *(NEET-I 2016)*

6. Microtubules are the constituents of
(a) centrioles, spindle fibres and chromatin
(b) centrosome, nucleosome and centrioles
(c) cilia, flagella and peroxisomes
(d) spindle fibres, centrioles and cilia.
(NEET-I 2016)

7. Which one of the following cell organelles is enclosed by a single membrane?
(a) Lysosomes (b) Nuclei
(c) Mitochondria (d) Chloroplasts
(NEET-I 2016)

8. Match the columns and identify the correct option.

	Column I		**Column II**
A.	Thylakoids	(i)	Disc-shaped sacs in Golgi apparatus
B.	Cristae	(ii)	Condensed structure of DNA
C.	Cisternae	(iii)	Flat membranous sacs in stroma
D.	Chromatin	(iv)	Infoldings in mitochondria

(a) A-(iii), B-(i), C-(iv), D-(ii)
(b) A-(iii), B-(iv), C-(ii), D-(i)
(c) A-(iv), B-(iii), C-(i), D-(ii)
(d) A-(iii), B-(iv), C-(i), D-(ii) *(2015)*

9. Which of the following structures is not found in a prokaryotic cell?
(a) Mesosome (b) Plasma membrane
(c) Nuclear envelope (d) Ribosome
(2015)

10. Cellular organelles with membranes are
(a) endoplasmic reticulum, ribosomes and nuclei
(b) lysosomes, Golgi apparatus and mitochondria
(c) nuclei, ribosomes and mitochondria
(d) chromosomes, ribosomes and endoplasmic reticulum.
(2015)

11. Which of the following are not membrane - bound?
(a) Lysosomes (b) Mesosomes
(c) Vacuoles (d) Ribosomes
(2015)

12. DNA is not present in
(a) nucleus (b) mitochondria
(c) chloroplast (d) ribosomes.
(2015 Cancelled)

13. Nuclear envelope is a derivative of
(a) microtubules
(b) rough endoplasmic reticulum
(c) smooth endoplasmic reticulum
(d) membrane of Golgi complex.
(2015 Cancelled)

14. The structures that are formed by stacking of organised flattened membranous sacs in the chloroplasts are
(a) stroma lamellae (b) stroma
(c) cristae (d) grana.
(2015 Cancelled)

15. Select the correct matching in the following pairs.
(a) Rough ER – Synthesis of glycogen
(b) Rough ER – Oxidation of fatty acids
(c) Smooth ER – Oxidation of phospholipids
(d) Smooth ER – Synthesis of lipids
(2015 Cancelled)

16. The chromosomes in which centromere is situated close to one end are
(a) telocentric (b) sub-metacentric
(c) metacentric (d) acrocentric.
(2015 Cancelled)

17. Which one of the following is not an inclusion body found in prokaryotes?
(a) Glycogen granule
(b) Polysome
(c) Phosphate granule
(d) Cyanophycean granule *(2015 Cancelled)*

18. The solid linear cytoskeletal elements having a diameter of 6 nm and made up of a single type of monomer are known as
(a) microtubules
(b) microfilaments
(c) intermediate filaments
(d) lamins. *(2014)*

19. The osmotic expansion of a cell kept in water is chiefly regulated by
(a) mitochondria (b) vacuoles
(c) plastids (d) ribosomes.
(2014)

20. Match the following and select the correct answer.

(A) Centriole	(i) lnfoldings in mitochondria
(B) Chlorophyll	(ii) Thylakoids
(C) Cristae	(iii) Nucleic acids
(D) Ribozymes	(iv) Basal body of cilia or flagella

	A	B	C	D
(a)	(iv)	(ii)	(i)	(iii)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(i)	(iii)	(ii)	(iv)
(d)	(iv)	(iii)	(i)	(ii)

(2014)

21. The Golgi complex plays a major role
(a) as energy transferring organelles
(b) in post translational modification of proteins and glycosylation of lipids
(c) in trapping the light and transforming it into chemical energy
(d) in digesting proteins and carbohydrates.
(NEET 2013)

22. Which one of the following organelle in the figure correctly matches with its function?

(a) Golgi apparatus, formation of glycolipids
(b) Rough endoplasmic reticulum, protein synthesis
(c) Rough endoplasmic reticulum, formation of glycoproteins
(d) Golgi apparatus, protein synthesis
(NEET 2013)

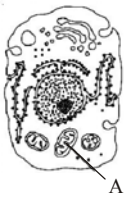
23. A major site for synthesis of lipids is
(a) symplast (b) nucleoplasm
(c) RER (d) SER.
(NEET 2013)

24. The term 'glycocalyx' is used for
(a) a layer present between cell wall and membrane of bacteria
(b) cell wall of bacteria
(c) bacterial cell glyco-engineered to possess N-glycosylated proteins
(d) a layer surrounding the cell wall of bacteria.
(Karnataka NEET 2013)

25. Which of the following types of plastid does not contain stored food material?
(a) Chromoplasts (b) Elaioplasts
(c) Aleuroplasts (d) Amyloplasts
(Karnataka NEET 2013)

26. Which of the following best illustrates "feedback" in development?
(a) Tissue X secretes RNA which changes the development of tissue Y.
(b) As tissue X develops, it secretes enzymes that inhibit the development of tissue Y.
(c) As tissue X develops, it secretes something that induces tissue Y to develop.
(d) As tissue X develops, it secretes something that slows down the growth of tissue Y.
(Karnataka NEET 2013)

27. Select the alternative giving correct identification and function of the organelle 'A' in the diagram.



(a) Mitochondria - Produce cellular energy in the form of ATP
(b) Golgi body - Provides packaging material
(c) Lysosomes - Secrete hydrolytic enzymes
(d) Endoplasmic reticulum - Synthesis of lipids
(Karnataka NEET 2013)

28. Select the correct statement from the following regarding cell membrane.
(a) Na^+ and K^+ ions move across cell membrane by passive transport.
(b) Proteins make up 60 to 70% of the cell membrane.
(c) Lipids are arranged in a bilayer with polar heads towards the inner part.
(d) Fluid mosaic model of cell membrane was proposed by Singer and Nicolson.
(2012)

29. What is true about ribosomes?
(a) The prokaryotic ribosomes are 80S, where "S" stands for sedimentation coefficient.
(b) These are composed of ribonucleic acid and proteins.
(c) These are found only in eukaryotic cells.
(d) These are self-splicing introns of some RNAs. *(2012)*

30. Which one of the following does not differ in *E.coli* and *Chlamydomonas*?
(a) Ribosomes
(b) Chromosomal organization
(c) Cell wall
(d) Cell membrane *(2012)*

31. Which one of the following cellular parts is correctly described?
(a) Thylakoids - flattened membranous sacs forming the grana of chloroplasts
(b) Centrioles - sites for active RNA synthesis
(c) Ribosomes - those on chloroplasts are larger (80S) while those in the cytoplasm are smaller (70S)
(d) Lysosomes - optimally active at a pH of about 8.5 *(Mains 2012)*

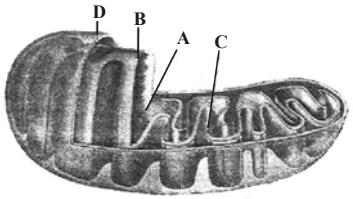
32. Which one of the following structures is an organelle within an organelle?
(a) Ribosome (b) Peroxisome
(c) ER (d) Mesosome
(Mains 2012)

33. Peptide synthesis inside a cell takes place in
(a) chloroplast (b) mitochondria
(c) chromoplast (d) ribosomes.
(2011)

34. Important site for formation of glycoproteins and glycolipids is
(a) vacuole (b) Golgi apparatus
(c) plastid (d) lysosome. *(2011)*

35. Which one of the following is not considered as a part of the endomembrane system?
(a) Golgi complex (b) Peroxisome
(c) Vacuole (d) Lysosome
(Mains 2011)

36. The figure below shows the structure of a mitochondrion with its four parts labelled A, B, C and D. Select the part correctly matched with its function.



(a) D (outer membrane) – gives rise to inner membrane by splitting
(b) B (inner membrane) – forms infoldings called cristae
(c) C (crista) – possesses single circular DNA molecule and ribosomes
(d) A (matrix) – major site for respiratory chain enzymes *(Mains 2011)*

37. The plasma membrane consists mainly of
(a) phospholipids embedded in a protein bilayer
(b) proteins embedded in a phospholipid bilayer

(c) proteins embedded in a polymer of glucose molecules
(d) proteins embedded in a carbohydrate bilayer. *(2010)*

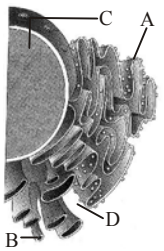
38. The main area of various types of activities of a cell is
(a) plasma membrane
(b) mitochondrion
(c) cytoplasm
(d) nucleus. *(2010)*

39. Which one of the following has its own DNA?
(a) Mitochondria (b) Dictyosome
(c) Lysosome (d) Peroxisome *(2010)*

40. Which one of the following structures between two adjacent cells is an effective transport pathway?
(a) Plasmodesmata
(b) Plastoquinones
(c) Endoplasmic reticulum
(d) Plasmalemma *(2010)*

41. An elaborate network of filamentous proteinaceous structures present in the cytoplasm which helps in the maintenance of cell shape is called
(a) thylakoid
(b) endoplasmic reticulum
(c) plasmalemma
(d) cytoskeleton. *(Mains 2010)*

42. Identify the components labelled A, B, C and D in the diagram below from the list (i) to (viii) given along with



Components:

(i) Cristae of mitochondria
(ii) Inner membrane of mitochondria
(iii) Cytoplasm
(iv) Smooth endoplasmic reticulum
(v) Rough endoplasmic reticulum
(vi) Mitochondrial matrix
(vii) Cell vacuole
(viii) Nucleus

The correct components are:

	A	B	C	D
(a)	(v)	(iv)	(viii)	(iii)
(b)	(i)	(iv)	(viii)	(vi)
(c)	(vi)	(v)	(iv)	(vii)
(d)	(v)	(i)	(iii)	(ii)

(Mains 2010)

43. Middle lamella is composed mainly of
(a) muramic acid
(b) calcium pectate
(c) phosphoglycerides
(d) hemicellulose. *(2009)*

44. Cytoskeleton is made up of
(a) callose deposits
(b) cellulosic microfibrils
(c) proteinaceous filaments
(d) calcium carbonate granules. *(2009)*

45. Plasmodesmata are
(a) locomotary structures
(b) membranes connecting the nucleus with plasmalemma
(c) connections between adjacent cells
(d) lignified cemented layers between cells. *(2009)*

46. In germinating seeds fatty acids are degarded exclusively in the
(a) peroxisomes (b) mitochondria
(c) proplastids (d) glyoxysomes. *(2008)*

47. Vacuole in a plant cell
(a) lacks membrane and contains air
(b) lacks membrane and contains water and excretory substances
(c) is membrane-bound and contains storage proteins and lipids
(d) is membrane-bound and contains water and excretory substances. *(2008)*

48. The two sub-units of ribosome remain united at a critical ion level of
(a) magnesium (b) calcium
(c) copper (d) manganese. *(2008)*

49. Keeping in view the 'fluid mosaic model' for the structure of cell membrane, which one of the following statement is correct with respect to the movements of lipids and proteins from one lipid monolayer to the other (described as flipflop movement)?
(a) While proteins can flip-flop, lipids can not
(b) Neither lipids, nor proteins can flip-flop
(c) Both lipids and proteins can flip-flop
(d) While lipids can rarely flip-flop, proteins cannot. *(2008)*

50. Which one of the following is not a constituent of cell membrane?
(a) Glycolipids (b) Proline
(c) Phospholipids (d) Cholesterol *(2007)*

51. Select the wrong statement from the following.
(a) Both chloroplasts and mitochondria have an internal compartment, the thylakoid space bounded by the thylakoid membrane.
(b) Both chloroplasts and mitochondria contain DNA.
(c) The chloroplasts are generally much larger than mitochondria.
(d) Both chloroplasts and mitochondria contain an inner and an outer membrane. *(2007)*

52. Biological organisation starts with
(a) cellular level
(b) organismic level
(c) atomic level
(d) submicroscopic molecular level. *(2007)*

53. Which of the following statements regarding mitochondrial membrane is not correct ?
(a) The outer membrane resembles a sieve.
(b) The outer membrane is permeable to all kinds of molecules.
(c) The enzymes of the electron transfer chain are embedded in the outer membrane.
(d) The inner membrane is highly convoluted forming a series of infoldings. *(2006)*

54. Which of the following statements regarding cilia is not correct ?
(a) Cilia contain an outer ring of nine doublet microtubules surrounding two singlet microtubules.
(b) The organized beating of cilia is controlled by fluxes of Ca^{2+} across the membrane.
(c) Cilia are hair-like cellular appendages.
(d) Microtubules of cilia are composed of tubulin. *(2006)*

55. A major breakthrough in the studies of cells came with the development of electron microscope. This is because
(a) the electron microscope is more powerful than the light microscope as it uses a beam of electrons which has wavelength much longer than that of photons
(b) the resolving power of the electron microscope is much higher than that of the light microscope
(c) the resolving power of the electron microscope is 200 - 350 nm as compared to 0.1 - 0.2 nm for the light microscope
(d) electron beam can pass through thick materials, whereas light microscopy requires thin sections. *(2006)*

56. Chlorophyll in chloroplasts is located in
(a) grana
(b) pyrenoid
(c) stroma
(d) both grana and stroma. *(2005)*

57. A student wishes to study the cell structure under a light microscope having 10X eyepiece and 45X objective. He should illuminate the object by which one of the following colours of light so as to get the best possible resolution?
(a) Blue (b) Green
(c) Yellow (d) Red *(2005)*

58. According to widely accepted "fluid mosaic model" cell membranes are semi-fluid, where lipids and integral proteins can diffuse randomly. In recent years, this model has been modified in several respects. In this regard, which of the following statements is incorrect?
(a) Proteins in cell membranes can travel within the lipid bilayer.
(b) Proteins can also undergo flip-flop movements in the lipid bilayer.
(c) Proteins can remain confined within certain domains of the membrane.
(d) Many proteins remain completely embedded within the lipid bilayer. *(2005)*

59. Centromere is required for
(a) movement of chromosomes towards poles
(b) cytoplasmic cleavage
(c) crossing over
(d) transcription. *(2005)*

60. Chemiosmotic theory of ATP synthesis in the chloroplasts and mitochondria is based on
(a) membrane potential
(b) accumulation of Na ions
(c) accumulation of K ions
(d) proton gradient. *(2005)*

61. The main organelle involved in modification and outing of newly synthesized proteins to their destinations is
(a) chloroplast
(b) mitochondria
(c) lysosome
(d) endoplasmic reticulum. *(2005)*

62. The telomeres of eukaryotic chromosomes consist of short sequences of
(a) thymine rich repeats
(b) cytosine rich repeats
(c) adenine rich repeats
(d) guanine rich repeats. *(2004)*

63. In chloroplasts, chlorophyll is present in the
(a) outer membrane (b) inner membrane
(c) thylakoids (d) stroma. *(2004)*

64. Cellular totipotency is demonstrated by
(a) only gymnosperm cells
(b) all plant cells
(c) all eukaryotic cells
(d) only bacterial cells. *(2003)*

65. Ribosomes are produced in
(a) nucleolus (b) cytoplasm
(c) mitochondria (d) golgi body. *(2002)*

66. In fluid mosaic model of plasma membrane
(a) upper layer is non-polar and hydrophilic
(b) upper layer is polar and hydrophobic
(c) phospholipids form a bimolecular layer in middle part
(d) proteins form a middle layer. *(2002)*

67. Element necessary for the middle lamella is
(a) Ca (b) Zn
(c) K (d) Cu. *(2001)*

68. Microtubules are absent in
(a) mitochondria (b) flagella
(c) spindle fibres (d) centrioles. *(2001)*

69. Proteinaceous pigment which controls the activities concerned with light is
(a) phytochrome (b) chlorophyll
(c) anthocyanin (d) carotenoids. *(2001)*

70. Lysosome contains
(a) oxidative enzymes
(b) hydrolytic enzymes
(c) reductive enzymes
(d) anabolic enzymes. *(2000)*

71. Which of the following ribosomes are engaged in protein synthesis in animal cell?
(a) Ribosomes which occur on nuclear membrane and ER
(b) Ribosomes of only cytosol
(c) Ribosomes of only nucleolus and cytosol
(d) Ribosomes of only mitochondria and cytosol *(2000)*

72. Function of telomeres in nucleus is
(a) poleward movement
(b) to initiate the RNA synthesis
(c) to seal the ends of chromosome
(d) to recognise the homologous chromosome. *(2000)*

73. Which cell organelle is concerned with glycosylation of protein?
(a) Ribosome
(b) Peroxisome
(c) Endoplasmic reticulum
(d) Mitochondria *(2000)*

74. Which of the following organelles has single membrane?
(a) Mitochondria (b) Spherosomes
(c) Nucleus (d) Cell wall *(1999)*

75. The proteins are synthesized at
(a) centrosomes (b) Golgi bodies
(c) ribosomes (d) mitochondria. *(1999)*

76. Which of the following structures will not be common to mitotic cell of a higher plant?
(a) Centriole (b) Spindle fibre
(c) Cell plate (d) Centromere *(1997)*

77. The mechanism of ATP formation both in chloroplast and mitochondria is explained by
(a) chemiosmotic theory
(b) Munch's hypothesis (mass flow model)
(c) relay pump theory of Godlewski
(d) Cholodny-Wont's model. *(1997)*

78. Protein synthesis in an animal cell, takes place
(a) in the cytoplasm as well as endoplasmic reticulum
(b) only on ribose attached to nucleon
(c) only in the cytoplasm
(d) in the nucleolus as well as in the cytoplasm. *(1997)*

79. Lysosomes are rich in
(a) nucleic acids
(b) hydrolytic enzymes
(c) carbohydrates
(d) hormones. *(1996)*

80. Colchicine is an inhibitory chemical, which
(a) stops the functioning of centriole
(b) prevents attaching of centromeres with rays
(c) prevents the spindle formation in mitosis
(d) prevents the formation of equatorial plane. *(1996)*

81. The prokaryotic flagella possess
(a) helically arranged protein molecule
(b) "9 + 2" membrane enclosed structure
(c) unit membrane enclosed fibre
(d) protein membrane enclosed fibre. *(1995)*

82. The desmosomes are concerned with
(a) cell division (b) cell adherence
(c) cytolysis (d) cellular excretion. *(1995)*

83. Which of the following organelles contain enzymes that have digestive action?
(a) Ribosomes (b) Polysomes
(c) Plastids (d) Lysosomes *(1994)*

84. In mitochondria, cristae act as sites for
(a) protein synthesis
(b) phosphorylation of flavoproteins
(c) breakdown of macromolecules
(d) oxidation-reduction reaction. *(1994)*

85. Centromere is required for
(a) replication of DNA
(b) chromosome segregation
(c) poleward movement of chromosomes
(d) cytoplasmic cleavage. *(1994)*

86. Which one of the following organelles is located near the nucleus and contains a collection of flattened membrane bound cisternae?
(a) Nucleolus (b) Mitochondrion
(c) Centriole (d) Golgi apparatus *(1994)*

87. The inner membrane of the mitochondria is, usually, highly convoluted forming a series of infoldings known as
(a) thylakoids (b) lamellae
(c) cristae (d) grana. *(1994)*

88. Besides giving out secretory vesicles, the Golgi apparatus is also concerned with the formation of
(a) lysosomes
(b) plastids
(c) grana of chloroplasts
(d) cell plates after cell division in plants. *(1994)*

89. Active and passive transports across cell membrane differ in
(a) passive transport is nonselective
(b) passive transport is along the concentration gradient while active transport is due to metabolic energy
(c) active transport is more rapid
(d) passive transport is confined to anions while active transport in confined to cations. *(1993)*

90. Balbiani rings (puffs) are sites of
(a) DNA replication
(b) RNA and protein synthesis
(c) synthesis of polysaccharides
(d) synthesis of lipids. *(1993)*

91. In plant cells, peroxisomes are associated with
(a) photorespiration (b) phototropism
(c) photoperiodism (d) photosynthesis. *(1993)*

92. Membranous bag with hydrolytic enzymes which is used for controlling intracellular digestion of macromolecules is
(a) endoplasmic reticulum
(b) nucleosome
(c) lysosome
(d) phagosome. *(1993)*

93. Golgi apparatus is absent in
(a) higher plants
(b) yeast
(c) bacteria and blue-green algae
(d) none. *(1993)*

94. Cell recognition and adhesion occur due to biochemicals of cell membranes named
(a) proteins
(b) lipids
(c) proteins and lipids
(d) glycoproteins and glycolipids. *(1993)*

95. In salivary gland chromosomes/polytene chromosomes, pairing is
(a) absent
(b) occasional
(c) formed between nonhomologous chromosomes
(d) formed between homologous chromosomes. *(1993)*

96. Which is correct about cell theory in view of current status of our knowledge about cell structure?
(a) It needs modification due to discovery of subcellular structures like chloroplasts and mitochondria.
(b) Modified cell theory means that all living being are composed of cells capable of reproducing.
(c) Cell theory does not hold good because all living beings (*e.g.*, viruses) do not have cellular organisation.
(d) Cell theory means that all living objects consists of cells whether or not capable of reproducing. *(1993)*

97. Names of Schleiden and Schwann are associated with
(a) protoplasm as the physical basis of life
(b) cell theory
(c) theory of cell lineage
(d) nucleus functions as control centre of cell. *(1993)*

98. Binding of specific protein on regulatory DNA sequency can be studied by means of
(a) ultra centrifugation
(b) electron microscope
(c) light microscope
(d) X-rays crystallography. *(1993)*

99. All types of plastids possess essentially the same structure because they
(a) perform the same function
(b) store food materials like starch, fat and protein
(c) occur in aerial parts
(d) can transform from one form to another. *(1992)*

100. Experiments on *Acetabularia* by Hammerling proved the role of
(a) cytoplasm in controlling differentiation
(b) nucleus in heredity
(c) chromosomes in heredity
(d) nucleo-cytoplasmic ratio. *(1992)*

101. Which one is *apparato reticolare*?
(a) Golgi apparatus
(b) Endoplasmic reticulum
(c) Microfilaments
(d) Microtubules *(1992)*

102. An outer covering membrane is absent over
(a) nucleolus (b) lysosome
(c) mitochondrion (d) plastid. *(1992)*

103. All plastids have similar structure because they can
(a) store starch, lipids and proteins
(b) get transformed from one type to another
(c) perform same function
(d) be present together. *(1992)*

104. Oxysomes or $F_0 - F_1$ particles occur on
(a) thylakoids
(b) mitochondrial surface
(c) inner mitochondrial membrane
(d) chloroplast surface. *(1992)*

105. Ribosomes are the centre for
(a) respiration
(b) photosynthesis
(c) protein synthesis
(d) fat synthesis. *(1992)*

106. Angstrom (Å) is equal to
(a) 0.01 mm (b) 0.001 mm
(c) 0.0001 mm (d) 0.00001 mm. *(1992)*

107. Electron microscope has a high resolution power. This is due to
(a) electromagnetic lenses
(b) very low wavelength of electron beam
(c) low wavelength of light source used
(d) high numerical aperture of glass lenses used. *(1992, 1990)*

108. Addition of new cell wall particles amongst the existing ones is
(a) deposition (b) apposition
(c) intussusception (d) aggregation. *(1991)*

109. Cell wall shows
(a) complete permeability
(b) semipermeability
(c) differential permeability
(d) impermeability. *(1991)*

110. Ribosomes were discovered by
(a) Golgi (b) Porter
(c) de Robertis (d) Palade. *(1991)*

111. Fluid mosaic model of cell membrane was put forward by
(a) Danielli and Davson
(b) Singer and Nicolson
(c) Garner and Allard
(d) Watson and Crick. *(1991)*

112. Resolution power is the ability to
(a) distinguish two close points
(b) distinguish two close objects
(c) distinguish amongst organelles
(d) magnify image. *(1991)*

113. Hammerling's experiments of *Acetabularia* involved exchanging
(a) cytoplasm
(b) nucleus
(c) rhizoid and stalk
(d) gametes. *(1990)*

114. The latest model for plasma membrane is
(a) lamellar model
(b) unit membrane model
(c) fluid mosaic model
(d) molecular lipid model. *(1990)*

115. Magnification of compound microscope is not connected with
(a) numerical aperture
(b) focal length of objective
(c) focal length of eye piece
(d) tube length. *(1990)*

116. A bivalent consists of
(a) two chromatids and one centromere
(b) two chromatids and two centromeres
(c) four chromatids and two centromeres
(d) four chromatids and four centromeres. *(1989)*

117. Nucleoproteins are synthesised in
(a) nucleoplasm (b) nuclear envelope
(c) nucleolus (d) cytoplasm. *(1989)*

118. Polyribosomes are aggregates of
(a) ribosomes and *r*RNA
(b) only *r*RNA
(c) peroxisomes
(d) several ribosomes held together by string of *m*RNA. *(1989)*

119. Plasma membrane is made of
(a) proteins and carbohydrates
(b) proteins and lipids
(c) proteins, lipids and carbohydrates
(d) proteins, some nucleic acid and lipids. *(1989)*

120. Organelles can be separated from cell homogenate through
(a) chromatography
(b) X-rays diffraction
(c) differential centrifugation
(d) auto-radiography. *(1989)*

121. *Acetabularia* used in Hammerling's nucleocytoplasmic experiments is
(a) unicellular fungus
(b) multicellular fungus
(c) unicellular uninucleate green algae
(d) unicellular multinucleate green algae. *(1988)*

122. According to fluid mosaic model, plasma membrane is composed of
(a) phospholipids and oligosaccharides
(b) phospholipids and hemicellulose
(c) phospholipids and integral proteins
(d) phospholipids, extrinsic proteins and intrinsic proteins. *(1988)*

Answer Key

1.	(c)	**2.**	(b)	**3.**	(b)	**4.**	(a)	**5.**	(a)	**6.**	(d)	**7.**	(a)	**8.**	(d)	**9.**	(c)	**10.**	(b)
11.	(d)	**12.**	(d)	**13.**	(b)	**14.**	(d)	**15.**	(d)	**16.**	(d)	**17.**	(b)	**18.**	(b)	**19.**	(b)	**20.**	(a)
21.	(b)	**22.**	(b)	**23.**	(d)	**24.**	(d)	**25.**	(a)	**26.**	(c)	**27.**	(a)	**28.**	(d)	**29.**	(b)	**30.**	(d)
31.	(a)	**32.**	(a)	**33.**	(d)	**34.**	(b)	**35.**	(b)	**36.**	(b)	**37.**	(b)	**38.**	(c)	**39.**	(a)	**40.**	(a)
41.	(d)	**42.**	(a)	**43.**	(b)	**44.**	(c)	**45.**	(c)	**46.**	(d)	**47.**	(d)	**48.**	(a)	**49.**	(d)	**50.**	(b)
51.	(a)	**52.**	(d)	**53.**	(c)	**54.**	(b)	**55.**	(b)	**56.**	(a)	**57.**	(a)	**58.**	(b)	**59.**	(a)	**60.**	(d)
61.	(d)	**62.**	(d)	**63.**	(c)	**64.**	(b)	**65.**	(a)	**66.**	(c)	**67.**	(a)	**68.**	(a)	**69.**	(a)	**70.**	(b)
71.	(a)	**72.**	(c)	**73.**	(c)	**74.**	(b)	**75.**	(c)	**76.**	(a)	**77.**	(a)	**78.**	(d)	**79.**	(b)	**80.**	(c)
81.	(a)	**82.**	(b)	**83.**	(d)	**84.**	(d)	**85.**	(c)	**86.**	(d)	**87.**	(c)	**88.**	(a)	**89.**	(b)	**90.**	(b)
91.	(a)	**92.**	(c)	**93.**	(c)	**94.**	(d)	**95.**	(d)	**96.**	(c)	**97.**	(b)	**98.**	(d)	**99.**	(d)	**100.**	(b)
101.	(a)	**102.**	(a)	**103.**	(b)	**104.**	(c)	**105.**	(c)	**106.**	(c)	**107.**	(b)	**108.**	(c)	**109.**	(a)	**110.**	(d)
111.	(b)	**112.**	(b)	**113.**	(c)	**114.**	(c)	**115.**	(a)	**116.**	(c)	**117.**	(d)	**118.**	(d)	**119.**	(c)	**120.**	(c)
121.	(c)	**122.**	(d)																

EXPLANATIONS

1. (c) : Mitochondria are miniature biochemical factories where food stuffs or respiratory substrates are completely oxidised to carbon dioxide and water. The energy liberated in the process is initially stored in the form of reduced coenzymes and reduced prosthetic groups. The latter soon undergo oxidation and form energy rich ATP. ATP comes out of mitochondria and helps perform various energy requiring processes of the cell like muscle contraction, nerve impulse conduction, biosynthesis, membrane transport, cell division, movement, etc. Because of the formation of ATP, the mitochondria are called power houses of the cell.

2. (b) : Large central vacuole is the characteristic of plant cell, not animal cell which may have many small scattered vacuoles.

3. (b) : Pili and fimbriae are bacterial appendages which are not involved in locomotion. Actually, pili are long fewer and thicker tubular outgrowths which develop in response to F^+ or fertility factor in Gram negative bacteria. Being long they are helpful in attaching to recipient cell and forming conjugation tube. Fimbriae are small bristle-like fibres sprouting from cell surface in large number. There are 300-400 of them per cell. They are involved in attaching bacteria to solid surfaces.

4. (a) : Lysosomes are small vesicles which are bounded by a single membrane and contain hydrolytic enzymes in the form of minute crystalline or semicrystalline granules of 5-8 nm. About 50 enzymes have been recorded to occur in them. All the enzymes do not occur in the same lysosome but there are different sets of enzymes in different types of lysosomes. The important enzymes are acid phosphatases, sulphatases, proteases, peptidases, nucleases, lipases and carbohydrases. They are also called acid hydrolases because these digestive enzymes usually function in acidic medium or pH of 4-5.

5. (a) : Both mitochondria and chloroplast are semi-autonomous organelles. They have their own DNA which produces its own, *m*RNA, *t*RNA and *r*RNA. These organelles also possess their own ribosomes and hence are able to synthesise some of their proteins.

6. (d) : Microtubules are unbranched hollow submicroscopic tubules of protein tubulin which develop on specific nucleating regions. It can undergo quick growth or dissolution at their ends by assembly or disassembly of monomers. They are present in the cytoplasm as well as in specialised structures like centrioles, basal bodies, cilia or flagella, sensory hair, equatorial ring of thrombocytes, spindle apparatus, chromosome fibres, nerve processes, sperm tails, axostyle of parasitic flagellates, fibre system of *Stentor*, cyto-pharyngeal basket of *Nassula*, etc.

7. (a) : Lysosomes are small vesicles bounded by a single membrane and contain hydrolytic enzymes. Nucleus, mitochondria and chloroplasts are double membrane bound cells organelles.

8. (d)

9. (c) : A prokaryotic cell is characterised by absence of an organised nucleus and membrane bound cell organelles. DNA is naked *i.e.*, without a nuclear envelope and lies variously coiled in the cytoplasm. It is commonly called nucleoid or genophore. Mesosomes, plasma membrane and 70S ribosomes are present in a prokaryotic cell.

10. (b) : Endoplasmic reticulum, nuclei, lysosomes, Golgi apparatus and mitochondria are membrane bound cell organelles whereas ribosomes are naked ribonucleoprotein protoplasmic particles. Chromosomes are the hereditary particles present in the nucleus.

11. (d) : *Refer to answer 10.*

12. (d) : Ribosome is a small spherical body within a living cell that is the site of protein synthesis. Ribosomes consist of two subunits, one large and one small, each of which comprises some RNA (called ribosomal RNA) and protein. They do not have any DNA.

13. (b) : Recent developments have shown that nuclear membrane is derived from rough endoplasmic reticulum. During cell division, nuclear membrane is disintegrated. The nuclear envelope transmembrane proteins are absorbed in the RER. Once the division is completed, RER reassembles the nuclear envelope.

14. (d) : A chloroplast is a vesicle, bound by an envelope of two unit membranes and filled with a fluid matrix called stroma. The lamellae, after separation from the inner membrane, usually take the form of closed, flattened, ovoid sacs, the thylakoids, which lie closely packed in piles, the grana.

15. (d) : Smooth endoplasmic reticulum (SER) is a system of smooth membranes (*i.e.*, membranes not having ribosomes) within the cytoplasm of plant and animal cells. It forms a link between the cell and nuclear membranes. It is the site of important metabolic reactions, including phospholipid and fatty acid synthesis. In animal cells lipid-like steroidal hormones are also synthesized.

16. (d) : Centromere is a part of a chromosome that attaches to the spindle during cell division. A chromosome with the centromere close to one end is acrocentric.

17. (b) : Polysome is a not an inclusion body. It is an aggregation of ribosomes formed under conditions of high concentration of magnesium. An inclusion body is any of various particulate structures, usually proteins, formed after viral infections in a prokaryotic or eukaryotic cell.

18. (b) : Microtubules are hollow microscopic tubular structures with an external diameter of 24 nm and of variable length. They are composed of tubulin. Intermediate filaments are the numerous microscopic protein fibres of about 10 nm thickness that form part of the cytoskeleton. They are made up of a variety of proteins *e.g.* keratin in nails.

19. (b) : Vacuoles are non cytoplasmic areas present inside cytoplasm and separated from latter by tonoplast. They are believed to be formed by expansion and pinching off from ER. There occurs a large central vacuole and many small vacuoles in plant cells. They play a major role in osmotic expansion of cell.

20. (a)

21. (b) : Post translational modification (PTM) is a step in protein biosynthesis. Proteins are created on ribosomes translating *m*RNA into polypeptide chains. These polypeptide chains undergo PTM, such as folding, cutting and other processes, before becoming the mature protein product. Proteins synthesized by the rough endoplasmic reticulum and lipids synthesized by smooth endoplasmic reticulum reach the cisternae of the Golgi apparatus. Here, they combine with carbohydrates to form glycoproteins and glycolipids. This process is called glycosylation.

22. (b) : The given figure shows endoplasmic reticulum bearing ribosomes on their surface. It is called rough endoplasmic reticulum or RER. RER is actively involved in protein synthesis and secretion.

23. (d) : *Refer to answer 15.*

24. (d) : Glycocalyx is a sticky, gelatinous material that collects outside the cell wall of bacteria to form an additional surface layer. When this layer is firmly attached to the surface of the cell, it is called a capsule. If it is loosely distributed around the cell, the glycocalyx is called a slime layer.

25. (a) : Chromoplasts are yellow or reddish in colour because of the presence of carotenoid pigments. They do not contain stored food material. Chromoplasts are formed either from leucoplasts or chloroplasts. Chromoplasts provide colour to many flowers for attracting pollinating insects. They provide bright red or orange colour to fruits for attracting animals for dispersal.

26. (c) : As tissue X develops it secretes something that induces tissue Y to develop indicating positive feedback mechanism.

27. (a) : *Refer to answer 1.*

28. (d) : According to the fluid mosaic model of cell membrane structure proposed by Singer and Nicolson (1972) plasma membrane contains about 50–60% proteins and 50–40% lipids. Lipids form a bilayer with hydrophilic heads pointing outwards. Cell membrane allows transport of some molecules by passive transport *e.g.*, water, neutral solutes while some are transported actively *e.g.*, Na^+/K^+ pump.

29. (b) : *Refer to answer 12.*

30. (d) : *E.coli* (bacteria) is a prokaryote while *Chlamydomonas* (algae) is a eukaryote. Ribosomes of both groups differ being 70S in prokaryotes and 80S in eukaryotes. Prokaryotic chromosomes lack histone protein unlike eukaryotic ones. Cell wall organization also differs as bacterial cell wall is rich in muramic acid while algal cell wall is cellulosic. It is the cell membrane which has similar organization in both the groups.

31. (a) : Thylakoid are the flattened sac-like membranous structures that are stacked on top of one another to form the grana of plant chloroplast. Chlorophyll and other photosynthetic pigments are situated in the thylakoid membranes, which are the site for the light-dependent reactions of photosynthesis.

32. (a) : Ribosomes occur in all living cells except mammalian erythrocytes or red blood corpuscles. Depending upon the place of their occurrence, ribosomes are of two types–cytoplasmic ribosomes and organelle ribosomes. The cytoplasmic ribosomes (cytoribosomes) may remain free in the cytoplasmic matrix or attached to the cytosolic surface of endoplasmic reticulum with the help of special

ribophorin or SRP protein. The organelle ribosomes are found in plastids (plastiribosomes) and mitochondria (mitoribosomes) Cytoplasmic ribosome are of 80S type in eukaryotic cell whereas organelle ribosomes are of 70S type.

33. (d) : Peptide synthesis inside a cell takes place in ribosome. Ribosomes are found in all cells and are involved in protein synthesis. The major constituents of ribosomes are RNA and proteins present in approximately equal amounts.

34. (b) : Eukaryotic cells contain a unique cluster of membrane vesicles known as Golgi apparatus. It principally performs the function of packaging materials. The newly synthesized proteins are handed over to the Golgi apparatus which is catalysed by the addition of carbohydrates, lipid or sulphates moieties to the proteins. Golgi apparatus is the important site of formation of glycoproteins and glycolipids.

35. (b) : While each of the membranous organelles is distinct in terms of its structure and function, many of these are considered together as an endomembrane system because their functions are coordinated. The endomembrane system include endoplasmic reticulum (ER), Golgi complex, lysosomes and vacuoles. Since the functions of the mitochondria, chloroplast and peroxisomes are not coordinated with the above components, these are not considered as part of the endomembrane system.

36. (b) : Each mitochondrion is a double membrane-bound structure with the outer membrane and the inner membrane dividing its lumen distinctly into two aqueous compartments, *i.e.*, the outer compartment and the inner compartment. The inner compartment is called the matrix. The outer membrane forms the continuous limiting boundary of the organelle. The inner membrane forms a number of infoldings called the cristae towards the matrix. The cristae increase the surface area. The two membranes have their own specific enzymes associated with the mitochondrial function.

37. (b) : Plasma membrane consists of lipids (20-79%), proteins (20-70%), carbohydrates (1-5%) and water (20%). Lipid molecules possess both hydrophobic and hydrophilic ends and are thus arranged in the form of lipid bilayer. Most common lipid of the bilayer is phospholipid. Protein molecules occur at places both inside (intrinsic proteins) and on the outer side (extrinsic proteins) of the phospholipid bilayer.

38. (c) : Cytoplasm is granular, crystallo-colloidal complex that forms the living protoplasm of a cell excluding its nucleus. It consists of proteins, nucleic acids, fats, carbohydrates, vitamins, minerals, waste metabolites, and all the organelles. It is the main area for various types of activities of a cell like respiration, nutrition, storage, etc.

39. (a) : *Refer to answer 5.*

40. (a) : Plasmodesmata are fine cytoplasmic strands that connect the protoplasts of adjacent plant cells by passing through their cell walls. Plasmodesmata are cylindrical in shape (about 20-40 nm in diameter) and are lined by the plasma membrane of the two adjacent cells. They permit the passage between cells of substances including ions, sugars, amino acids, and macromolecules.

41. (d)

42. (a) : A – Rough endoplasmic reticulum
B – Smooth endoplasmic reticulum
C – Nucleus
D – Cytoplasm

43. (b) : Middle lamella of cell wall is composed of calcium and magnesium pectate. It joins the adjoining cells together and thus acts as a cementing layer.

44. (c) : The ability of eukaryotic cells to adopt a variety of shapes and to carry out coordinated and directed movements depends on the cytoskeleton.
The main proteins that are present in the cytoskeleton are tubulin (in the microtubules), actin, myosin, tropomyosin and other (in the microfilaments) and keratins, vimentin, desmin,lamin and other (in intermediate filaments).

45. (c) : *Refer to answer 40.*

46. (d) : Glyoxysomes are small, spherical vesicles enclosed by a single unit membrane. Glyoxysomes are generally found in cells of yeast, *Neurospora* and in germinating fatty seeds where fat is being converted into carbohydrates, *i.e.*, glyoxylate cycle (gluconeogenesis).

47. (d) : In a plant cell, vacuole may be defined as a non-living reservoir, bounded by a differentially or selectively permeable membrane, the tonoplast. It is filled with a highly concentrated solution called vascular sap or cell sap which contains many dissolved solutes such as organic acids, soluble carbohydrates, soluble nitrogenous compounds as nitrates, enzyme, tannins, chlorides, phosphates, amino acids, alkaloids and anthocyanin pigments.

48. (a) : Ribosomes are very small organelles having a diameter of 150 Å – 250 Å. Each ribosome is made up of two subunits, a smaller subunit and another larger subunit. These two subunits are associated with the help of Mg^{2+} ions (at 0.001 M concentration). If the Mg^{2+} ions concentration is less in cytoplasm, the two units of ribosome separate but when the Mg^{2+} ions concentration is increased ten times, the two unites and form a dimer.

49. (d) : According to fluid mosaic model there is rapid internal motion involving flexing within each lipid molecule a rapid lateral diffusion of the lipids is possible and a slow 'flip-flop' motion, *i.e.*, a transfer of lipid molecules from one side of the bilayer to the other, is also possible. The lipid molecules might also rotate about their axes. The proteins of the membrane are concerned with the enzymatic activity of the membrane, with transport of molecules, and with a receptor function whereas, the lipid bilayer provides the permeability barrier.

50. (b) : Chemically a biomembrane consists of lipids (20-70%), proteins (20-70%), carbohydrates (1-5%) and water (20%). The important lipids of the membrane are phospholipids (some hundred types), sterols, (*e.g.* cholesterol), glycolipids, sphingolipid (*e.g.*, sphingomyelin, cerebrosides). Protein can be fibrous or globular structural carrier, receptor or enzymatic.

51. (a) : *Refer to answer 5.*

52. (d) : Molecular assemblies are large organised sets of molecular units that make up parts of organelles. For example, one common macromolecular assembly is the microtubule which is important in forming structure in the cell related to maintaining the cell structure or related to cell movement. The cell (plasma) membrane that surrounds many organelles and the cell is a highly organised molecular assembly.

53. (c) : The outer membrane of mitochondrion is smooth, freely permeable to most small molecules, contains fewer enzymes and is poor in proteins. It has porin proteins which form channels for the passage of molecules through it. It allows uptake of substrates and release of ATP. The inner membrane is semipermeable and regulates the passage of materials into and out of the mitochondrion. It is rich in enzymes and carrier proteins (permeases). It is usually produced into numerous infolds called cristae (singular crista). It bears minute regularly spaced lollipop-shaped particles known as oxysomes. The rest of the inner membrane contains the electron carrier molecules of the electron transport chain.

54. (b) : Cilia are fine hair like vibratile, cytoplasmic processes borne by certain cell types. Their movement either propel the organism or move the medium past a fixed cell. The cilia are enclosed by a unit membrane which is an extension of the plasma membrane of the cell. Within the membrane, is a fluid matrix having a supporting axial shaft, or axoneme.
The microtubules, single as well as double, are composed of the globular units of the protein tubulin. The arms of A microtubules contain a protein dynein. The latter is ATPase enzyme which catalyzes hydrolysis of ATP to ADP, and transfers the free energy released direct to ciliary work.

55. (b) : Microscopes are used for studying cellular structures. They are used to magnify small objects. In electron microscopes, a high energy beam of electrons is focused through electromagnetic lenses. It can magnify very small details with high resolving power. The increased resolution results from the shorter wavelength of the electron beam.

56. (a) : *Refer to answer 31.*

57. (a) : Resolution of microscope is inversely proportional to wavelength of light used. Out of four options given, blue light has minimum wavelength and hence maximum resolution.

58. (b) : *Refer to answer 49.*

59. (a) : Centromere is the point at which the two chromatids of a chromosome are held together. During movement of chromosomes, the spindle fibres (on which the chromatids move) are attached to the centromere. Crossing over involves physical exchange of genetic material between non-sister chromatids of homologous chromosomes.
Cytoplasmic cleavage is the division of cytoplasm. Transcription is the process in which the genetic information of DNA is transferred to *m*RNA as the first step in protein synthesis.

60. (d) : Chemiosmotic coupling hypothesis is the most widely accepted explanation for oxidative phosphorylation in mitochondria and photophosphorylation in thylakoid membranes. Mitchell proposed the idea of chemiosmotic coupling. He suggested that a concentration gradient of protons is established across the mitochondrial membrane because there is an accumulation of hydrogen ions on one side of the mitochondrial membrane. The proton accumulation is necessary for energy transfer to the endergonic ADP phosphorylation process.

61. (d) : The proteins formed on ribosomes pass into the ER lumen where they are modified. Then the

modified proteins move on into the transitional area, where the ER buds off membranous sacs, the transport vesicles, carrying the proteins to the Golgi apparatus.

62. (d) : Telomeres are highly conserved element throughout the eukaryotes both in structure and function. Telomeric DNA has been shown to consist of simple randomly repeated sequences, characterised by clusters of G residues in one strand and C residues in other strand. A short sequence of (12-16 nucleotides in length) of G rich strand as 3′ overhang is another feature of telomere.

63. (c) : *Refer to answer 31.*

64. (b) : Totipotency is the ability of a living somatic plant cell to develop into a complete plant. It was first demonstrated by Steward et. al (1964) using phloem cells of carrot. This technique is now used for multiplying rare and endangered plants through micro-propagations. This technique is widely used for multiplying plants *e.g.*, *Chrysanthemum*, *Dioscorea floribunda*, *Coleus*, *Crotons*, carnation plants etc.

65. (a) : Nucleolus synthesizes and stores RNA. The ribosomal proteins are synthesized in the cytoplasm and shift to the nucleolus for the formation of ribosomal subunits by complexing with *r*RNA.

66. (c)

67. (a) : Middle lamella is the first formed layer, present between the two adjacent cells. It is situated outside the primary cell wall. It is made up of calcium and magnesium pectate.

68. (a)

69. (a) : Phytochrome is a plant pigment that can detect the presence or absence of light and is involved in regulating many processes that are linked to day length (photoperiod), such as seed germination and initiation of flowering. It consists of a light-detecting portion, called a chromophore, linked to a small protein and exists in two intercovertible forms with different physical properties, particularly in the ability to bind to membranes.

70. (b) : A lysosome is a tiny sac bounded by a single unit membrane of lipoprotein. It contains a dense, finely granular fluid. The latter consists of glycoprotein hydrolytic (digestive) enzymes called acid hydrolases. These include proteases, lipases, nucleases, glycosidases, sulphatases, acid phosphatases, etc.

71. (a) : Ribosomes present in nuclear membrane and endoplasmic reticulum take part in protein synthesis. Two or more ribosomes simultaneously engaged in protein synthesis on the same *m*RNA strand forming polyribosomes. The ribosome functions as a template, bringing together different components required for protein synthesis.

72. (c)

73. (c) : Glycolysation of protein means linking of sugars to proteins which starts in rough endoplasmic reticulum and completed in golgi complex.

74. (b) : The spherosomes are, spherical bodies, about 0.5-1 μm wide and enclosed by a single unit membrane. They contain granular contents rich in lipids but also have some proteins. They occur in most plant cells but are abundant in the endosperm cells of oil seeds. Spherosomes, arise from the endoplasmic reticulum.

75. (c) : The ribosomes provide space for the synthesis of proteins in the cell. Hence, they are known as the "protein factories" of the cell. The ribosomes bound to the membranes generally synthesize proteins for export as secretions by exocytosis, or for incorporation into membranes, or for inclusion into lysosomes.
The free ribosomes generally produce enzymic proteins for use in the cell itself.

76. (a) : The centrioles occur in nearly all animal cells and in motile plant cells, such as zoospores of algae, sperm cells of ferns, and motile algae. They are absent is amoebae, prokaryotic cells, higher gymnosperms and all angiosperms. An interphase (undividing) cell has a pair of centrioles (diplosome) usually near the nucleus. They lie in a small mass of specialized, distinctly staining cytoplasm that lacks other cell organelles. The centrioles and the centrosphere are together referred to as centrosome. Before cell division, the centrioles duplicate so that a dividing cell has a pair of centrioles at each pole of the spindle. Spindle fibre, cell plate and centromere are present in all plant cells.

77. (a) : *Refer to answer 60.*

78. (d) : Protein synthesis in an animal cell, takes place in the nucleolus as well as in the cytoplasm. Main part of protein synthesis (transcription and translation) occurs in nucleolus. Chain elongation occurs in cytoplasm.

79. (b) : *Refer to answer 70.*

80. (c) : Colchicine is an alkaloid derived from the autumn crocus, *Colchicum autumnale*. It inhibits spindle formation in cells during mitosis so that

chromosomes cannot separate during anaphase, thus inducing multiple sets of chromosomes. Colchicine is used in genetics, cytology, and plant breeding research and also in cancer therapy to inhibit cell division.

81. (a) : Prokaryotic flagellum is not surrounded by any membrane. It consists of a single thread. The thread is made of numerous identical spherical protein sub-units called, flagellin. Each subunit is about 40 Å in diameter. The flagellin sub-units are arranged in helical spirals and form a hollow cylinder. Each flagellum is about 120-150 Å thick.

82. (b) : In desmosomes circular patches of cell membranes are held together by interaction of proteins that extend through each membrane into the space between cells. The cell membrane has on the inner side a dense plate of protein for mechanical support and bears fine filaments, the tonofibrils, radiating into the cell. The desmosomes act as "spot welds" and keep the cells firmly together.

83. (d) : *Refer to answer 70.*

84. (d) : Respiratory chain is located in the inner membrane (cristae) of mitochondria. It consists of a series of proteins containing oxidation-reduction groups. Chemical treatment of the mitochondrial membrane results in the isolation of five complexes which have been designated as complexes I, II, III, IV and V.

85. (c) : *Refer to answer 59.*

86. (d) : Golgi apparatus is a stack of parallel, flattened, intercommunicating sacs or cisternae and many peripheral tubules and vesicles. The cisternae vary in number from 3 to 7 in most animal cells and from 10 to 20 in plant cells. They are usually equally spaced in the pile, separated from each other by thin layers of intercisternal cytoplasm. The latter may contain a layer of parallel fibres, called intercisternal elements, that support the cisternae. The cisternae are free of ribosomes and have swollen ends. They look like the smooth endoplasmic reticulum.

87. (c) : *Refer to answer 53.*

88. (a) : The two poles of a Golgi apparatus are called cis face and trans face, which act respectively as the receiving and shipping departments.
The vesicles lie near the ends and concave surface of the Golgi complex. They are pinched off from the tubules of the cisternae. They are of two types : smooth or secretory vesicles, which have a smooth surface and contain secretions of the cell; and coated vesicles, that have rough surface and elaborate membrane proteins. They carry materials to or from the cisternae. The Golgi complex gives rise to primary lysosomes by budding from the trans face of cisternae.

89. (b) : Active and passive transports across cell membrane differ in passive transport is due to metabolic energy. There is always expenditure of energy in active transport.

90. (b) : Balbiani rings (puffs) are site of RNA and protein synthesis. These chromosomes show distinct dark and light bands. Euchromatin is present in dark bands and heterochromatin is present in light bands. These bands helps in mapping of chromosomes in cytogenetic studies. These chromosomes form puffs or loops (in region of dark bands) which are called Balbiani puffs or Balbiani rings where synthesis of *m*RNA occurs.

91. (a) : In plant cells, peroxisomes are associated with photorespiration. Peroxisomes are found only in C_3 plants where a wasteful phenomenon of photorespiration occurs. The other organelles associated with this process are chloroplast and mitochondria. Peroxisomes are also reported in animal cells, *i.e.*, liver and kidney cells. The peroxisome contains several enzyme such as amino transferse, glycolate oxidase, glyoxylate reductase, peroxidase and catalase etc.

92. (c) : *Refer to answer 70.*

93. (c) : Golgi apparatus is absent in bacteria and blue green algae. Golgi bodies are absent in prokaryotic cells and present in eukaryotic cells except in male gametes of bryophytes and pteridophytes, mammalian RBCs, sieve tubes of plants and in cells of fungi.

94. (d) : Cell recognition and adhesion occur due to biochemicals of cell membranes named glycoproteins and glycolipids. These are formed due to small carbohydrate molecules present on lipids and extrinsic proteins.

95. (d) : In salivary gland chromosomes/polytene chromosomes, pairing is formed between homologous chromosomes. A characteristics feature of these chromosomes is that somatic pairing occurs in them and hence their number appears half of normal somatic cells.

96. (c) : Viruses are an exceptions to the cell theory as they are obligate parasites (subcellular in nature).

Paramecium, *Rhizopus*, *Vaucheria* are some examples which may or may not be exceptions to the theory.

97. (b) : Names of Schleiden and Schwann are associated with cell theory in 1839. The concept that "All living organisms are composed of cell" is known as cell theory.

98. (d) : X-rays crystallography is a technique which is used to study of binding protein on regulatory DNA sequence. In this technique, X-rays pass through a crystal of a substance and form a diffraction pattern. With the help of this technique, the arrangement of atoms in the molecular structure of enzymes, proteins, DNA, etc. can be studied. Wilkins, Watson and Crick used this technique to determine the molecular configuration of double helix of DNA.

99. (d) : All the plastids have a common origin and one type of plastid can change into another. Plastids are of 2 main types lencoplasts and chromoplasts. The leucoplasts are colourless and occur in the cells not exposed to sunlight. The chromoplasts are coloured occur in the cells exposed to sunlight.

100. (b) : *Acetabularia* used in Hammerling's nucleocytoplasmic experiment is unicellular uninucleate green algae. Hammerling's experiment on *Acetabularia* involved exchanging rhizoid and stalk. Presence of hereditary information in the nucleous was proved by the work of Hammerling on single celled alga *Acetabularia*.

101. (a) : *Apparato reticolare* are Golgi apparatus. The Golgi apparatus was named after Camillo Golgi (1906) who discovered this cell structure in nerve cells (1898) and assigned it the role of a cell organelle. Inspired by its appearance, Golgi named this cell structure the inner reticular apparatus (*apparato reticolare interno*).

102. (a) : An outer covering membrane is absent over nucleolus. Nucleolus is a dense, spherical, colloidal body which remains attached with nucleolar organizing chromosomes. It was discovered by Fontana (1781) and termed as nucleolus by Bowman (1840). The main function of nucleolus is the synthesis of ribosomal RNA and it is called store house of RNA. It plays important role in cell division also.

103. (b) : *Refer to answer 99.*

104. (c) : Oxysomes or F_0 - F_1 particles occurs on inner mitochondrial membrane. Each particle is made up of base, stalk and head and is about 10 mm in length. The number of oxysomes per mitochondrion varies from 10^4 - 10^5. Chemically these are made up of phospholipid core and protein cortex. Oxysomes have ATP as enzyme molecules and therefore, responsible for ATP synthesis. These elementary particles are also called F_0 - F_1 particles by some workers. The base of these is called F_0 subunit and head is called F_1 subunit.

105. (c) : *Refer to answer 33.*

106. (c) : An angstrom (symbol Å) is a non-SI unit of length that is internationally recognised, equal to 0.1 nanometer (nm). It can be written in scientific notations as 1×10^{-10} m. It is used in expressing the size of atoms, length of chemical bonds etc. It is named after Anders Jonas Angstrom.

Angstrom = 0.0001mm.

107. (b) : *Refer to answer 55.*

108. (c) : Addition of new cell wall particles amongst the existing one is intussusception. Growth of cell wall occurs by two methods - by intussusception and by apposition. By intussusception, the primary wall is stretched and materials of secondary wall are deposited. By apposition, material of secondary wall are deposited in the form of thin layers.

109. (a) : Cell wall shows complete permeability because it helps in the transport of substances into and out of the cell. The main function of cell wall is to provide mechanical support.

110. (d): Ribosomes are minute cellular, non-membranous particles having an average diameter of 23 mm (230 A°). In plant cells ribosomes were first of all observed by Robinson and Brown (1953) in bean roots. In animal cells, these were discovered by Palade (1955), hence are called Palade particles. Ribosomes form a part of fraction microsome, a term given by A. Claude (made of broken ER, ribosomes and Golgi bodies).

111. (b) : *Refer to answer 28.*

112. (b) : Resolution power is the ability to distinguish two close objects. It is the ability of a system to distinguish two close points as two separate points. Resolving power of microscope depends upon the numerical aperature of the objective lens system and its wavelength.

113. (c) : *Refer to answer 100.*

114. (c) : *Refer to answer 28.*

115. (a) : Magnification of compound microscope is not connected with numerical aperature. The magnifying power is represented by the symbol 'X'. The total magnification of a microscope is obtained by multiplying the objective magnification and ocular lens magnification *e.g.*, if the magnifying power of an ocular lens is 10X and of the objective is 40X, then the total magnifying power of a microscope is $10 \times 40 = 400X$.

116. (c) : A bivalent consist of four chromatids and two centromeres. Bivalent is a pair of homologous chromosome lying together in the zygotene stage of prophase I of first meiotic division.

117. (d) : Nucleoproteins are compounds present in cells of living organisms that consist of nucleic acids with proteins. Nucleoproteins are synthesized in cytoplasm. These are conjugated proteins. They are of two types -Deoxyribonucleoproteins and ribo-nucleoproteins.

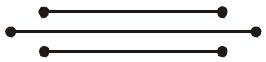
118. (d) : Polyribosomes are aggregates of several ribosomes held together by string of *m*RNA. Polyribosomes consists of 4 - 8 ribosomes which are attached to a single strand of messenger RNA or *m*RNA. This mechanism help in synthesis of several copies of the same protein.

119. (c): *Refer to answer 37.*

120. (c) : Organelles can be separated from cell homogenate through differential centrifugation. The basic principle involved here is sedimentation of particles in a suspension by centrifugal force. In a centrifuge, the particles sediment at different rates when an accelerating force is subjected. The rate of sedimentation depends upon the size of the particles, its shape and density.

121. (c) : *Refer to answer 100.*

122. (d) : *Refer to answer 37.*



Chapter

9

Biomolecules

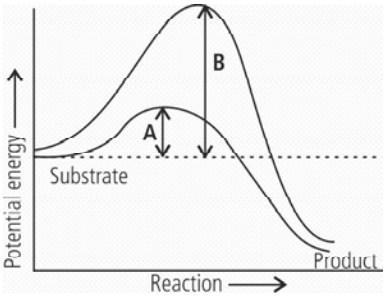
1. Which of the following statements is correct with reference to enzymes?
(a) Holoenzyme = Apoenzyme + Coenzyme
(b) Coenzyme = Apoenzyme + Holoenzyme
(c) Holoenzyme = Coenzyme + Co-factor
(d) Apoenzyme = Holoenzyme + Coenzyme
(NEET 2017)

2. Which of the following are not polymeric?
(a) Proteins (b) Polysaccharides
(c) Lipids (d) Nucleic acids
(NEET 2017)

3. A non-proteinaceous enzyme is
(a) lysozyme
(b) ribozyme
(c) ligase
(d) deoxyribonuclease. *(NEET-II 2016)*

4. Which of the following is the least likely to be involved in stabilising the three-dimensional folding of most proteins?
(a) Hydrogen bonds
(b) Electrostatic interaction
(c) Hydrophobic interaction
(d) Ester bonds *(NEET-II 2016)*

5. Which of the following describes the given graph correctly?



(a) Endothermic reaction with energy A in presence of enzyme and B in absence of enzyme.
(b) Exothermic reaction with energy A in presence of enzyme and B in absence of enzyme.
(c) Endothermic reaction with energy A in absence of enzyme and B in presence of enzyme.
(d) Exothermic reaction with energy A in absence of enzyme and B in presence of enzyme.
(NEET-II 2016)

6. A typical fat molecule is made up of
(a) one glycerol and one fatty acid molecule
(b) three glycerol and three fatty acid molecules
(c) three glycerol molecules and one fatty acid molecule
(d) one glycerol and three fatty acid molecules.
(NEET-I 2016)

7. Which one of the following statements is wrong?
(a) Uracil is a pyrimidine.
(b) Glycine is a sulphur containing amino acid.
(c) Sucrose is a disaccharide.
(d) Cellulose is a polysaccharide.
(NEET-I 2016)

8. The chitinous exoskeleton of arthropods is formed by the polymerisation of
(a) N - acetyl glucosamine
(b) lipoglycans
(c) keratin sulphate and chondroitin sulphate
(d) D - glucosamine. *(2015)*

9. Which of the following biomolecules does have a phosphodiester bond?
(a) Amino acids in a polypeptide
(b) Nucleic acids in a nucleotide
(c) Fatty acids in a diglyceride
(d) Monosaccharides in a polysaccharide
(2015)

10. Which one of the following statements is incorrect?
(a) The competitive inhibitor does not affect the rate of breakdown of the enzyme-substrate complex.
(b) The presence of the competitive inhibitor decreases the K_m of the enzyme for the substrate.

(c) A competitive inhibitor reacts reversibly with the enzyme to form an enzyme-inhibitor complex.
(d) In competitive inhibition, the inhibitor molecule is not chemically changed by the enzyme.
(2015 Cancelled)

11. Select the option which is not correct with respect to enzyme action.
(a) Substrate binds with enzyme at its active site.
(b) Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate.
(c) A non-competitive inhibitor binds the enzyme at a site distinct from that which binds the substrate.
(d) Malonate is a competitive inhibitor of succinic dehydrogenase. *(2014)*

12. Which one of the following is a non - reducing carbohydrate?
(a) Maltose
(b) Sucrose
(c) Lactose
(d) Ribose 5-phosphate *(2014)*

13. A phosphoglyceride is always made up of
(a) a saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached.
(b) a saturated or unsaturated fatty acid esterified to a phosphate group which is also attached to a glycerol molecule.
(c) only a saturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached.
(d) only an unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached. *(NEET 2013)*

14. Macromolecule chitin is
(a) sulphur containing polysaccharide
(b) simple polysaccharide
(c) nitrogen containing polysaccharide
(d) phosphorous containing polysaccharide.
(NEET 2013)

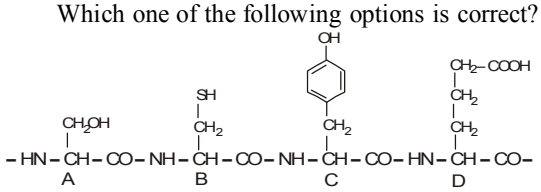
15. Transition state structure of the substrate formed during an enzymatic reaction is
(a) transient and unstable
(b) permanent and stable
(c) transient but stable
(d) permanent but unstable. *(NEET 2013)*

16. The essential chemical components of many coenzymes are
(a) carbohydrates (b) vitamins
(c) proteins (d) nucleic acids.
(NEET 2013)

17. Which of the following statements about enzymes is wrong?
(a) Enzymes are denatured at high temperatures.
(b) Enzymes are mostly proteins but some are lipids also.
(c) Enzymes are highly specific.
(d) Enzymes require optimum pH and temperature for maximum activity.
(Karnataka NEET 2013)

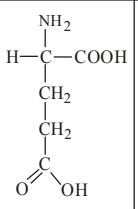
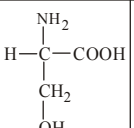
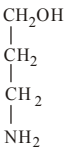
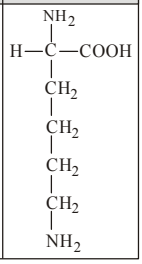
18. Uridine, present only in RNA is a
(a) nucleoside (b) nucleotide
(c) purine (d) pyrimidine.
(Karnataka NEET 2013)

19. The figure shows a hypothetical tetrapeptide portion of a protein with parts labelled A-D. Which one of the following options is correct?



(a) D is the acidic amino acid-glutamic acid.
(b) C is an aromatic amino acid-tryptophan.
(c) A is the C-terminal amino acid and D is N-terminal amino acid.
(d) A is a sulphur containing amino acid methionine. *(Karnataka NEET 2013)*

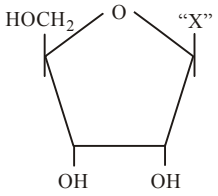
20. Which one out of A – D given below correctly represents the structural formula of the basic amino acid?

A	B	C	D
			

(a) C (b) D
(c) A (d) B
(2012)

21. Which one is the most abundant protein in the animal world?
(a) Trypsin (b) Haemoglobin
(c) Collagen (d) Insulin *(2012)*

22. The given diagrammatic representation shows one of the categories of small molecular weight organic compounds in the living tissues. Identify the category shown and the one blank component "X" in it.

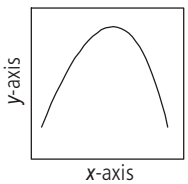


	Category	**Component**
(a)	Cholesterol	Guanine
(b)	Amino acid	NH_2
(c)	Nucleotide	Adenine
(d)	Nucleoside	Uracil *(2012)*

23. Which one of the following is wrong statement?
(a) *Anabaena* and *Nostoc* are capable of fixing nitrogen in free-living state also.
(b) Root nodule forming nitrogen fixers live as aerobes under free-living conditions.
(c) Phosphorus is a constituent of cell membranes, certain nucleic acids and all proteins.
(d) *Nitrosomonas* and *Nitrobacter* are chemo-autotrophs. *(2012)*

24. Which one of the following biomolecules is correctly characterized?
(a) Lecithin - a phosphorylated glyceride found in cell membrane.
(b) Palmitic acid - an unsaturated fatty acid with 18 carbon atoms.
(c) Adenylic acid - adenosine with a glucose phosphate molecule.
(d) Alanine amino acid - contains an amino group and an acidic group anywhere in the molecule.
(Mains 2012)

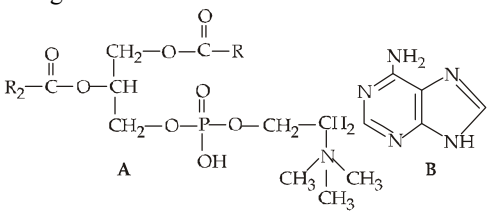
25. The curve given below shows enzymatic activity in relation to three conditions (pH, temperature and substrate concentration). What do the two axes (x and y) represent?



	***x*-axis**	***y*-axis**
(a)	enzymatic activity	pH
(b)	temperature	enzyme activity
(c)	substrate concentration	enzymatic activity
(d)	enzymatic activity	temperature

(2011)

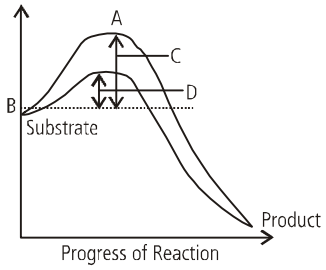
26. Which one of the following structural formulae of two organic compounds is correctly identified along with its related function?



(a) B : Adenine - A nucleotide that makes up nucleic acids
(b) A : Triglyceride - Major source of energy
(c) B : Uracil - A component of DNA
(d) A : Lecithin - A component of cell membrane
(2011)

27. Three of the following statements about enzymes are correct and one is wrong. Which one is wrong?
(a) Enzymes require optimum pH for maximal activity.
(b) Enzymes are denatured at high temperature but in certain exceptional organisms they are effective even at temperatures 80° - 90°C.
(c) Enzymes are highly specific.
(d) Most enzymes are proteins but some are lipids. *(Mains 2010)*

28. The figure given below shows the conversion of a substate into product by an enzyme. In which one of the four options (a-d) the components of reaction labelled as A, B, C and D are identified correctly?



	A	B	C	D
(a)	Potential energy	Transition state	Activation energy with enzyme	Activation energy without enzyme
(b)	Transition state	potential energy	Activation energy without enzyme	Activation energy with enzyme
(c)	Potential energy	Transition state	Activation energy with enzyme	Activation energy without enzyme
(d)	Activation energy with enzyme	Transition state	Activation energy without enzyme	Potential energy

(Mains 2010)

29. Carbohydrates are commonly found as starch in plants storage organs. Which of the following five properties of starch (1-5) make it useful as a storage material?

(1) Easily translocated
(2) Chemically non-reactive
(3) Easily digested by animals
(4) Osmotically inactive
(5) Synthesized during photosynthesis

The useful properties are
(a) (1), (3) and (5) (b) (1) and (5)
(c) (2) and (3) (d) (2) and (4).*(2008)*

30. Cellulose is the major component of cell walls of
(a) *Pseudomonas* (b) *Saccharomyces*
(c) *Pythium* (d) *Xanthomonas*.
(2008)

31. A competitive inhibitor of succinic dehydrogenase is
(a) α-ketoglutarate (b) malate
(c) malonate (d) oxaloacetate.
(2008)

32. Modern detergents contain enzyme preparations of
(a) thermoacidophiles (b) thermophiles
(c) acidophiles (d) alkaliphiles.
(2008)

33. About 98 percent of the mass of every living organism is composed of just six elements including carbon, hydrogen, nitrogen, oxygen and
(a) sulphur and magnesium
(b) magnesium and sodium
(c) calcium and phosphorus
(d) phosphorus and sulphur. *(2007)*

34. An organic substance bound to an enzyme and essential for its activity is called
(a) isoenzyme (b) coenzyme
(c) holoenzyme (d) apoenzyme.
(2006)

35. The catalytic efficiency of two different enzymes can be compared by the
(a) formation of the product
(b) pH of optimum value
(c) K_m value
(d) molecular size of the enzyme. *(2005)*

36. Which one of the following statements regarding enzyme inhibition is correct?
(a) Competitive inhibition is seen when a substrate competes with an enzyme for binding to an inhibitor protein.
(b) Competitive inhibition is seen when the substrate and the inhibitor compete for the active site on the enzyme.
(c) Non-competitive inhibition of an enzyme can be overcome by adding large amount of substrate.
(d) Non-competitive inhibitors often bind to the enzyme irreversibly. *(2005)*

37. Enzymes, vitamins and hormones can be classified into a single category of biological chemicals, because all of these
(a) help in regulating metabolism
(b) are exclusively synthesized in the body of a living organism as at present
(c) are conjugated proteins
(d) enhance oxidative metabolism. *(2005)*

38. Which of the following is the simplest amino acid?
(a) Alanine (b) Asparagine
(c) Glycine (d) Tyrosine *(2005)*

39. Nucleotides are building blocks of nucleic acids. Each nucleotide is a composite molecule formed by
(a) base-sugar-phosphate
(b) base-sugar-OH
(c) $(\text{base-sugar-phosphate})_n$
(d) sugar-phosphate. *(2005)*

40. Carbohydrates, the most abundant biomolecule on earth, are produced by
(a) some bacteria, algae and green plant cells
(b) fungi, algae and green plant cells
(c) all bacteria, fungi and algae
(d) viruses, fungi and bacteria. *(2005)*

41. In which one of the following enzymes, is copper necessarily associated as an activator?
(a) Carbonic anhydrase
(b) Tryptophanase
(c) Lactic dehydrogenase
(d) Tyrosinase *(2004)*

42. The major role of minor elements inside living organisms is to act as
(a) co-factors of enzymes
(b) building blocks of important amino acids
(c) constituent of hormones
(d) binder of cell structure. *(2003)*

43. Lipids are insoluble in water because lipid molecules are
(a) hydrophilic (b) hydrophobic
(c) neutral (d) zwitter ions. *(2002)*

44. Which of the following is a reducing sugar?
(a) Galactose
(b) Gluconic acid
(c) β-methyl galactoside
(d) Sucrose *(2002)*

45. Enzyme first used for nitrogen fixation
(a) nitrogenase (b) nitroreductase
(c) transferase (d) transaminase. *(2001)*

46. Role of enzyme in reactions is to/as
(a) decrease activation energy
(b) increase activation energy
(c) inorganic catalyst
(d) none of the above. *(2000)*

47. Which factor is responsible for inhibition of enzymatic process during feedback?
(a) Substrate (b) Enzymes
(c) End product (d) Temperature *(2000)*

48. Enzymes are not found in
(a) fungi (b) algae
(c) virus (d) cyanobacteria. *(2000)*

49. ATP is
(a) nucleotide (b) nucleoside
(c) nucleic acid (d) vitamin. *(2000)*

50. Which of the following have carbohydrate as prosthetic group?
(a) Glycoprotein (b) Chromoprotein
(c) Lipoprotein (d) Nucleoprotein *(2000)*

51. Cellulose, the most important constituent of plant cell wall is made up of
(a) branched chain of glucose molecules linked by β-1, 4 glycosidic bond in straight chain and α-1, 6 glycosidic bond at the site of branching
(b) unbranched chain of glucose molecules linked by β-1, 4 glycosidic bond
(c) branched chain of glucose molecules linked by α-1, 6 glycosidic bond at the site of branching
(d) unbranched chain of glucose molecules linked by α-1, 4 glycosidic bond. *(1998)*

52. Lactose is composed of
(a) glucose + galactose
(b) fructose + galactose
(c) glucose + fructose
(d) glucose + glucose. *(1998)*

53. Co-factor (prosthetic group) is a part of holoenzyme. It is
(a) loosely attached organic part
(b) loosely attached inorganic part
(c) accessory non-protein substance attached firmly
(d) none of these. *(1997)*

54. Which is a typical example of 'feedback inhibition'?
(a) Cyanide and cytochrome reaction
(b) Sulpha drugs and folic acid synthesizer bacteria
(c) Allosteric inhibition of hexokinase by glucose 6-phosphate
(d) Reaction between succinic dehydro-genase and succinic acid *(1996)*

55. In which of the following groups are all polysaccharides?
(a) Sucrose, glucose and fructose
(b) Maltose, lactose and fructose
(c) Glycogen, sucrose and maltose
(d) Glycogen, cellulose and starch *(1996)*

56. What are the most diverse molecules in the cell?
(a) Lipids (b) Mineral salts
(c) Proteins (d) Carbohydrates *(1996)*

57. Which purine base is found in RNA?
(a) Thymine (b) Uracil
(c) Cytosine (d) Guanine *(1996)*

58. Which of the following nucleotide sequences contains 4 pyrimidine bases?
(a) GATCAATGC (b) GCUAGACAA
(c) UAGCGGUAA (d) Both (b) and (c) *(1994)*

59. The four elements that make up 99% of all elements found in a living system are
(a) C, H, O and P (b) C, N, O and P
(c) H, O, C and N (d) C, H, O and S. *(1994)*

60. Which is wrong about nucleic acids?
(a) DNA is single stranded in some viruses.
(b) RNA is double stranded occasionally.
(c) Length of one helix is 45 Å in B-DNA.
(d) One turn of Z-DNA has 12 bases. *(1993)*

61. Glycogen is a polymer of
(a) galactose (b) glucose
(c) fructose (d) sucrose. *(1993)*

62. In RNA, thymine is replaced by
(a) adenine (b) guanine
(c) cytosine (d) uracil. *(1992)*

63. Amino acids are mostly synthesised from
(a) mineral salts (b) fatty acids
(c) volatile acids
(d) α-ketoglutaric acid. *(1992)*

64. Which is distributed more widely in a cell?
(a) DNA (b) RNA
(c) Chloroplasts (d) Sphaerosomes *(1992)*

65. Living cell contains 60 – 95% water. Water present in human body is
(a) 60 – 65% (b) 50 – 55%
(c) 75 – 80% (d) 65 – 70%. *(1992)*

66. Adenine is
(a) purine (b) pyrimidine
(c) nucleoside (d) nucleotide. *(1992)*

67. Enzymes having slightly different molecular structure but performing identical activity are
(a) holoenzymes (b) isoenzymes
(c) apoenzymes (d) coenzymes. *(1991)*

68. A nucleotide is formed of
(a) purine, pyrimidine and phosphate
(b) purine, sugar and phosphate
(c) nitrogen base, sugar and phosphate
(d) pyrimidine, sugar and phosphate. *(1991)*

69. DNA is composed of repeating units of
(a) ribonucleosides
(b) deoxyribonucleosides
(c) ribonucleotides
(d) deoxyribonucleotides. *(1991)*

70. A segment of DNA has 120 adenine and 120 cytosine bases. The total number of nucleotides present in the segment is
(a) 120 (b) 240
(c) 60 (d) 480. *(1991)*

71. The basic unit of nucleic acid is
(a) pentose sugar (b) nucleoid
(c) nucleoside (d) nucleotide. *(1991)*

72. Mineral associated with cytochrome is
(a) Cu (b) Mg
(c) Cu and Mg (d) Fe. *(1991)*

73. Which is not consistent with double helical structure of DNA?
(a) A = T, C = G
(b) Density of DNA decreases on heating.
(c) A + T/C + G is not constant.
(d) Both (a) and (b) *(1990)*

74. RNA does not possess
(a) uracil (b) thymine
(c) adenine (d) cytosine. *(1988)*

75. In double helix of DNA, the two DNA strands are
(a) coiled around a common axis
(b) coiled around each other
(c) coiled differently
(d) coiled over protein sheath. *(1988)*

Answer Key

1.	(a)	**2.**	(c)	**3.**	(b)	**4.**	(d)	**5.**	(b)	**6.**	(d)	**7.**	(b)	**8.**	(a)	**9.**	(b)	**10.**	(b)
11.	(b)	**12.**	(b)	**13.**	(a)	**14.**	(c)	**15.**	(a)	**16.**	(b)	**17.**	(b)	**18.**	(a)	**19.**	(*)	**20.**	(b)
21.	(c)	**22.**	(d)	**23.**	(c)	**24.**	(a)	**25.**	(b)	**26.**	(d)	**27.**	(d)	**28.**	(b)	**29.**	(d)	**30.**	(c)
31.	(c,d)	**32.**	(d)	**33.**	(d)	**34.**	(b)	**35.**	(c)	**36.**	(b)	**37.**	(a)	**38.**	(c)	**39.**	(a)	**40.**	(a)
41.	(d)	**42.**	(a)	**43.**	(b)	**44.**	(a)	**45.**	(a)	**46.**	(a)	**47.**	(c)	**48.**	(c)	**49.**	(a)	**50.**	(a)
51.	(b)	**52.**	(a)	**53.**	(c)	**54.**	(c)	**55.**	(d)	**56.**	(c)	**57.**	(d)	**58.**	(a)	**59.**	(c)	**60.**	(c)
61.	(b)	**62.**	(d)	**63.**	(d)	**64.**	(b)	**65.**	(d)	**66.**	(a)	**67.**	(b)	**68.**	(c)	**69.**	(d)	**70.**	(d)
71.	(d)	**72.**	(d)	**73.**	(c)	**74.**	(b)	**75.**	(a)										

(*) *None of these.*

EXPLANATIONS

1. (a) : Holoenzyme is the complete conjugate enzyme consisting of an apoenzyme and a cofactor. Cofactor may be organic or inorganic in nature. Organic cofactors are of two types-coenzyme and prosthetic group.

2. (c) : Lipids are fatty acids esters of alcohols and related substances. Polysaccharides are polymers of monosaccharides. Proteins are polymers of amino acids and nucleic acids are polymer of nucleotides.

3. (b) : A ribozyme is a ribonucleic acid (RNA) enzyme that catalyses a chemical reaction in a similar way to that of a protein enzyme. These are found in ribosomes and are also called catalytic RNAs.

4. (d) : Tertiary structure or three dimensional structure of protein is stabilised by several types of bonds—hydrogen bonds, ionic bonds, van der Waal's interactions, covalent bonds and hydrophobic bonds.

5. (b)

6. (d) : Neutral or true fats are triglycerides which are formed by esterification of three molecules of fatty acids with one molecule of trihydric alcohol, glycerol (glycerine or trihydroxy propane).

7. (b) : Glycine is a neutral amino acid. Cysteine and methionine are sulphur containing amino acid.

8. (a) : Chitin is a structural polysaccharide that constitutes the exoskeleton of arthropods. It is a complex carbohydrate in which N-acetyl glucosamine monomers are joined together by (1, 4) β-linkages. Chitinous exoskeleton provides strength and elasticity to arthropods.

9. (b)

10. (b) : Competitive inhibition is a reversible inhibition where inhibitor competes with the normal substrate for the active site of enzyme. A competitive inhibitor is usually chemically similar to the normal substrate and therefore, fits into the active site of an enzyme and binds with it. The inhibition is thus due to substrate analogue. The enzyme, now cannot act upon the substrate and reaction products are not formed. *E.g.*, the activity of succinate dehydrogenase is inhibited by malonate. K_m value or Michaelis constant is defined as the substrate concentration at which half of the enzyme molecules are forming enzyme substrate (ES) complex, or concentration of the substrate when the velocity of the enzyme reaction is half the maximal possible. A smaller K_m value indicates greater affinity of the enzyme for its substrate, hence, shows a quicker reaction. The competitive inhibitor decreases the affinity of enzyme for substrate, thus increases the K_m value.

11. (b) : The reduction of activity of succinate dehydrogenase by malonate is an example of competitive inhibition. Competitive inhibition is a reversible inhibition where inhibitor competes with the normal substrate for the active site of enzyme. A competitive inhibitor is usually similar to the normal substrate and, therefore, fits into the active site of an enzyme and binds with it. The enzyme, now cannot act upon the substrate and reaction products are not formed. Hence, action of an enzyme may be reduced or inhibited. Since a competitive inhibitor occupies the site only temporarily, the enzyme action is not permanently affected. Thus, addition of a lot of succinate can reverse the inhibition of succinic dehydrogenase by malonate.

12. (b) : In non-reducing sugars, a free aldehyde or ketonic group is absent. Sucrose is a non-reducing sugar formed by condensation of one molecule each of glucose and fructose with release of a water molecule. A glycosidic bond is established between carbon atom 1 of glucose and carbon atom 2 of fructose.

13. (a) : Phosphoglycerides are the triesters of fatty acids (either saturated or unsaturated) and glycerol to which a phosphate group is also attached.

14. (c) : *Refer to answer 8.*

15. (a) : Transition state is formation of unstable intermediate structural state. During this, substrate bonds are broken and new bonds are established that transform the substrate molecules into products. This state is transient and highly unstable.

16. (b) : Coenzyme is the non protein organic group which gets attached to the apoenzyme to form holoenzyme or conjugate enzyme. It helps in removing a product of chemical reaction besides bringing contact between the substrate and the enzyme. Most of the coenzymes are made of water soluble vitamins B and C, *e.g.*, thiamine, riboflavin, nicotinamide, pyridoxine.

17. (b) : Enzymes are mostly proteins but some are RNA (ribozymes). No lipid working as enzymes are known.

18. (a) : A nucleoside is pentose sugar and base together, without the phosphate group. Uracil is present as uridine in RNA only.

Uracil + Ribose → Uridine

19. None of the options is correct.

A - Serine (Neutral - Polar)
B - Cysteine (Neutral - Polar)
C - Tyrosine (Neutral - Polar)
D - Not an amino acid

20. (b) : Basic amino acids have an additional amino group without forming amides thus they are diamino monocarboxylic acids *e.g.*, arginine, lysine, etc.

21. (c) : Collagen is an insoluble fibrous protein found extensively in the connective tissue of skin, tendons and bone. Collagen accounts for over 30% of the total body proteins of mammals and it is the most abundant animal protein.

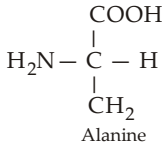
22. (d) : The given structure corresponds with the structure of ribose sugar. As it lacks a phosphoric acid hence it can be a nucleoside not a nucleotide.

23. (c) : Phosphorus is present in plasma membrane in the form of phospholipid bilayer. It is an essential component of all nucleic acids not 'certain' nucleic acids. Moreover, phosphorus is never found in proteins.

24. (a) : Lecithin is a triglyceride lipid where one fatty acid is replaced by phosphoric acid which is linked to additional nitrogenous group called choline. It is a common membrane lipid. It is an amphipathic phospholipid having both hydrophilic polar and hydrophobic nonpolar groups. The hydrocarbon chains of two fatty acids function as hydrophobic non-polar tails whereas the phosphate and choline behave as hydrophilic polar head group of the molecule.

Palmitic acid is a saturated fatty acid (as it does not possess double bonds in its carbon chain) and contains 16 carbon atoms with formula $C_{16}H_{32}O_2$.

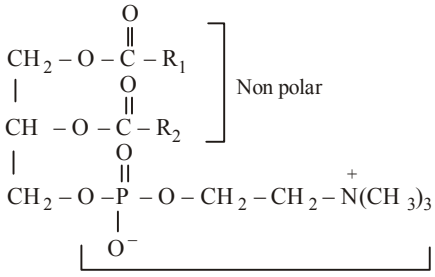
Adenylic acid or adenosine monophosphate is a nucleotide formed by union of adenine (nitrogenous base), ribose (pentose sugar) and phosphate. It is formed through phosphorylation of nucleoside as phosphate combines with sugar molecule at its 5′ carbon atom. Amino acids are organic acids with carboxylic group (–COOH) having amino group (–NH_2) generally attached to α-carbon or carbon next to carboxylic group. Alanine is a nonpolar and neutral amino acid having one methyl group and having amino group attached to carbon next to carboxylic group.



Alanine

25. (b) : Enzymes generally function in a narrow range of temperature and pH. Each enzyme shows its highest activity at a particular temperature and pH called the optimum temperature and optimum pH. Activity declines both below and above the optimum values. X-axis always represents temperature or pH and Y axis represents enzyme activity.

26. (d) : 'A' is a structural formula of lecithin. It is probably the most common phospholipid. Phospholipids are major components in the lipid bilayers of cell membrane.



Choline (polar)

Fig. : Lecithin.

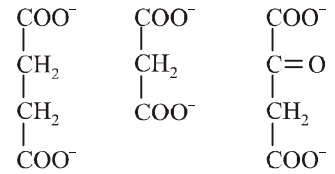
27. (d) : *Refer to answer 17.*

28. (b)

29. (d) : Starch is the major storage carbohydrate of plants. In most plant species it is accumulated in the chloroplast of leaves, whereas in storage organ it accumulates in amyloplast as reserve starch. It is the osmotically inactive form of photosynthetic product and is a hexosan polysaccharide made of large number of glucose unit so, chemically non reactive.

30. (c) : The cell wall of most fungi consist of chitin or cellulose. In *Pythium,* the hyphal wall contains cellulose whereas, in yeast the cell wall is thin and is composed of chitin in combination with other compounds (carbohydrates, glucan and mannan). The bacterial cell wall contains N-acetyl glucosamine and N-acetyl muramic acid.

31. (c, d) : Malonate or oxaloacetate, which resemble succinate in structure and inhibit the activity of succinate dehydrogenase. Such competitive inhibitors are often used in control of bacterial pathogen.



Succinate Malonate Oxaloacetate

32. (d) : Modern detergents contain enzyme preparation of alkaline protease which are called alkaliphiles, for removing protein stain.

33. (d) : Living organisms requires 6 elements in relatively large amounts. C, H, O, N, P, S. These elements contribute to the structural organization of living organisms.

34. (b) : Enzymes are simple if they are made of only proteins (*e.g.,* pepsin, amylase etc.) while conjugate enzymes have an additional non-protein cofactor which may be organic or inorganic. Loosely attached organic cofactor is coenzyme. It plays an accessory role in enzyme catalyzed processes often by acting as a donor or acceptor of a substance involved in the reaction. ATP and NAD are common coenzymes.

35. (c) : K_m value or Michaelis constant is defined as the substrate concentration at which half of the enzyme molecules are forming (ES) complex or concentration of the substrate when the velocity of the enzyme reaction is half the maximal possible. The K_m varies from enzyme to enzyme and is used in characterizing the different enzymes. A smaller K_m value indicates greater affinity of the enzyme for its substrate, hence, shows a quicker reaction. K_m value is a constant characteristic of an enzyme for its conversion of a substrate.

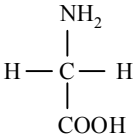
36. (b) : *Refer to answer 10.*

37. (a) : Enzymes control all the life processes. They increase the rate of a biological reaction. The magnitude of increase may be greater than those affected by other catalysts.

Vitamins are accessory indispensable food factor, organic in nature (organic acid, amino acid esters, alcohols, steroids etc.) required by an organism in small amounts to maintain normal growth and regulate the metabolic processes.

Hormones are biologically active organic substance that are produced in minute quantities by some specialized organs and exert physiological effects at sites remote from their origin.

38. (c) : Glycine is considered as the simplest amino acid as it has one amino group, one carboxylic group and no substituent functional group.



39. (a) : Each nucleotide consists of three distinct units - a phosphate group derived from phosphoric acid, a pentose sugar and a ring shaped nitrogenous base.

Nucleoside + Phosphoric acid $\rightarrow$ Nucleotide + H_2O

40. (a) : Carbohydrates are organic compounds synthesized in the chlorophyll containing cells of some bacteria, algae and green plant cells, during photosynthesis. Certain photo-autotrophic bacteria *e.*g., Green sulphur bacteria and purple sulphur bacteria contain pigments like chlorobium chlorophyll and bacteriochlorophyll respectively that helps them in photosynthesis.

41. (d) : Copper is associated as an activator with tyrosinase. It is widely distributed in plants, animals and man. It is also known as polyphenol oxidase or catecholase. It oxidizes tyrosine to melanin in mammals and causes the cut surfaces of many fruits and vegetable to darken.

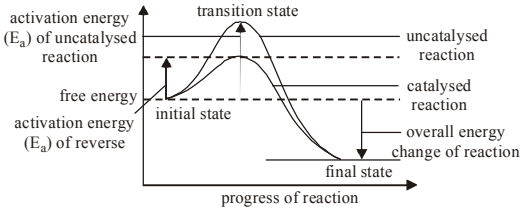
42. (a) : Minor element are those which are required in quantity of less than milligram/gram of dry matter but they are essential for proper growth and development of an organism *e.g.*, Cl, Mn, B, Zn, Cu, Mo etc. These elements work as non-protein cofactor in enzymes *e.g.*, Zn, Cu etc. They also take part in oxidation reduction reactions *e.g.*, Cu, with variable valency. Chloride ion enhances activity of salivary amylase. Zinc is required for activity of carbonic anhydrase and alcohol dehydrogenase, etc.

43. (b) : Lipid molecules are insoluble or sparingly soluble in water but are freely soluble in organic solvents like ether, alcohol and benzene. Insolubility of lipids in water is due to the fact that the polar groups they contain are much smaller than their nonpolar portions. The nonpolar chains are long complex hydrophobic hydrocarbon chains. If shaken in water lipids often form small droplets or micelles. The complex formed is called emulsions. These non polar proteins give them water repellent or hydrophobic property.

44. (a) : All those sugars which have free aldehyde or ketone group are called reducing sugars. These are able to reduce cupric ions (Cu^{+2}) into cuprous ions (Cu^{+}). Sucrose, starch are non-reducing sugars.

45. (a) : Nitrogen fixation involves conversion of atmospheric nitrogen to ammonia. It is done with the help of nitrogenase enzyme which occurs inside thick walled heterocysts of the blue green algae. These provide suitable anaerobic environment for nitrogenase activity even in aerobic conditions.

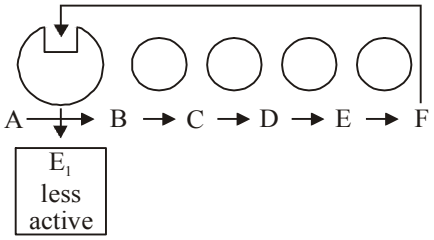
46. (a) : All molecules require certain amount of energy for activation (to overcome energy barrier) before they can react. This energy is called activation energy. This energy is recovered when products are formed. The essence of an enzyme is its ability to speed up (catalyze) a reaction by making or breaking specific covalent bonds (bonds in which atoms are held together by sharing of electrons). Enzymes act by somehow lowering the temperature at which a given bond is unstable *i.e.*, they speed up a reaction by lowering the activation energy. It is the magnitude of the activation energy which determines how fast the reaction will proceed.



Graph showing energy requirement of catalysed and uncatalysed reactions.

47. (c) : Feedback inhibition or end product inhibition is the inhibition of the activity of an enzyme catalysing some early reactions of the series by the end product of the metabolic pathway.

For example a substrate A is converted into a product F through B, C, D and E intermediate products. As the concentration of end product F increases, it diffuses to allosteric enzyme (E_1) causing a reduced synthesis of the product B which in turn lowers the rate of enzymatic reactions in rest of the pathway.



Feedback inhibition : Product F inhibits the action of enzyme E_1.

48. (c) : Viruses do not have enzymes so they cannot synthesize proteins. They multiply only inside the living host cell and for multiplication and metabolism they take over the machinery of the host cell. They lack their own cellular machinery and enzymes.

49. (a) : ATP is a nucleotide as it is composed of adenine, ribose sugar and phosphoric acid. There are two additional phosphate groups attached to the phosphate group of AMP. The last two phosphate molecules are connected by high energy bonds.

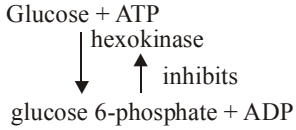
50. (a) : Glycoproteins are proteins that contain sugars like carbohydrates as prosthetic group. In most glycoproteins, the linkage is between asparagine and N-acetyl-D-glucosamine. Some glycoproteins are immunoglobulins, membrane proteins and muscle proteins. Lipoproteins are protein complexed with lipids like triglycerides, phospholipids etc. Nucleoproteins are proteins associated with nucleic acids and chromoproteins are proteins associated with pigments *e.g.*, cytochrome, phytochrome.

51. (b) : Cellulose is the most abundant carbohydrate. Cellulose molecule is composed of 1600 to 6000 glucose molecules joined together. Those polymers form long twisting macromolecules of cellulose. The chains are unbranched and linear. The successive glucose residues are joined together by β-1-4, linkages.

52. (a) : Lactose is popularly known as milk sugar. It is a disaccharide composed of one molecule of glucose and one molecule of galactose. The covalent bond that joins these two monosaccharide units is called glycosidic bond or glycosidic linkage. It is a reducing sugar.

53. (c)

54. (c) : Feedback inhibition or end product inhibition occurs when the end product of a metabolic pathway inhibits the activity of an enzyme catalysing some early reactions of the series. The end product is the inhibitor and the enzyme inactivated is called allosteric enzyme. The enzyme is regulated by modulators that bind non-covalently at site other than the active site. An example of feedback inhibition is the inhibition of the activity of the enzyme hexokinase by glucose 6-phosphate in glycolysis. This enzyme catalyses conversion of glucose into glucose 6-phosphate but as the reaction proceeds, increase in concentration of glucose 6-phosphate inhibits the activity of hexokinase.



55. (d) : Polysaccharides are complex long chain carbohydrates which are formed by dehydrate synthesis or polymerisation of more than 10 but generally very large number of units called monosacccharides. Starch,

glycogen and cellulose are all polysaccharides. Starch is a glucosan homopolysaccharide which is the main reserve food of plants. Glycogen is also a glucosan homopoly-saccharide which is the major reserve food of fungi, animals and some bacteria. It is also called animal starch. Cellulose is the structural polysaccharide of plant cell walls, some fungi, protists. It is a fibrous glucosan homopolysaccharide of high tensile strength.

56. (c) : Proteins show enormous diversity because of different proportions and sequences of twenty amino acid within the protein molecule. A large number of permutations and combinations of these amino acids are responsible for the unlimited variety of proteins. Proteins are the most abundant and most varied of the macromolecules having one or more polypeptides (chains of amino acids). The proteins constitute almost 50% of the total dry weight of the cell. Proteins may be simple or conjugated. Among conjugated, proteins may be phosphoprotein, glycoprotein, nucleoprotein, chromoprotein, lipoprotein, flavoprotein, metallo protein etc. Functionally proteins may be structural protein, enzymes, hormones, respiratory pigment etc.

57. (d) : The bases are of two types-purines and pyrimidines. The purine derivatives adenine (A) and guanine (G) are double ring structures whereas pyrimidine derivatives thymine, cytosine and uracil are single ring structures. Thymine (T) and cytosine (C) are found in DNA and cytosine (C) and uracil (U) is found in RNA.

58. (a) : In the given question there are 4 pyrimidines as 2 cytosine and 2 thymine in option '*a*'.

59. (c) : Carbon, hydrogen, oxygen and nitrogen are called four big elements of living body they make up about 99% of the mass of most cells. As C, H, O and N are lightest elements so the bonds they form are the strongest covalent bonds. So that the compounds formed are stable, varied in size and shapes. Carbon constitutes more than 50% of the dry matter. It has been observed that human body contains 0.5% hydrogen, 18.5% carbon, 65% oxygen and 3.3% nitrogen. Other elements are present in very lesser amount.

60. (c) : One complete turn of DNA is 34Å long and has 10 base pairs.

61. (b) : Glycogen (animal starch) is a polysaccharide consisting of a highly branched polymer of glucose occurring in animal tissues, especially in liver and muscle cells. It is the major store of carbohydrate energy in animal cells.

62. (d) : *Refer to answer 57.*

63. (d) : Amino acids are mostly synthesized from α-ketoglutaric acid. These are the precursors of amino acids. A five carbon compound formed during Krebs' cycle is a α-ketoglutaric acid which is the first dicarboxylic acid formed. Pyruvic acid converted into alanine, α-ketoglutaric acid into glutamic acid, OAA into aspartic acid, polymerization of such amino acids results into formation of proteins.

64. (b) : RNA occurs in the nucleus as well as in the cytoplasm of the eukaryotic cells and in prokaryotic cell, it is found in the cytoplasm. DNA is found in the nucleus, mitochondria and chloroplast. Chloroplast and sphaerosomes are found only in cytoplasm.

65. (d) : Water is the most abundant substance of living beings. The water content of actively living cells varies between 60–95%. In human beings maximum water content is found in the embryo 90 – 95%. Water content decreases thereafter in adult and the aged where it is 65 – 70%.

66. (a) : *Refer to answer 57.*

67. (b) : Enzymes having slightly different molecular structures but performing identical activities are called isoenzymes. Over 100 enzymes are known to have isoenzymes. Thus α-amylase of wheat endosperm has 16 isozymes, lactic dehydrogenase has 5 isoenzymes in man.

68. (c) : Nucleotide is an organic compound consisting of a nitrogen-containing purine or pyrimidine base linked to a sugar (ribose or deoxyribose) and a phosphate group.

69. (d) : DNA is the largest macromolecule in the organisms. It is a long, double chain of deoxy-ribonucleotide, or deoxyribotide units. The two deoxyribonucleotide chains are twisted around a common axis to form a right-handed double helix (spiral) that encloses a cylindrical space in it. Each deoxyribonucleotide unit, in turn, consists of three different molecules : phosphate, ($PO^{3}_{4}{}^{-}$), a 5-carbon deoxyribose sugar ($C_5H_{10}O_4$) and a nitrogenous base.

70. (d) : According to Chargaff's rules, the amount of adenine is always equal to that of thymine, and the amount of guanine is always equal to that of cytosine *i.e.,* A = T (120) and G = C (120), therefore, the total no. of nucleotides would be $120 \times 4 = 480$.

71. (d) : The nucleic acids (DNA and RNA) are the molecules having complex structure and very high

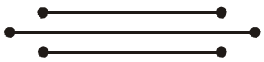
molecular weights. The nucleic acid is composed of a large number of nucleotide molecules joined into a linear, unbranched chain. Nucleotide is an organic compound consisting of a nitrogen-containing purine or pyrimidine base linked to a sugar (ribose or deoxyribose) and a phosphate group.

72. (d) : Cytochromes are generally membrane-bound hemoproteins that contain heme groups and carry out electron transport. The heme group is a highly conjugated ring system (which means its electrons are very mobile) surrounding a metal ion, which readily interconverts between the oxidation states. For many cytochromes the metal ion present is that of iron, which interconverts between Fe^{2+} (reduced) and Fe^{3+} (oxidized) states (electron-transfer processes) or between Fe^{2+} (reduced) and Fe^{3+} (formal, oxidized) states (oxidative processes). Cytochromes are thus capable of performing oxidation and reduction.

73. (c) : The density of DNA decreases on heating as hydrogen bonds breakdown. According to Chargaff's rules, the amount of adenine is always equal to that of thymine, and the amount of guanine is always equal to that of cytosine *i.e* A = T and G = C. The base ratio A + T/ G + C may vary form species to species, but is constant for a given species.

74. (b) : *Refer to answer 57.*

75. (a) : According to Watson-Crick model, the DNA molecule consists of two long, parallel chains which are joined together by short crossbars at regular intervals. The two chains are spirally coiled around a common axis in a regular manner to form a right handed double helix.



Chapter
10

Cell Cycle and Cell Division

1. Which of the following options gives the correct sequence of events during mitosis ?
(a) Condensation → Nuclear membrane disassembly → Arrangement at equator → Centromere division → Segregation → Telophase
(b) Condensation → Crossing over → Nuclear membrane disassembly → Segregation → Telophase
(c) Condensation → Arrangement at equator → Centromere division → Segregation → Telophase
(d) Condensation → Nuclear membrane disassembly → Crossing over → Segregation → Telophase
(NEET 2017)

2. Anaphase Promoting Complex (APC) is a protein degradation machinery necessary for proper mitosis of animal cell. If APC is defective in a human cell, which of the following is expected to occur?
(a) Chromosomes will be fragmented.
(b) Chromosomes will not segregate.
(c) Recombination of chromosome arms will occur.
(d) Chromosomes will not condense.
(NEET 2017)

3. During cell growth, DNA synthesis takes place on
(a) S-phase (b) G_1-phase
(c) G_2-phase (d) M phase.
(NEET-II 2016)

4. When cell has stalled DNA replication fork, which checkpoint should be predominantly activated?
(a) G_1/S (b) G_2/M
(c) M (d) Both G_2/M and M
(NEET-II 2016)

5. Match the stages of meiosis in column I to their characteristic features in column II and select the correct option using the codes given below.

	Column I		**Column II**
A.	Pachytene	(i)	Pairing of homologous chromosomes
B.	Metaphase I	(ii)	Terminalisation of chiasmata
C.	Diakinesis	(iii)	Crossing-over takes place
D.	Zygotene	(iv)	Chromosomes align at equatorial plate

(a) A-(iii), B-(iv), C-(ii), D-(i)
(b) A-(i), B-(iv), C-(ii), D-(iii)
(c) A-(ii), B-(iv), C-(iii), D-(i)
(d) A-(iv), B-(iii), C-(ii), D-(i)
(NEET-II 2016)

6. Spindle fibres attach on to
(a) centromere of the chromosome
(b) kinetosome of the chromosome
(c) telomere of the chromosome
(d) kinetochore of the chromosome.
(NEET-I 2016)

7. Which of the following is not a characteristic feature during mitosis in somatic cells?
(a) Chromosome movement
(b) Synapsis (c) Spindle fibres
(d) Disappearance of nucleolus
(NEET-I 2016)

8. In meiosis crossing over is initiated at
(a) zygotene (b) diplotene
(c) pachytene (d) leptotene.
(NEET-I 2016)

9. Arrange the following events of meiosis in correct sequence
(i) Crossing over
(ii) Synapsis
(iii) Terminalisation of chiasmata
(iv) Disappearance of nucleolus

(a) (i), (ii), (iii), (iv) (b) (ii), (iii), (iv), (i)
(c) (ii), (i), (iv), (iii) (d) (ii), (i), (iii), (iv)
(2015)

10. A somatic cell that has just completed the S phase of its cell cycle, as compared to gamete of the same species, has
(a) twice the number of chromosomes and four times the amount of DNA
(b) four times the number of chromosomes and twice the amount of DNA
(c) twice the number of chromosomes and twice the amount of DNA
(d) same number of chromosomes but twice the amount of DNA.
(2015 Cancelled)

11. Select the correct option.

	Column I	**Column II**
A.	Synapsis aligns homologous chromosomes	(i) Anaphase II
B.	Synthesis of RNA and protein	(ii) Zygotene
C.	Action of enzyme recombinase	(iii) G_2-phase
D.	Centromeres do not separate but chromatids move towards opposite poles	(iv) Anaphase I
		(v) Pachytene

(a) A-(i), B-(ii), C-(v), D-(iv)
(b) A-(ii), B-(iii), C-(iv), D-(v)
(c) A-(ii), B-(i), C-(iii), D-(iv)
(d) A-(ii), B-(iii), C-(v), D-(iv)
(2015 Cancelled)

12. During which phase(s) of cell cycle, amount of DNA in a cell remains at 4C level if the initial amount is denoted as 2C?
(a) G_0 and G_1 (b) G_1 and S
(c) Only G_2 (d) G_2 and M
(2014)

13. In 'S' phase of the cell cycle
(a) amount of DNA doubles in each cell
(b) amount of DNA remains same in each cell
(c) chromosome number is increased
(d) amount of DNA is reduced to half in each cell. *(2014)*

14. The enzyme recombinase is required at which stage of meiosis?
(a) Pachytene (b) Zygotene
(c) Diplotene (d) Diakinesis
(2014)

15. The complex formed by a pair of synapsed homologous chromosomes is called
(a) bivalent (b) axoneme
(c) equatorial plate (d) kinetochore.
(NEET 2013)

16. A stage in cell division is shown in the figure. Select the answer which gives correct identification of the stage with its characteristics.

(a) Cytokinesis — Cell plate formed, mitochondria distributed between two daughter cells.
(b) Telophase — Endoplasmic reticulum and nucleolus not reformed yet.
(c) Telophase — Nuclear envelope reforms,Golgi complex reforms.
(d) Late anaphase — Chromosomes move away from equatorial plate, Golgi complex not present.
(NEET 2013)

17. During meiosis I, the chromosomes start pairing at
(a) zygotene (b) pachytene
(c) diplotene (d) leptotene.
(Karnataka NEET 2013)

18. During the metaphase stage of mitosis, spindle fibres attach to chromosomes at
(a) kinetochore
(b) both centromere and kinetochore
(c) centromere, kinetochore and areas adjoining centromere
(d) centromere.
(*Karnataka NEET 2013)*

19. A stage of mitosis is shown in the diagram. Which stage is it and what are its characteristics?

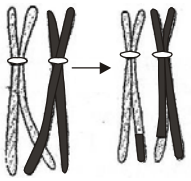
(a) Metaphase - Spindle fibers attached to kinetochores, centromeres split and chromatids separate.
(b) Metaphase - Chromosomes moved to spindle equator, chromosomes made up of two sister chromatids.
(c) Anaphase - Centromeres split and chromatids separate and start moving away.
(d) Late prophase - Chromosomes move to spindle equator.

(Karnataka NEET 2013)

20. During gamete formation, the enzyme recombinase participates during
(a) metaphase I (b) anaphase II
(c) prophase I (d) prophase II.

(2012)

21. The given figure is the representation of a certain event at a particular stage of a type of cell division. Which is this stage?



(a) Prophase I during meiosis
(b) Prophase II during meiosis
(c) Prophase of mitosis
(d) Both prophase and metaphase of mitosis

(2012)

22. Identify the meiotic stage in which the homologous chromosomes separate while the sister chromatids remain associated at their centromeres.
(a) Metaphase I (b) Metaphase II
(c) Anaphase I (d) Anaphase II

(Mains 2012)

23. Select the correct option with respect to mitosis.
(a) Chromatids separate but remain in the centre of the cell in anaphase
(b) Chromatids start moving towards opposite poles in telophase
(c) Golgi complex and endoplasmic reticulum are still visible at the end of prophase.
(d) Chromosomes move to the spindle equator and get aligned along equatorial plate in metaphase.

(2011)

24. At metaphase, chromosomes are attached to the spindle fibres by their
(a) satellites
(b) secondary constrictions
(c) kinetochores
(d) centromeres. *(Mains 2011)*

25. During mitosis, ER and nucleolus begin to disappear at
(a) late prophase (b) early metaphase
(c) late metaphase (d) early prophase.

(2010)

26. Which stages of cell division do the following figures A and B represent respectively?

Fig. A

Fig. B

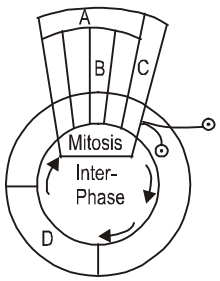
	A	B
(a)	Metaphase	Telophase
(b)	Telophase	Metaphase
(c)	Late anaphase	Prophase
(d)	Prophase	Anaphase

(2010)

27. Synapsis occurs between
(a) *m*RNA and ribosomes
(b) spindle fibres and centromere
(c) two homologous chromosomes
(d) a male and a female gamete.

(2009)

28. Given below is a schematic break-up of the phases/stages of cell cycle. Which one of the following is the correct indication of the stage/phase in the cell cycle?



(a) C - karyokinesis
(b) D - synthetic phase
(c) A - cytokinesis
(d) B - metaphase *(2009)*

29. At what stage of the cell cycle are histone proteins synthesized in a eukaryotic cell?
(a) During G_2 stage of prophase
(b) During S-phase
(c) During entire prophase
(d) During telophase *(2005)*

30. In the somatic cell cycle
(a) in G_1 phase DNA content is double the amount of DNA present in the original cell
(b) DNA replication takes place in S phase
(c) a short interphase is followed by a long mitotic phase
(d) G_2 phase follows mitotic phase. *(2004)*

31. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most conveniently look into?
(a) Metaphase (b) Telophase
(c) Anaphase (d) Prophase
(2004)

32. Which one of the following precedes re-formation of the nuclear envelope during M phase of the cell cycle?
(a) Decondensation from chromosomes, and reassembly of the nuclear lamina
(b) Transcription from chromosomes, and reassembly of the nuclear lamina
(c) Formation of the contractile ring, and formation of the phragmoplast
(d) Formation of the contractile ring, and transcription from chromosomes
(2004)

33. Mitotic spindle is mainly composed of which protein?
(a) Actin (b) Myosin
(c) Actomyosin (d) Myoglobin
(2002)

34. Best material for the study of mitosis in laboratory is
(a) anther (b) root tip
(c) leaf tip (d) ovary. *(2002)*

35. Spindle fibre unite with which structure of chromosomes?
(a) Chromocentre (b) Chromomere
(c) Kinetochore (d) Centriole *(2000)*

36. In which stage of cell cycle, DNA replication occurs?
(a) G_1-phase (b) S-phase
(c) G_2-phase (d) M-phase
(2000)

37. Microtubule is involved in the
(a) muscle contraction
(b) membrane architecture
(c) cell division
(d) DNA recognition. *(1998)*

38. How many mitotic divisions are needed for a single cell to make 128 cells?
(a) 28 (b) 32
(c) 7 (d) 14 *(1997)*

39. During cell division in apical meristem, the nuclear membrane appears in
(a) telophase (b) cytokinesis
(c) metaphase (d) anaphase. *(1997)*

40. When paternal and maternal chromosomes change their materials with each other in cell division this event is called
(a) bivalent-forming (b) dyad-forming
(c) synapsis (d) crossing-over.
(1996)

41. Which typical stage is known for DNA replication?
(a) S-phase (b) G_2-phase
(c) metaphase (d) G_1-phase *(1996)*

42. In a somatic cell cycle, DNA synthesis takes place in
(a) G_1 phase
(b) prophase of mitosis
(c) S-phase
(d) G_2 phase. *(1994)*

43. Which of the following represents the best stage to view the shape, size and number of chromosomes?
(a) Prophase (b) Metaphase
(c) Interphase (d) Telophase
(1994)

44. Which statement best explains the evolutionary advantage of meiosis?
(a) Meiosis is necessary for sexual reproduction.

(b) Genetic recombinations are possible from generation to generation
(c) Meiosis alternates with mitosis from generation to generation
(d) The same genetic system is passed on from generation to generation. *(1994)*

45. Meiosis II performs
(a) separation of sex chromosomes
(b) synthesis of DNA and centromere
(c) separation of homologous chromosomes
(d) separation of chromatids. *(1993)*

46. Number of chromatids at metaphase is
(a) two each in mitosis and meiosis
(b) two in mitosis and one in meiosis
(c) two in mitosis and four in meiosis
(d) one in mitosis and two in meiosis. *(1992)*

47. Mitotic anaphase differs from metaphase in possessing
(a) same number of chromosomes and same number of chromatids
(b) half number of chromosomes and half number of chromatids
(c) half number of chromosomes and same number of chromatids
(d) same number of chromosomes and half number of chromatids. *(1991)*

48. In meiosis, the daughter cells differ from parent cell as well as amongst themselves due to
(a) segregation, independent assortment and crossing over
(b) segregation and crossing over
(c) independent assortment and crossing over
(d) segregation and independent assortment. *(1991)*

49. Segregation of Mendelian factor (Aa) occurs during
(a) diplotene (b) anaphase I
(c) zygotene/pachytene (d) anaphase II. *(1990)*

50. Meiosis I is reductional division. Meiosis II is equational division due to
(a) pairing of homologous chromosomes
(b) crossing over
(c) separation of chromatids
(d) disjunction of homologous chromosomes. *(1988)*

Answer Key

1.	(a)	**2.**	(b)	**3.**	(a)	**4.**	(b)	**5.**	(a)	**6.**	(d)	**7.**	(b)	**8.**	(c)	**9.**	(d)	**10.**	(a)
11.	(d)	**12.**	(c)	**13.**	(a)	**14.**	(a)	**15.**	(a)	**16.**	(c)	**17.**	(a)	**18.**	(a)	**19.**	(b)	**20.**	(c)
21.	(a)	**22.**	(c)	**23.**	(d)	**24.**	(c)	**25.**	(d)	**26.**	(c)	**27.**	(c)	**28.**	(b)	**29.**	(b)	**30.**	(b)
31.	(a)	**32.**	(c)	**33.**	(c)	**34.**	(b)	**35.**	(c)	**36.**	(b)	**37.**	(c)	**38.**	(c)	**39.**	(a)	**40.**	(d)
41.	(a)	**42.**	(c)	**43.**	(b)	**44.**	(b)	**45.**	(d)	**46.**	(a)	**47.**	(d)	**48.**	(a)	**49.**	(b)	**50.**	(c)

EXPLANATIONS

1. (a) : Mitosis is divided into four phase prophase, metaphase, anaphase and telophase. During prophase the indistinct and interwined DNA molecules condenses to form elongated chromosomes. The nuclear membrane disintegrates during prometaphase. During metaphase, the chromosomes align themselves at the equatorial plate. During anaphase, centromere of each chromosome divides into two so that each chromosome come to have its own centromere. Chromatids move towards opposite poles along the path of their chromosome fibres. Finally during telophase, two chromosome groups reorganise to form two nuclei. Nuclear envelope reappears, Golgi complex and endoplasmic reticulum are reformed, etc. Crossing over occurs during meiosis.
Option (c) also gives the correct sequence of events but it misses step II (nuclear membrane disassembly). Hence, is ruled out as best appropriate answer is answer (a).

2. (b) : During anaphase in mitosis, sister chromatids segregate at opposite poles. Therefore, a defective APC will affect chromosome segregation.

3. (a) : In S-phase (synthetic phase) of cell cycle, the chromosomes replicate. For this their DNA molecules function as templates and form carbon copies. The DNA content doubles *i.e.*, 1C to 2C for haploid cells and 2C to 4C for diploid cells. As a result duplicate sets of genes are formed. Along with replication of DNA new chromatin fibres are formed which, however, remain attached in pairs and the number of chromosomes does not increase. As chromatin fibres are elongated chromosomes, each chromosome comes to have two chromatin threads or sister chromatids which remain attached at a common point called centromere.

4. (b) : If cell has stalled DNA replication fork, it implies that it has crossed CG_1 or G_1 cyclin cell cycle check point and has entered S-phase of cell cycle, where it is preparing for chromosome replication. Afterwards it will enter G_2 phase and will soon approach second check point called mitotic cyclin (CM) which lies between G_2 and M-phase).

5. (a)

6. (d) : Small disc-shaped structures at the surface of the centromeres are called kinetochores. These structures serve as the sites of attachment of spindle fibres to the chromosomes that are moved into position at the centre of the cell.

7. (b) : Synapsis is the process of association of homologous chromosomes. It takes place during zygotene stage of prophase I of meiosis. This stage is not seen during mitosis.

8. (c) : Crossing over is a process of exchange of genetic material or chromatid segments between two homologous chromosomes. It is initiated during pachytene stage of meiosis.

9. (d) : Prophase-I of meiosis has been divided into five sub-stages which occur in the sequence as : Leptotene → Zygotene → Pachytene → Diplotene → Diakinesis. Synapsis *i.e.*, pairing of homologous chromosomes occurs during zygotene. Crossing over *i.e.*, exchange of chromatid segments occurs during pachytene. Terminalisation of chiasmata *i.e.,* shifting of chiasmata towards the ends of chromosomes and complete disappearance of nucleolus take place during diakinesis.

10. (a) : In diploid cells (somatic cells) during G_1 phase, DNA content is 2C and chromosome number is $2n$ whereas in haploid cells (gamete) during G_1 phase, DNA content is 1C and chromosome number is n. S phase is marked by replication of DNA and the amount of DNA per cell is doubled *i.e.*, it becomes 4C in somatic cells, whereas chromosome number remains same *i.e.*, $2n$. Thus, a somatic cell which has just completed S phase, will have 4C DNA content but $2n$ chromosome number, while the gamete cell has 1C DNA content and n chromosome number.

11. (d) :

Synapsis aligns homologous chromosomes	–	Zygotene
Synthesis of RNA and protein	–	G_2 phase
Action of enzyme recombinase	–	Pachytene
Centromeres do not separate but chromatids move towards opposite poles	–	Anaphase I

12. (c) : A cell cycle is divided into G_1 S, G_2 and M phases. G_1 or first growth phase is followed by S phase or synthesis phase. DNA replication occurs in S phase and DNA amount doubles up *i.e.,* a cell with 2C DNA in G_1 phase will now have 4C DNA. G_2 phase is second growth phase where DNA content remains 4C. M phase is the phase of division where DNA content either regains 2C level (mitosis) or becomes halved

i.e. 1C (in meiosis). G_0 phase is the phase of differentiation where cell contains DNA as in the same amount as its parent cell and does not divide further.

13. (a) : In 'S' phase of cell cycle the DNA content doubles, *i.e.*, 1C to 2C for haploid cells and 2C to 4C for diploid cells. However, the number of chromosomes does not increase.

14. (a) : Pachytene is characterized by the appearance of recombination nodules, the sites at which crossing over occurs between non-sister chromatids of the homologous chromosomes. Nodules contain multienzyme complex called recombinase. Recombinase is made of endonuclease, exonuclease, unwindase, R-protein, etc.

15. (a) : During zygotene stage chromosomes start pairing together and this process of association is called synapsis. Such paired chromosomes are called homologous chromosomes. Electron micrographs of this stage indicate that chromosome synapsis is accompanied by the formation of complex structure called synaptonemal complex. The complex formed by a pair of synapsed homologous chromosomes is called a bivalent or a tetrad.

16. (c) : The figure given in the question shows a stage of mitotic cell division called as telophase stage. The individual chromosomes are no longer seen and chromatin material tends to collect in a mass at the two poles. This is the stage which shows the following key events:

- Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.
- Nuclear envelope assembles around the chromosome clusters.
- Nucleolus, Golgi complex and ER reform.

17. (a) : During zygotene or zygonema of meiotic prophase I the chromosomes become shorter and thicker. The homologous chromosomes come to lie side-by-side in pairs. This pairing of homologous chromosomes is known as synapsis, or syndesis. A pair of homologous chromosomes lying together is called a bivalent.

18. (a) : In metaphase, chromosomes consisting of two sister chromatids get arranged at equator. Discontinuous fibres radiate out from two spindle poles and get connected to the disc shaped structure at the surface of the centromere called kinetochores. These are known as chromosome fibres or tractile fibrils. A kinetochore is a complex protein structure that is analogous to a ring for the microtubule hook; it is the point where microtubules attach themselves to the chromosome.

19. (b) : *Refer to answer 18.*

20. (c) : During gamete formation, the enzyme recombinase participates during pachytene stage of prophase I. This stage is characterized by the appearance of recombination nodules, the sites at which crossing over occurs between non-sister chromatids of the homologous chromosomes. Crossing over is the exchange of genetic material between two homologous chromosomes. Crossing over is also an enzyme-mediated process and the enzyme involved is called recombinase.

21. (a) : The given figure shows crossing over *i.e.*, exchange of segments between two homologous chromosomes. Crossing over is characteristic of meiosis and occurs during pachytene stage of prophase I.

22. (c) : During anaphase I, from each tetrad two chromatids of a chromosome move as a unit (dyad) to one pole of a spindle, and the remaining two chromatids of its homologue migrate to the opposite pole. Thus, the homologous chromosomes of each pair, rather than the chromatids of a chromosome, are separated. As a result, half of the chromosomes, which appear in early prophase, go to each pole. Thus the paternal and maternal chromosomes of each homologous pair segregate during anaphase I independently of the other chromosomes.

23. (d) : The plane of alignment of the chromosomes at metaphase is referred to as the metaphase plate. The key features of metaphase are, (1) Spindle fibres attach to kinetochores of chromosomes (2) Chromosomes are moved to spindle equator and get aligned along metaphase plate through spindle fibres to both poles.

24. (c) : The key feature of metaphase is the attachment of spindle fibres to kinetochores of chromosomes. Kinetochores are disc-shaped structures at the surface of the centromeres. These structures serve as the sites of attachment of spindle fibres to the chromosomes that are moved into position.

25. (d) : During early prophase of mitosis, nucleus and cell become spheroid. Viscocity and refractivity of cytoplasm increases. DNA molecules condense to form shortened chromosome. Endoplasmic reticulum and nucleolus starts disappearing.

26. (c)

27. (c) : *Refer to answer 17.*

28. (b) : In cell cycle there are two main phases-interphase and mitotic phase. Interphase is divided into 3 stage G_1, S and G_2. G_1 is first growth phase. S is synthetic phase and G_2 is second growth phase.

29. (b) : During S phase or synthetic phase the replication of DNA takes place. For replication of DNA histone proteins are required so they are also synthesized during this phase. It takes about 30%-50% of the total cell cycle.
Prophase and telophase are stages involved in mitosis or meiosis. During G_2 phase division of centrioles, mitochondria and chloroplasts occurs.

30. (b) : Interphase is the stage between two successive cell divisions. During interphase, chromosomes are decondensed and are distributed throughout the nucleus. It is the largest period in the cell cycle and is divided into three phases - G_1, S and G_2. During G_1 phase the cell grows and synthesis of *t*RNA, *m*RNA, ribosomes, enzymes and proteins necessary for DNA synthesis occurs. During S phase replication of DNA takes place. The nucleotides get assembled and DNA molecules are synthesized.
During G_2 phase organelles like centrioles are doubled and mitochondria, chloroplasts etc. divide.

31. (a) : Metaphase is the best time to count and study the number and morphology of chromosomes. The distinctly visible chromosome arrange themselves at the equatorial or metaphasic plate. The centromeres lie at the equatorial plate while the limbs are placed variously according to their size and spiral arrangement. At prophase the chromosomes appear thin and filamentous, forming a network. So they are not very clearly visible. At telophase the chromosomes uncoil and lengthen and therefore are not clearly seen. Anaphase also shows chromosomes distinctly and they can be counted. But during anaphase chromatids seperate and start moving towards opposite pole. So for counting metaphase is the best stage.

32. (c) : M phase or mitotic phase is the actual division phase and formation of contractile ring and formation of phragmoplast precedes reformation of nuclear envelope. Contractile ring is belt-like bundle of actin and myosin that appears during cell division immediately below the plasma membrane. Contraction of this ring leads to the separation of the two daughter cells.
Phragmoplast is the region of plant cell cytoplasm that becomes evident in the latter stages of mitosis. It forms from the residual microtubules of the polar mitotic spindle and appears to function in transporting materials to the new cell plate forming between the daughter cells. Once the cell plate is complete, the phragmoplast is divided and gradually disappears, the cell plate finally becoming transformed into the middle lamella lying between the new cell walls.

33. (c) : A spindle of fine fibres begins to develop during prophase. It consists of microtubules which are made of protein called tubulin and certain other associated proteins. These delicate fibres radiate from the centriole and constitute aster.
This option was not given in the entrance paper.
As actin and myosin are involved as contractile machinery in many nonmuscle cells so it can be considered as the correct answer. Myoglobin is present in muscles which can bind to oxygen.

34. (b) : Mitosis occurs both in somatic cells as well as in germ cells of the gonads. In plants mitosis occurs in the meristematic cells of root tip or shoot tip. These cells divide at a faster rate. So the root tip shows active cell division and are used in the laboratory to study mitosis. For studying meiosis young anthers are used.

35. (c) : Spindle is microtubular apparatus that appears in many eukaryotic cells at the beginning of nuclear division and is responsible for the ordered separation of the chromosomes, chromosomes being attached to the spindle fibres by their centromeres. Two types of spindle fibres can be distinguished as the interpolar fibre, which stretches continuously from pole to pole of the spindle; the kinetochore fibre, which stretches from the pole to the centromere (kinetochore) of an individual chromosome. The mechanism by which the chromosomes move and the spindle fibres contract remains unclear. Cells of animals and lower plants possess centrioles, which act as organizer regions for spindle microtubule formation, but centrioles are absent from the cells of higher plants.

36. (b) : *Refer to answer 29.*

37. (c) : Microtubules are unbranched hollow submicroscopic tubules of protein tubulin which develop on specific nucleating regions and can undergo quick growth or dissolution at their ends by assembly or disassembly of monomers. Microtubules form spindle during cell division. Centrioles help in cell division by forming spindle poles or microtubules. In animal cells, microfilament collect in the middle region of the cell below the cell membrane. They induce the cell membrane to invaginate.
In plant cells, cell plate is formed to separate the two daughter cells. Some of the spindle fibres called interzonal microtubules are deposited around phragmoplast. Vesicles from Golgi apparatus are deposited and coalesce on the phragmoplast to form a cell plate.

38. (c) : Mitosis is an equational division where after division each cell produces two daughter cells, therefore after 7 divisions one cell will give 128 cells in case of mitosis.

$$1 \xrightarrow{1} 2 \xrightarrow{2} 4 \xrightarrow{3} 8 \xrightarrow{4} 16 \xrightarrow{5} 32 \xrightarrow{6} 64 \xrightarrow{7} 128$$

39. (a) : In apical meristems mitotic divisions occur at a rapid rate. In late telophase of mitosis, a nuclear membrane appears on the outside from either pieces of nuclear envelope or endoplasmic reticulum. The telophase may last as long as the prophase.

40. (d) : Crossing over is responsible for inducing variability. It involves an exchange of equal segments of non-sister chromatids belonging to two different but homologous chromosomes. Crossing over takes place at four stranded stage. Only two of the four chromatids take part in crossing over. The other two are called non crossovers. Zygotene is characterized by pairing of homologous chromosomes which is called synapsis. The first meiotic division which is completed at first telophase may be followed by cytokinesis giving rise to a dyad.

41. (a) : *Refer to answer 30.*

42. (c) : *Refer to answer 30.*

43. (b) : *Refer to answer 31.*

44. (b) : Meiosis involves exchange of genes between homologous chromosomes. So the gametes produced are genetically different from each other. Offsprings produced by the fusion of gametes therefore also show recombinations or genetic variations. These variations in the offsprings make organisms more adaptable to the environment and these have a definite role in evolution.

45. (d) : Meiosis II is shorter than the typical mitotic division because of the shortening of prophase of this division. The division maintains the number of chromosomes produce at the end of reduction division. Hence, it is called homotypic or equational division, though it is similar to mitosis. The main function of homotypic division or meiosis II is to separate the chromatids of univalent chromosomes which differ from each other in their linkage groups due to crossing over.

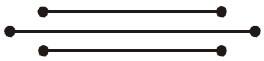
46. (a) : Number of chromatids at metaphase is two each in mitosis and meiosis. Chromatid is a half chromosome during duplication in early prophase and metaphase of mitosis and between diplotene and the second metaphase of meiosis. After these stages chromatids are called a daughter chromosomes.

47. (d) : Mitotic anaphase differs from metaphase in possessing same number of chromosomes and half number of chromatids. During anaphase of mitosis, chromosomes divide at the point of centromere or kinetochore and thus two sister chromatids are formed which are called as chromosomes. While during metaphase, chromosomes become maximally distinct due to further contraction and thus size of chromosomes is measured at mitotic metaphase.

48. (a) : In meiosis, the daughter cells differ from parent cell as well as amongst themselves due to segregation, independent assortment and crossing over. Daughter cells inhibit variations. Meiosis leads to recombinations or new combinations of genes or characters as a result of crossing over. Due to these recombinations, variations are created, which have role in process of evolution.

49. (b) : Segregation of Mendelian factor (Aa) occurs during Anaphase I. The paired homologous chromosomes separate in meiosis I so that each gamate receives one chromosomes of each homologous pair. During Anaphase I chromosome divides at the point of centromere or kinetochore and thus two sister chromatids are formed, which are called as chromosomes.

50. (c) : August Weismann in 1887 predicted that the number of chromosomes must be reduced by one half during gamete formation. The two divisions of meiosis are called the first and the second meiotic divisions. In meiosis I, the number of chromosomes are reduced from diploid to haploid condition, whereas in meiosis II, the two chromatids of each chromosomes separate from each other and go to separate daughter cells, as a result the number of chromosomes remains the same as produced by meiosis I.



Chapter
11

Transport in Plants

1. The water potential of pure water is
(a) less than zero
(b) more than zero but less than one
(c) more than one
(d) zero. *(NEET 2017)*

2. Which of the following facilitates opening of stomatal aperture?
(a) Decrease in turgidity of guard cells
(b) Radial orientation of cellulose microfibrils in the cell wall of guard cells
(c) Longitudinal orientation of cellulose microfibrils in the cell wall of guard cells
(d) Contraction of outer wall of guard cells
(NEET 2017)

3. A few drops of sap were collected by cutting across a plant stem by a suitable method. The sap was tested chemically. Which one of the following test results indicates that it is phloem sap?
(a) Acidic
(b) Alkaline
(c) Low refractive index
(d) Absence of sugar *(NEET-II 2016)*

4. Root pressure develops due to
(a) passive absorption
(b) active absorption
(c) increase in transpiration
(d) low osmotic potential in soil. *(2015)*

5. A column of water within xylem vessels of tall trees does not break under its weight because of
(a) lignification of xylem vessels
(b) positive root pressure
(c) dissolved sugars in water
(d) tensile strength of water. *(2015)*

6. In a ring girdled plant
(a) the shoot and root die together
(b) neither root nor shoot will die
(c) the shoot dies first
(d) the root dies first. *(2015 Cancelled)*

7. Transpiration and root pressure cause water to rise in plants by
(a) pushing it upward
(b) pushing and pulling it, respectively
(c) pulling it upward
(d) pulling and pushing it, respectively.
(2015 Cancelled)

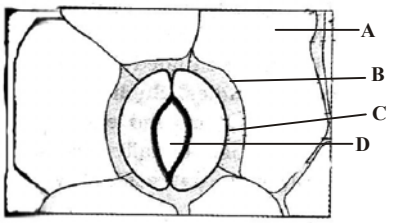
8. Which one gives the most valid and recent explanation for stomatal movement?
(a) Starch hydrolysis
(b) Guard cell photosynthesis
(c) Transpiration
(d) Potassium influx and efflux
(2015 Cancelled)

9. Which of the following criteria does not pertain to facilitated transport?
(a) Transport saturation
(b) Uphill transport
(c) Requirement of special membrane proteins
(d) High selectivity *(NEET 2013)*

10. In land plants, the guard cells differ from other epidermal cells in having
(a) cytoskeleton
(b) mitochondria
(c) endoplasmic reticulum
(d) chloroplasts. *(2011)*

11. Guttation is the result of
(a) diffusion (b) transpiration
(c) osmosis (d) root pressure.
(Mains 2011)

12. Given below is the diagram of a stomatal apparatus. In which of the following all the four parts labelled as A, B, C and D are correctly identified?



	A	B	C	D
(a)	Subsidiary cell	Epidermal cell	Guard cell	Stomatal aperture
(b)	Guard cell	Stomatal aperture	Subsidiary cell	Epidermal cell
(c)	Epidermal cell	Guard cell	Stomatal aperture	Subsidiary cell
(d)	Epidermal cell	Subsidiary cell	Stomatal aperture	Guard cell

(Mains 2010)

13. Guard cells help in
(a) transpiration
(b) guttation
(c) fighting against infection
(d) protection against grazing. *(2009)*

14. The rupture and fractionation do not usually occur in the water column in vessel/tracheids during the ascent of sap because of
(a) weak gravitational pull
(b) transpiration pull
(c) lignified thick walls
(d) cohesion and adhesion. *(2008)*

15. Two cells A and B are contiguous. Cell A has osmotic pressure 10 atm, turgor pressure 7 atm and diffusion pressure deficit 3 atm. Cell B has osmotic pressure 8 atm, turgor pressure 3 atm and diffusion pressure deficit 5 atm. The result will be
(a) no movement of water
(b) equilibrium between the two
(c) movement of water from cell A to B
(d) movement of water from cell B to A.
(2007)

16. The translocation of organic solutes in sieve tube members is supported by
(a) cytoplasmic streaming
(b) root pressure and transpiration pull
(c) P-proteins
(d) mass flow involving a carrier and ATP.
(2006)

17. Potometer works on the principle of
(a) osmotic pressure
(b) amount of water absorbed equals the amount transpired
(c) root pressure
(d) potential difference between the tip of the tube and that of the plant. *(2005)*

18. Stomata of a plant open due to
(a) influx of potassium ions
(b) efflux of potassium ions
(c) influx of hydrogen ions
(d) influx of calcium ions. *(2003)*

19. Main function of lenticel is
(a) transpiration (b) guttation
(c) gaseous exchange (d) bleeding. *(2002)*

20. Opening and closing of stomata is due to the
(a) hormonal change in guard cells
(b) change in turgor pressure of guard cells
(c) gaseous exchange
(d) respiration. *(2002)*

21. Passive absorption of minerals depends on
(a) temperature
(b) temperature and metabolic inhibitor
(c) metabolic inhibitor
(d) humidity. *(2001)*

22. Glycolate induces opening of stomata in
(a) presence of oxygen
(b) low CO_2 concentration
(c) high CO_2
(d) CO_2 absent. *(2001)*

23. Loading of phloem is related to
(a) increase of sugar in phloem
(b) elongation of phloem cell
(c) separation of phloem parenchyma
(d) strengthening of phloem fiber. *(2001)*

24. The movement of ions against the concentration gradient will be
(a) active transport (b) osmosis
(c) diffusion (d) all of the above.
(2000)

25. In soil, water available for plants is
(a) gravitational water
(b) chemically bound water
(c) capillary water
(d) hygroscopic water. *(1999)*

26. The water potential and osmotic potential of pure water are
(a) 100 and 200 (b) zero and 100
(c) 100 and zero (d) zero and zero.
(1998)

27. When a cell is fully turgid, which of the following will be zero?
(a) Turgor pressure (b) Water potential
(c) Wall pressure (d) Osmotic pressure
(1997)

28. With an increase in the turgidity of a cell, the wall pressure will be
(a) fluctuate (b) remain unchanged
(c) increase (d) decrease. *(1997)*

29. Bidirectional translocation of solutes takes place in
(a) parenchyma (b) cambium
(c) xylem (d) phloem. *(1997)*

30. When water enters in roots due to diffusion, is termed as
(a) osmosis (b) passive absorption
(c) endocytosis (d) active absorption. *(1996)*

31. The movement of water, from one cell of cortex to adjacent one in roots, is due to
(a) accumulation of inorganic salts in the cells
(b) accumulation of organic compounds in the cells
(c) water potential gradient
(d) chemical potential gradient. *(1995)*

32. Translocation of carbohydrate nutrients usually occurs in the form of
(a) glucose (b) maltose
(c) starch (d) sucrose. *(1993)*

33. In guard cells when sugar is converted into starch, the stomatal pore
(a) closes completely
(b) opens partially
(c) opens fully
(d) remains unchanged. *(1992)*

34. At constant temperature, the rate of transpiration will be higher at
(a) sea level
(b) 1 km below sea level
(c) 1 km above sea level
(d) 1.5 km above sea level. *(1992)*

35. Conversion of starch to organic acids is required for
(a) stomatal opening
(b) stomatal closing
(c) stomatal formation
(d) stomatal activity. *(1992)*

36. In terrestrial habitats, temperature and rainfall conditions are influence by
(a) water transformations
(b) transpiration
(c) thermoperiodism
(d) translocation. *(1992)*

37. Guttation is mainly due to
(a) root pressure (b) osmosis
(c) transpiration (d) imbibition. *(1992)*

38. Which of the following is used to determine the rate of transpiration in plants?
(a) Porometer/Hygrometer
(b) Potometer
(c) Auxanometer
(d) Tensiometer/Barometer *(1992)*

39. Water movement between cells is due to
(a) T.P.
(b) W.P.
(c) D.P.D.
(d) incipient plasmolysis. *(1992)*

40. The most widely accepted theory for ascent of sap in trees is
(a) capillarity
(b) role of atmospheric pressure
(c) pulsating action of living cell
(d) transpiration pull and cohesion theory of Dixon and Jolly. *(1991)*

41. In soil, the water available for root absorption is
(a) gravitational water
(b) capillary water
(c) hygroscopic water
(d) combined water. *(1991)*

42. The principal pathway of water translocation in angiosperms is
(a) sieve cells
(b) sieve tube elements
(c) xylem vessel system
(d) xylem and phloem. *(1990)*

43. A bottle filled with previously moistened mustard seeds and water was screw capped tightly and kept in a corner. It blew up suddenly after about half an hour. The phenomenon involved is
(a) diffusion (b) imbibition
(c) osmosis (d) DPD. *(1990)*

44. Minerals absorbed by root move to the leaf through
(a) xylem (b) phloem
(c) sieve tubes (d) none of the above. *(1989)*

45. Stomata open and close due to
(a) circadian rhythm
(b) genetic clock
(c) pressure of gases inside the leaves
(d) turgor pressure of guard cells. *(1988)*

46. Phenyl mercuric acetate (PMA) results in
(a) reduced photosynthesis
(b) reduced transpiration
(c) reduced respiration
(d) killing of plants. *(1988)*

47. Transpiration is least in
(a) good soil moisture
(b) high wind velocity
(c) dry environment
(d) high atmospheric humidity. *(1988)*

48. Water potential is equal to
(a) Ψ_s + O.P. (b) Ψ_s = T.P.
(c) $\Psi_p + \Psi_w$ (d) $\Psi_s + \Psi_p$. *(1988)*

Answer Key

1.	(d)	**2.**	(b)	**3.**	(b)	**4.**	(b)	**5.**	(d)	**6.**	(d)	**7.**	(d)	**8.**	(d)	**9.**	(b)	**10.**	(d)
11.	(d)	**12.**	(d)	**13.**	(a)	**14.**	(d)	**15.**	(c)	**16.**	(c)	**17.**	(b)	**18.**	(a)	**19.**	(c)	**20.**	(b)
21.	(a)	**22.**	(b)	**23.**	(a)	**24.**	(a)	**25.**	(c)	**26.**	(d)	**27.**	(b)	**28.**	(c)	**29.**	(d)	**30.**	(b)
31.	(c)	**32.**	(d)	**33.**	(a)	**34.**	(d)	**35.**	(a)	**36.**	(b)	**37.**	(a)	**38.**	(b)	**39.**	(c)	**40.**	(d)
41.	(b)	**42.**	(c)	**43.**	(b)	**44.**	(a)	**45.**	(d)	**46.**	(b)	**47.**	(d)	**48.**	(d)				

EXPLANATIONS

1. (d)

2. (b) : When turgidity increases within the two guard cells flanking each stomatal aperture or pore, the thin outer wall bulge out and force the inner walls into a crescent shape. This results in the opening of stomata. The opening of stomata is also aided by the radial orientation of cellulose microfibrils in the cell wall of guard cells rather than longitudinal orientation.

3. (b)

4. (b) : Root pressure is positive pressure that develops in the xylem sap of the root of some plants. It is a manifestation of active water absorption.

5. (d) : Cohesion, adhesion and surface tension are the forces responsible for movement of water up the tracheary elements. Water molecules remain attached to one another by a strong mutual force of attraction called cohesion force. On account of cohesion force, the water column can bear a tension or pull of upto 100 atm. Therefore, the cohesion force is also called tensile strength. Its theoretical value is about 15,000 atm but the measured value inside the tracheary elements ranges between 45 atm to 207 atm. Water column does not further break its connection from the tracheary elements because of another force called adhesion force between their walls and water molecules. Another force called surface tension accounts for high capillarity through tracheids and vessels.

6. (d) : In girdling or ringing experiments, a ring of bark is cut from the stem. It also removes phloem. Nutrients collect above the ring, where the bark also swells up and may give rise to adventitious roots. Growth is also vigorous above the ring. The tissues below the ring not only show stoppage of growth but also begin to shrivel. Roots can be starved and killed, if the ring is not healed after some time. Killing of roots shall kill the whole plant, clearly showing that bark or phloem is involved in the movement of organic solutes towards root.

7. (d) : The transpiration process, pulls water upwards with the help of cohesion and adhesion properties of water molecules. According to transpiration pull theory, due to transpiration, the water column inside the plant comes under tension. This is called 'transpiration pull'. On account of this tension, the water column is pulled up passively from below to top of the plant (almost like a rope). Root pressure is the pressure that forces water, absorbed from the soil, to move through the roots and up (*i.e.*, pushes it up) the stem of a plant. It may be due to both the osmosis of water from the soil into the root cells, and the active pumping of salts into xylem tissue which maintains a concentration gradient along which the water moves.

8. (d) : According to this theory, K^+ ion enter and accumulate in guard cells during daytime, causing opening of stomata and during night, K^+ ions move out of stomata and stomata closes.

Malic acid is formed in guard cells
↓ Dissociates into
H^+ + malate ions
↓ K^+ ion exchange from subsidiary cells
K^+ + malate ions in guard cells
↓
Osmotic pressure of guard cells increased
↓
Endosmosis into guard cells
↓
Guard cells turgid
↓
Stomata open

9. (b) : Facilitated transport or facilitated division is the spontaneous passage of molecules or ions across a biological membrane passing through specific transmembrane integral proteins. Facilitated diffusion is mediated by protein channels and carrier proteins. Most transport proteins that mediate facilitated diffusion are very selective and only transport certain molecules. The major classes of proteins involved in facilitated diffusion are aquaporins, ion channels, and carrier proteins. Importantly, neither channels nor carrier proteins require energy to facilitate the transport of molecules; they enable molecules to move down their concentration gradients (downhill transport).

10. (d) : The leaf and stem epidermis is covered with pores called stomata (sing., stoma), part of a stoma complex consisting of a pore surrounded on each side by chloroplast-containing guard cells, and two to four subsidiary cells that lack chloroplasts. The guard cells differ from the epidermal cells in the following aspects:

- The guard cells are bean-shaped in surface view, while the epidermal cells are irregular in shape.
- The guard cells contain chloroplasts, so they can manufacture food by photosynthesis (The epidermal cells do not contain chloroplasts).

- Guard cells are the only epidermal cells that can synthesis sugar.

11. (d) : Various ions from the soil are actively transported into the vascular tissues of roots, water follows its potential gradient and increase the pressure inside the xylem. This positive pressure is called root pressure.

Effect of root pressure is observable at night and early morning when evaporation is low and excess water collects in the form of droplets near the tip of leaves of many herbaceous plants. Such water loss in its liquid phase is known as guttation.

12. (d) : A – Epidermal cell
B – Subsidiary cell
C – Stomatal aperture
D – Guard cell

13. (a) : Stomata are the main organs for transpiration. The stem and leaf epidermis are provided with numerous stomata. Diffusion of water vapour through the stomatal pores is known as stomatal transpiration. Transpiration occurs while the stomata are open for the passage of carbon dioxide and oxygen during photosynthesis. Stomatal opening and closing is regulated by the movement of guard cells.

14. (d) : *Refer to answer 5.*

15. (c) : Diffusion pressure deficit is the reduction in the diffusion pressure of water in a system over its pure state. It is given by DPD = O.P – W.P (T.P). DPD determines the direction of net movement of water. It is always from an area or cell of lower DPD to the area or cell of higher DPD. So, cell A having lower DPD, water will move from cell A to B.

16. (c) : P-proteins (Phloem proteins) are components found in large amounts in phloem sieve tubes.

The main function of these bodies is to seal off the sieve tube element or sieve cell by bringing about the blockage of sieve plate. These bodies perform this function when the sieve element is injured. These bodies and callose together block the pores of sieve tube elements. P-protein bodies and callose form blocking plugs. These bodies remain along the walls of sieve tube elements. P-protein bodies are assigned some in the translocation of food material in the sieve tubes but is not universally accepted.

17. (b) : Potometer is an instrument or apparatus with the help of which, rate of transpiration can be measured. Main types of potometers are as under:

Simple potometer, Farmer's potometer and Ganong's potometer.

The whole instrument is made of glass and is consisted of a long tube, having a side tube, bent at right angles. A fresh plant shoot is cut under water and is inserted into the side tube through a cork, fitted into the mouth of this tube. The whole apparatus is filled with water and the joints are made air tight.

The apparatus is placed in the sunlight. Air bubble enters the tube and after this lower end of the tube is placed in the beaker, containing water. Water is absorbed by the shoot and is transpired through the leaves. Transpiration pull is created and the air bubble begins to move alongwith the transpiration pull. Readings are taken for the air bubble and thus amount of water absorbed and transpired is calculated.

18. (a) : The mechanism of opening and closing of stomata is explained by active K^+ ion transport theory.

During day time :

Malic acid is formed in guard cells
↓ Dissociates into
H^+ + malate ions
↓ Dissociates into
K^+ + malate ions in guard cells
↓
O.P. of guard cells increased
↓
Endosmosis into guard cells
↓
Guard cells turgid
↓
Stomata open

During night or dark : CO_2 conc. increases in sub-stomatal cavities → ABA participation → K^+ ions exchange stopped → K^+ ions transported back into subsidiary cells → Decreased pH → Starch synthesized in guard cells → Decreased O.P. of guard cells → Exosmosis from guard cell → Stomata close.

19. (c) : Lenticels generally appear under stomata. The lenticel of phellogen itself also has intercellular spaces. Because of this relatively open arangement of cells, the lenticels are regarded as structures permitting the entry of air through the periderm.

Lenticels are characterstics of woody stem but they are also found in roots of trees and other perennials for entry of oxygen through them.

20. (b) : *Refer to answer 18.*

21. (a) : Rate of salt absorption increases when temperature increases but to a certain limit as salt absorption is inhibited at higher temperature because certain enzymes are not active at higher temperature and carriers are not synthesised. These carriers are required for active transport of salts from outer space in inner space.

Rate of diffusion of ions and molecules increases at enhanced temperature due to their increased kinetic activity. Thus passive salt absorption will increase.

22. (b) : Zelitch (1963) suggested that glycolic acid is formed in the guard cells. This acid is formed under low concentration of CO_2. Glycolate formed gives rise to carbohydrates. Under this condition, osmotically active material is produced and ATP synthesis also takes place. ATP is produced during glyoxylate-glycolate shuttle. This ATP helps in the active pumping of water in the guard cells and stomata open. Stomata close when this process is reversed.

23. (a) : When the phloem cells, just near the source, for example green leaves attain higher concentration of sugars, it is called the process of phloem loading. Sucrose is photosynthesised in the chloroplasts of mesophyll cells of leaves. Mesophyll cells are connected with each other through plasmodesmata. Similarly plasmodesmata are also present between the mesophyll cells and companion cells and also between mesophyll cells and sieve tubes. There plasmodesmata are the "channels" meant for the passage of sucrose.

24. (a) : Active transport involves movement of materials across the membrane against the concentration gradient of the solute particles. It requires energy in the form of ATP and carrier molecules.

25. (c) : Water occurs in the soil in the different forms as: free water, gravitational water, hygroscopic water, chemically combined water and capillary water.

Free water is that water which runs away and is not held by the soil. Obviously it is not available to the plants. Gravitational water goes down into the deeper strata of earth and it is also, not available to the plants. Hygroscopic water is present in the form of thin films around the soil particles and it is also not available to the plants under normal condition but it may be available under adverse conditions. Chemically combined water is not available to the plants at all. The only water which is available to the plants capillary water. Capillary water makes up about 75% of the total water available to plants. The rest of soil water (hygroscopic, combined, free, gravitational and 25% capillary water) are not available to plants. These are called echard or unavailable water.

26. (d) : Water potential or chemical potential in pure water is zero bar, arbitrarily. Osmotic potential or solute potential represents the effect of dissolved solutes on water potential solutes reduce the free energy of water by diluting the water. The osmotic potential of pure water is zero. If solutes are added to water its potential becomes less than that of pure waters is expressed as a negative value.

27. (b) : In a full turgid cell, DPD = O because it has T.P. = O.P. It means that the cell has no further capacity to absorb any water. Water potential is equal but opposite in sign to DPD. So in a fully turgid cell the water potential is zero.

28. (c) : When a cell is placed in a hypotonic solution then endosmosis occurs it means water enters in the cell and makes the cell turgid. This entry of water in the cell develops in a cell turgor pressure, which exerts pressure on the cell membrane or on the cell wall. If the cell wall is absent as is the case in animal cells then the cells burst due to turgor pressure. But in case of plant cells, wall is present to counteract the turgor pressure. This prevents the plant cells from busting in a hypotonic solution.

29. (d) : The movement of organic food or solute in soluble form from one organ to another organ is called translocation of solutes, *e.g.*, from leaves to stem and roots for consumption.

The movement of organic material is bidirectional. Because xylem is responsible for upward movement of water and minerals, so it cannot account for downdard translocation of solute at the same time. Cortex and pith are not structurally suitable for this purpose. Thus only phloem is left where there is end to end arrangement of sieve tubes united by sieve pores which is responsible for translocation of solutes in both direction.

30. (b) : Water is absorbed from soil by root system and mainly by root tips. There are two independent mechanisms of water absorption in plants active water absorption and passive water absorption. In active water aborption water is absorbed by the activity of the root itself. In passive water absorption transpiration pull is responsible for absorption of water.

According to this theory loss of water from mesophyll cells of leaves in transpiration decreases their TP and hence increases their DPD or SP. As a result of their increased DPD, they absorb water from adjacent xylem vessels of leaves. This xylem of the leaves is in continuation with xylem of stem and roots and hence this pull is transmitted downwards. The pull or tension is removed only when water is absorbed through root hair and this is passive water absorption. Thus transpiration pull is responsible for passive water absorption.

31. (c) : Movement of water always occurs from low DPD to high DPD. During water absorption by roots, water as well as solutes enter through root hair. After absorption of water by root hair, its TP is increased and thus DPD or SP is decreased. Then water from

root hair moves to the cells of the cortex along the concentration gradient and finally reaches the xylem.

32. (d) : Translocation of carbohydrates, nutrients usually occurs in the form of sucrose through sieve tube of phloem. Starch is converted to soluble sucrose form.

33. (a) : In guard cells when sugar is converted into starch, the stomatal pore closed completely. At night time, the CO_2 released during respiration accumulates. As a result, the acidity of the guard cells increases and pH decreases. The decreased pH favours conversion of sugar to starch. Pressure of the guard cells falls and hence they become flaccid. As a result, stomatal aperature closes.

34. (d) : At constant temperature, the rate of transpiration will be higher at 1.5 km above the sea level. At lower atmospheric pressure there is increase in the rate of evaporation.

35. (a) : There is evidence to believe that besides organic acids the turgidity of guard cells is usually controlled by K^+, Cl^- and H^+. The opening of stomata is initiated by exertion of H^+ by guard cells, intake if K^+ and Cl^-, disappearance of starch and appearance of organic acids like malic acid.

36. (b) : In terrestrial habitats, temperature and rainfall conditions are influenced by transpiration. The rate of transpiration is directly proportional to the saturation deficit of atmosphere. Plants growing in region where transpiration is meagre do not show over heating. So transpiration prevents overheating.

37. (a) : The loss of water through water stomata (hydathodes) is called as guttation. Guttation occurs when transpiration rate is very low as compared to rate of water absorption, due to this, root pressure is developed and water is pushed out through specialized pores at vein endings called hydathodes. Therefore guttation is not due to the activity of hydathodes but due to root pressure.

38. (b) : *Refer to answer 17.*

39. (c) : Water movement between cells is due to DPD. If a cell is placed in pure water it shows endosmosis and as a result water enters into the cell. Thus, the osmotic entry of water is due to high osmotic pressure of the cell sap. The inward movement of water is, therefore due to the fact that it's OP > TP. The net force with which water is drawn into a cell is equal to the difference of OP and TP, known as diffusion pressure deficit. DPD = OP – TP.

40. (d) : Transpiration pull cohesion theory for ascent of sap in trees is most widely accepted. This concept was proposed by Dixon and Jolly, 1884. It is based up on three basic assumptions which are cohesion in between water molecules, continuity of water column and transpiration pull.

41. (b) : *Refer to answer 25.*

42. (c) : The principal pathway of water translocation in angiosperms is xylem vessel system. The sap (*i.e.*, water with dissolved minerals) is absorbed mainly by roots and is moved upward to all the parts of plants *via* stem. It occurs mainly through xylem.

43. (b) : A bottle filled with previously moistened mustard seeds and water was screw capped tightly and kept in a corner. It blews up suddenly after about half an hour due to phenomenon of imbibition. The absorption of water by the solid particles of an adsorbent causing it to enormously increase in volume without forming a solution is called imbibition.

44. (a) : Minerals absorbed by roots move to the leaf through xylem. Xylem plays an important role in conduction of water. Hence, when water moves upward through xylem, minerals are also absorbed by the roots and move towards leaves through xylem only. This is known as ascent of sap.

45. (d) : The pressure that develops in a cell due to osmotic diffusion of water inside it, is called turgor pressure. Stomata open and close due to turgor pressure of guard cells. When turgid, they swell and bend outward. As a result, the stomatal aperture opens. When they are flaccid, the tension from the wall is released and the stomatal aperture closes.

46. (b) : Phenyl mercuric acetate (PMA) results in reduced transpiration. PMA is an antitranspirant. These are some chemicals whose limited application on the leaf surface reduces or checks transpiration. A good antitranspirant increases leaf resistance but does not affect the mesophyll resistance.

47. (d) : Transpiration is least in high atmospheric humidity. The rate of transpiration is directly proportional to the saturation deficit. In other words, transpiration rate depends upon the gradient of vapour pressure. Hence, at high atmospheric humidity transpiration rate is low.

48. (d) : Water potential is the difference in the free energy or chemical potential per unit molal volume of water in a system and that of pure water at the same temperature and pressure.
Water potential is represented by Greek letter ψ (psi) or ψ_w. Water potential is the sum total of ψ_s and ψ_p. Therefore, $\psi_w = \psi_s + \psi_p$.

Chapter
12

Mineral Nutrition

1. Which is essential for the growth of root tip?
(a) Zn (b) Fe
(c) Ca (d) Mn
(NEET-II 2016)

2. In which of the following all three are macronutrients?
(a) Molybdenum, magnesium, manganese
(b) Nitrogen, nickel, phosphorus
(c) Boron, zinc, manganese
(d) Iron, copper, molybdenum
(NEET-I 2016)

3. The oxygen evolved during photosynthesis, comes from water molecules. Which one of the following pairs of elements is involved in this reaction?
(a) Magnesium and Molybdenum
(b) Magnesium and Chlorine
(c) Manganese and Chlorine
(d) Manganese and Potassium *(2015)*

4. During biological nitrogen fixation, inactivation of nitrogenase by oxygen poisoning is prevented by
(a) carotene (b) cytochrome
(c) leghaemoglobin (d) xanthophyll.
(2015)

5. Minerals known to be required in large amounts for plant growth include
(a) potassium, phosphorus, selenium, boron
(b) magnesium, sulphur, iron, zinc
(c) phosphorus, potassium, sulphur, calcium
(d) calcium, magnesium, manganese, copper.
(2015 Cancelled)

6. Deficiency symptoms of nitrogen and potassium are visible first in
(a) senescent leaves (b) young leaves
(c) roots (d) buds.
(2014)

7. The first stable product of fixation of atmospheric nitrogen in leguminous plants is
(a) NO_3^- (b) glutamate
(c) NO_2^- (d) ammonia.
(NEET 2013)

8. Specialized cells for fixing atmospheric nitrogen in *Nostoc* are
(a) heterocysts (b) hormogonia
(c) nodules (d) akinetes.
(Karnataka NEET 2013)

9. Which of the following elements is a constituent of biotin?
(a) Magnesium (b) Calcium
(c) Phosphorus (d) Sulphur
(Karnataka NEET 2013)

10. Which two distinct microbial processes are responsible for the release of fixed nitrogen as dinitrogen gas (N_2) to the atmosphere?
(a) Aerobic nitrate oxidation and nitrite reduction
(b) Decomposition of organic nitrogen and conversion of dinitrogen to ammonium compounds
(c) Enteric fermentation in cattle and nitrogen fixation by *Rhizobium* in root nodules of legumes
(d) Anaerobic ammonium oxidation and denitrification
(Karnataka NEET 2013)

11. Best defined function of manganese in green plants is
(a) photolysis of water (b) Calvin cycle
(c) nitrogen fixation (d) water absorption.
(2012)

12. Which one of the following is correctly matched?
(a) Passive transport of nutrients – ATP
(b) Apoplast – Plasmodesmata
(c) Potassium – Readily immobilisation
(d) Bakane of rice seedlings – F. Skoog
(2012)

13. For its action, nitrogenase requires
(a) high input of energy
(b) light
(c) Mn^{2+}
(d) super oxygen radicals. *(Mains 2012)*

14. Which one of the following elements in plants is not remobilised?
(a) Phosphorus (b) Calcium
(c) Potassium (d) Sulphur *(2011)*

15. Nitrifying bacteria
(a) oxidize ammonia to nitrates
(b) convert free nitrogen to nitrogen compounds
(c) convert proteins into ammonia
(d) reduce nitrates to free nitrogen. *(2011)*

16. The function of leghaemoglobin in the root nodules of legumes is
(a) inhibition of nitrogenase activity
(b) oxygen removal
(c) nodule differentiation
(d) expression of *nif* gene. *(2011)*

17. Which one of the following helps in absorption of phosphorus from soil by plants?
(a) *Glomus* (b) *Rhizobium*
(c) *Frankia* (d) *Anabaena*
(2011)

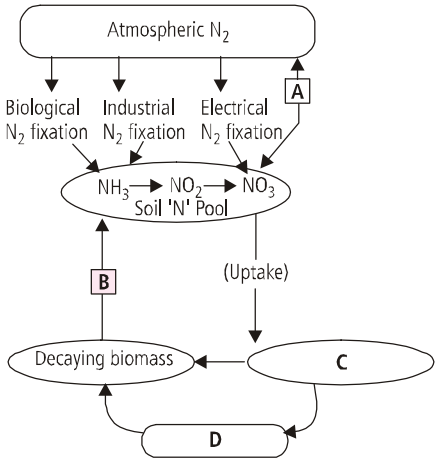
18. Which one of the following is not an essential mineral element for plants while the remaining three are?
(a) Iron (b) Manganese
(c) Cadmium (d) Phosphorus
(Mains 2011)

19. An element playing important role in nitrogen fixation is
(a) molybdenum (b) copper
(c) manganese (d) zinc. *(2010)*

20. Which one of the following is not a micronutrient?
(a) Molybdenum (b) Magnesium
(c) Zinc (d) Boron *(2010)*

21. Leguminous plants are able to fix atmospheric nitrogen through the process of symbiotic nitrogen fixation. Which one of the following statements is not correct during this process of nitrogen fixation?
(a) Leghaemoglobin scavenges oxygen and is pinkish in colour.
(b) Nodules act as sites for nitrogen fixation.
(c) The enzyme nitrogenase catalyses the conversion of atmospheric N_2 to NH_3.
(d) Nitrogenase is insensitive to oxygen.
(Mains 2010)

22. Study the cycle shown below and select the option which gives correct words for all the four blanks A, B, C and D.



	A	B	C	D
(a)	Nitrification	Ammoni-fication	Animals	Plants
(b)	Denitrification	Ammoni-fication	Plants	Animals
(c)	Nitrification	Denitri-fication	Animals	Plants
(d)	Denitrification	Nitrification	Plants	Animals

(Mains 2010)

23. Manganese is required in
(a) plant cell wall formation
(b) photolysis of water during photosynthesis
(c) chlorophyll synthesis
(d) nucleic acid synthesis. *(2009)*

24. Which one of the following elements is not an essential micronutrient for plant growth?
(a) Zn (b) Cu
(c) Ca (d) Mn *(2007)*

25. A plant requires magnesium for
(a) protein synthesis
(b) chlorophyll synthesis
(c) cell wall development
(d) holding cells together. *(2007)*

26. Sulphur is an important nutrient for optimum growth and productivity in
(a) oilseed crops (b) pulse crops
(c) cereals (d) fibre crops.
(2006)

27. The deficiencies of micronutrients, not only affects growth of plants but also vital functions such as photosynthetic and mitochondrial electron flow. Among the list given below, which group of three elements shall affect most, both photosynthetic and mitochondrial electron transport?
(a) Co, Ni, Mo (b) Ca, K, Na
(c) Mn, Co, Ca (d) Cu, Mn, Fe *(2005)*

28. If by radiation all nitrogenase enzyme are inactivated, then there will be no
(a) fixation of nitrogen in legumes
(b) fixation of atmospheric nitrogen
(c) conversion from nitrate to nitrite in legumes
(d) conversion from ammonium to nitrate in soil. *(2004)*

29. Gray spots of oat are caused by deficiency of
(a) Cu (b) Zn
(c) Mn (d) Fe. *(2003)*

30. Boron in green plants assists in
(a) activation of enzymes
(b) acting as enzyme co-factor
(c) photosynthesis
(d) sugar transport. *(2003)*

31. Choose the correct match.
Bladderwort, sundew, Venus flytrap
(a) *Nepenthes, Dionea, Drosera*
(b) *Nepenthes, Utricularia, Vanda*
(c) *Utricularia, Drosera, Dionea*
(d) *Dionea, Trapa, Vanda.* *(2002)*

32. Roots of which plant contains a red pigment which have affinity for oxygen?
(a) Carrot (b) Soybean
(c) Mustard (d) Radish *(2001)*

33. Which aquatic fern performs nitrogen fixation?
(a) *Azolla* (b) *Nostoc*
(c) *Salvia* (d) *Salvinia* *(2001)*

34. Mg is a component of
(a) chlorophyll (b) cytochrome
(c) haemoglobin (d) haemocyanin. *(2000)*

35. Plants take zinc in the form of
(a) $ZnSO_4$ (b) Zn^{++}
(c) ZnO (d) Zn. *(2000)*

36. When the plants are grown in magnesium deficient but urea rich soil, the symptoms expressed are
(a) yellowish leaves (b) colourless petiole
(c) dark green leaves (d) shoot apex die. *(2000)*

37. Which of the following is not caused by deficiency of mineral nutrition?
(a) Etiolation
(b) Shortening of internode
(c) Necrosis
(d) Chlorosis *(1997)*

38. Which one of the following elements is almost non-essential for plants?
(a) Zn (b) Na
(c) Ca (d) Mo *(1996)*

39. Which of the following elements plays an important role in biological nitrogen fixation?
(a) Copper (b) Molybdenum
(c) Zinc (d) Manganese *(1995)*

40. Which one is an essential mineral, not constituent of any enzyme but stimulates the activity of many enzymes?
(a) Zn (b) Mn
(c) K (d) Mg *(1989)*

41. Phosphorous and nitrogen ions generally get depeleted in soil because they usually occur as
(a) neutral ions
(b) negatively charged ions
(c) positively charged ions
(d) both positively and negatively charged but disproportionate mixture. *(1989)*

Answer Key

1.	(c)	**2.**	(*)	**3.**	(c)	**4.**	(c)	**5.**	(c)	**6.**	(a)	**7.**	(d)	**8.**	(a)	**9.**	(d)	**10.**	(d)
11.	(a)	**12.**	(c)	**13.**	(a)	**14.**	(b)	**15.**	(a)	**16.**	(b)	**17.**	(a)	**18.**	(c)	**19.**	(a)	**20.**	(b)
21.	(d)	**22.**	(b)	**23.**	(b)	**24.**	(c)	**25.**	(b)	**26.**	(a)	**27.**	(d)	**28.**	(a)	**29.**	(c)	**30.**	(d)
31.	(c)	**32.**	(b)	**33.**	(a)	**34.**	(a)	**35.**	(b)	**36.**	(a)	**37.**	(a)	**38.**	(b)	**39.**	(b)	**40.**	(c)
41.	(b)																		

(*) *None of these.*

EXPLANATIONS

1. (c) : Calcium (Ca) is necessary for the proper growth and functioning of root tips and meristems.

2. None of the options is correct.
Macronutrients are essential elements which are present in easily detectable quantities, 1-10 mg per gram of dry weight. The macronutrients include carbon, hydrogen, oxygen, nitrogen, phosphorous, sulphur, potassium, calcium and magnesium. Micronutrients or trace elements, are needed in very small amounts (equal or less than 0.1 mg/gm of dry matter). These include iron, manganese, copper, molybdenum, zinc, boron, chlorine and nickel.

3. (c) : Oxygen is evolved during photosynthesis by the process of photolysis of water taking place in the membranes of grana thylakoids. The phenomenon of breaking up of water into hydrogen and oxygen in the illuminated chloroplasts is called photolysis or photocatalytic splitting of water. Light energy, an oxygen evolving complex (OEC) and electron carrier Y_z are required for this process. Oxygen evolving complex is attached to the inner surface of thylakoid membrane and the enzyme has four Mn ions. Light energised changes in Mn (Mn^{2+}, Mn^{3+}, Mn^{4+}) remove electrons from OH^- component of water forming oxygen. Liberation of O_2 also requires two other ions, Ca^{2+} and Cl^-

$$4H_2O \rightleftharpoons 4H^+ + 4OH^-$$

$$4OH^- \xrightarrow[Mn^{2+},Ca^{2+},Cl^-]{\text{Oxygen evolving complex}} 2H_2O + O_2\uparrow + 4e^-$$

4. (c) : Leghaemoglobin is a pinkish pigment present in the root nodules of leguminous plants. It acts as oxygen scavenger and prevents the inactivation of nitrogenase enzyme by oxygen poisoning.

5. (c) : Macroelements (macronutrients) are those essential elements which are present in easily detectable quantities, *i.e.*, 1-10 mg per gram of dry matter. Macroelements are usually involved in the synthesis of organic molecules and development of osmotic potential. They are nine in number — C, H, O, N, P, K, S, Mg and Ca.

6. (a) : Deficiency symptoms appear first in young leaves and young tissues in case of elements which are relatively immobile inside the plant *e.g.*, Ca, S. For mobile elements like N and K, deficiency symptoms first appear in old and senescent leaves as the elements are mobilised from senescing regions for supply to young tissues.

7. (d) : The enzyme nitrogenase is a Mo- Fe protein and catalyses the conversion of atmospheric nitrogen to ammonia, the first stable product of nitrogen fixation. Nitrogen fixation is the conversion of inert atmospheric nitrogen or dinitrogen (N_2) into utilisable compounds of nitrogen like nitrate, ammonia, amino acids etc. There are two methods of nitrogen fixation - abiological and biological. Biological nitrogen fixation is performed by both free living and symbiotic forms. Symbiotic nitrogen fixing organisms hand over a part of their nitrogen to the host in return for shelter and food. The nodule of leguminous plants contains all the necessary biochemical components, such as the enzyme nitrogenase and leghaemoglobin, for nitrogen fixation.

8. (a) : Certain species of cyanobacteria (*Nostoc*) possess some special cells called heterocysts which occur in terminal, basal and intercalary positions. Heterocysts are yellowish in colour and contents are homogenous. Heterocysts are now known as sites of nitrogen fixation. Atmospheric nitrogen is made available in the form of ammonia by cyanobacteria.

9. (d) : Sulphur is present in two vitamins of B complex, thiamine and biotin. Biotin is important to hair. It is normally found in protein foods, such as eggs, lettuce, sprouts etc.

10. (d) : Denitrification is a chemical process in which nitrates in the soil are reduced to molecular nitrogen (N_2) which is released into the atmosphere. It is done by denitrifying bacteria like *Pseudomonas denitrificans*. Anaerobic oxidation of ammonium (NH_4) also releases nitrogen in the atmosphere.

11. (a) : Manganese (Mn^{2+}) is used for photolysis of water to produce oxygen and electrons during light reaction of photosynthesis. It is the phenomenon of breaking up of water into hydrogen and oxygen in the illuminated chloroplast. It acts as an essential cofactor.

12. (c) : Immobilization or fixation of a nutrient means that the nutrient becomes unavailable for plant. The process of converting exchangeable or water soluble potassium to its non exchange or water insoluble form is known as potassium immobilisation. Potassium is present in relatively large quantities in soil (averaging about 1.9%). Depending on the circumstances, soil potassium may be not easily available, slowly available or readily available. The

first category accounts for 90 to 98% of the total soil potassium, which is only slightly soluble, the second category constitutes 2-10% of total mineral soil and third category makes up for about 1%.

13. (a) : Nitrogenase enzyme is present in prokaryotic nitrogen fixers. The enzyme nitrogenase requires a high input of energy to carry out biological nitrogen fixation. This can be illustrated by the following equation.

$$N_2 + 8e^- + 8H^+ + 16\,ATP \xrightarrow{\text{Nitrogenase}} 2NH_3 + H_2 + 16ADP + 16\,P_i$$

14. (b)

15. (a) : Nitrifying bacteria involves the oxidation of ammonia to nitrates through nitrites called nitrification. Nitrite bacteria (*Nitrosomonas* and *Nitrococcus*) convert ammonia to nitrites whereas, nitrate bacteria (*Nitrobacter* and *Nitrocystis*) convert nitrite to soluble nitrates.

16. (b) : The root nodule of legume contains enzyme nitrogenase and leghaemoglobin. Nitrogenase catalyses the conversion of atmospheric nitrogen to ammonia. It is highly sensitive to the molecular oxygen and requires anaerobic conditions. The nodules have adaptations that ensure that the enzyme is protected from oxygen. To protect these enzymes, the nodule contains an oxygen scavenger called leghaemoglobin.

17. (a) : Some fungi form symbiotic associations with plants (mycorrhiza). Many members of the genus *Glomus* form mycorrhiza. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.

18. (c) : C, H, O, N, P, K, S, Mg, Ca, Fe, B, Mn, Cu, Zn, Mo, Cl, Ni are essential elements, which has a specific structural or physiological role and without which plant cannot complete their life cycle.

19. (a) : Molybdenum is a micronutrient which is required in very minute amount by the plants. It is responsible for nodulation in legumes. It is part of nitrate reductase enzyme which helps in nitrogen fixation.

20. (b) : *Refer to answer 2.*

21. (d)

22. (b) : A – Denitrification
B – Ammonification
C – Plants
D – Animals

23. (b) : *Refer to answer 11.*

24. (c) : Calcium is an essential macronutrient for plant growth. Macronutrients are essential elements which are required by plants in quantity more than 1 mg/g dry matter. It is used as a calcium pectinate for the formation of middle lamella in cell wall for lipid metabolism, for cell division and cell enlargement, helps in translocation of carbohydrates and also activates enzyme activity in plants. All other like Zn, Cu and Mn are micronutrients of plants.

25. (b) : Magnesium is an important constituent of chlorophyll, found in all green plants and essential for photosynthesis. The chlorophyll molecule has a tetrapyrolic or porphyrin head and a phytol tail. Mg atom is present in the centre of porphyrin head. It is like tennis racket.

26. (a) : Sulphur is present in all the cells of the body in association with proteins made of sulphur containing amino acids, *viz*., cystine, cysteine and methionine. Members of Cruciferae and animal proteins are rich sources of sulphur; other vegetable proteins (*e.g*., pulses) have only little sulphur.

Plants absorb sulphur from soil in the form of sulphate ions (SO_4^{--}). It is a constituent of ferredoxin and some of the lipids present in chloroplasts. Pungent floroue and odour of mustard, cabbage, turnip etc. of Family Brassicaceae is due to the presence of sulphur containing oils. Application of 40 kg/ha to oilsed based cropping system is found to increase the yield, oil and protein content of the seeds.

27. (d) : Iron is mainly available in the ferrous form and it is absorbed in the ferric form, also. It is a part of catalases, peroxidases, cytochromes etc. and plays a role in electron transport system in photosynthesis.

Manganese is absorbed by the plants when it is in the bivalent form. Manganese participates in the photolysis of water in pigment system II during photosynthesis and thus it helps in the electron transport from water to chlorophyll.

Copper is absorbed on the clay particles as divalent cations, from where it can be absorbed by the plants by exchange mechanism. It is constituent of plastocyanin which takes part in electron transport during photosynthetic phosphorylation.

28. (a) : The process by which N_2 is reduced to NH_4^+ is called nitrogen fixation. Nitrogenase enzyme catalyzes this reduction. It is only carried out by prokaryotic microorganisms. Principal N_2-fixers include certain free living cyanobacteria in symbiotic associations with fungi in lichens or with ferns, mosses, and liverworts, and by bacteria or other microbes associated symbiotically with roots,

especially those of legumes. About 15 percent of the nearly 20,000 species in the Fabaceae (Leguminosae) family have been examined for N_2 fixation, and approximately 90 percent of these have root nodules in which fixation occurs. So without active nitrogenase enzyme there will be no N_2 fixation in legumes.

29. (c) : Gray spot diseases of oat is caused due to deficiency of manganese. Its symptoms include greyish - brown elongated specks and streaks, empty panicles, interveinal chlorosis on stem and leaves. The symptoms that occur only on leaves are irregular, greyish brown lesions which coalesce and bring about collapse of leaf. This is called grey speck symptom.

30. (d) : Boron occurs in the soil as a part of silicates, boric acid, calcium borate and magnesium borate. It is available to the plants as boric acid and borates of calcium and magnesium. It plays a role in carbohydrate metabolism and translocation of sugar is facilitated through the cell membrane through the agency of borate ion as it forms complexes with the carbohydrates.

31. (c) : Bladderwort or *Utricularia* is a rootless free floating insectivorous plant. Its stem is green and bears green lobed or dissected leaves. Some lobes of the leaves become modified into bladder like structures for catching insects. Sundew or *Drosera* is another insectivorous plant which has leaves that are green and bear many glandular hairs or tentacles having shining droplets to attract the insects and later trap them. Venus flytrap or *Dionea* is also an insectivorous plant in which the leaf is modified into two jaw like structures. Each jaw has long sensitive hairs on its upper surface and also has many digestive enzymes. These jaws interlock to trap the insect that enters in it. Thus *Utricularia*, *Drosera* and *Dionea* are all insectivorous plants.

32. (b) : Leghaemoglobin is a red respiratory pigment found in the root nodules of leguminous plant if *Rhizobium* is present. Soybean is a legume plant so it contains leghaemoglobin in its root nodules.

33. (a) : *Azolla* is an aquatic fern which is inoculated in the rice field to increase the yield. *Azolla* contains *Nostoc* and *Anabaena* (BGA) in its leaf cavities which perform nitrogen fixation.

34. (a) : *Refer to answer 25.*

35. (b) : Zinc is available to the plants for absorption in the divalent form. The availability of soil decreases when the pH of soil shifts towards alkaline side. Zinc may form zinc phosphate in the soil which is insoluble and in that case, it is not available to the plants. It is essential for synthesis of tryptophan amino acid, which forms IAA (Indole Acetic Acid) its deficiency causes chlorosis of older leaves.

36. (a) : Magnesium is important constituent of chlorophyll, thus it is found in all green plants and is essential for photosynthesis. It also helps in binding of ribosomal particles where protein synthesis occurs. It is also part of many enzymes of respiration. The deficiency symptoms of magnesium includes interveinal chlorosis in leaves and yellowing of leaves starting from basal to younger ones.

37. (a) : When the plants are kept in dark, they become pale yellow in colour and also become abnormally long with considerable internodal elongation, it is called etiolation. It is because 'flavonoids', which are inhibitors of GA are not formed in dark and hence in absence of flavonoids, GA show their full effect, *i.e.*, elongation (etiolation). Chlorosis involves non-development or loss of chlorophyll. It occurs due to deficiency of nitrogen and sulphur.

Necrosis involves death of tissues. It occurs due to deficiency of copper. Stunted growth occurs due to deficiency of potassium.

38. (b) : The 16 elements necessary for plants called essential elements, are as : C, H, O, N, P, S, K, Mg, Ca, Fe, Cu, B, Zn, Mn, Mo and Cl.

Zn is essential for the synthesis of tryptophan amino acid.

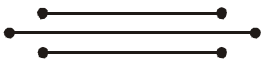
Ca is the part of middle lamella, it stabilizes the structure of chromosomes. Mo is responsible for nodulation in legumes. It is a part of nitrate reductase enzyme which helps in nitrogen fixation.

Na is a non-essential element. It seems to be involved in membrane permeability but its essentiality has not been proved.

39. (b) : *Refer to answer 19.*

40. (c) : Potassium is an essential mineral. It is not a constituent of any enzyme but accelerates the rate of activity of many enzymes. Potassuim is rich in actively dividing cells of buds, young leaves root tips. It is needed for proper growth and development. It regulates movement of stomata. A high amount of potassium is required in the process of protein synthesis.

41. (b) : Phosphorus and nitrogen ions generally get depleted in soil because they usually occur as negatively charged ions. Both the elements are essential for plants and acts as macromolecules which are required in large quantities.



Chapter
13

Photosynthesis in Higher Plants

1. With reference to factors affecting the rate of photosynthesis, which of the following statements is not correct?
(a) Increasing atmospheric CO_2 concentration up to 0.05% can enhance CO_2 fixation rate.
(b) C_3 plants respond to higher temperature with enhanced photosynthesis while C_4 plants have much lower temperature optimum.
(c) Tomato is a greenhouse crop which can be grown in CO_2-enriched atmosphere for higher yield.
(d) Light saturation for CO_2 fixation occurs at 10% of full sunlight. *(NEET 2017)*

2. Phosphoenol pyruvate (PEP) is the primary CO_2 acceptor in
(a) C_4 plants (b) C_2 plants
(c) C_3 and C_4 plants (d) C_3 plants.
(NEET 2017)

3. The process which makes major difference between C_3 and C_4 plants is
(a) glycolysis (b) Calvin cycle
(c) photorespiration (d) respiration.
(NEET-II 2016)

4. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of following options.
(a) The above processes happen only during night time.
(b) One process occurs during day time and the other at night.
(c) Both processes cannot happen simultaneously.
(d) Both processes can happen together because the diffusion coefficient of water and CO_2 is different. *(NEET-I 2016)*

5. In a chloroplast the highest number of protons are found in
(a) intermembrane space
(b) antennae complex
(c) stroma
(d) lumen of thylakoids. *(NEET-I 2016)*

6. Emerson's enhancement effect and Red drop have been instrumental in the discovery of
(a) photophosphorylation and cyclic electron transport
(b) oxidative phosphorylation
(c) photophosphorylation and non-cyclic electron transport
(d) two photosystems operating simultaneously.
(NEET-I 2016)

7. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In which of the following physiological groups would you assign this plant?
(a) CAM (b) Nitrogen fixer
(c) C_3 (d) C_4 *(NEET-I 2016)*

8. Water soluble pigments found in plant cell vacuoles are
(a) carotenoids (b) anthocyanins
(c) xanthophylls (d) chlorophylls.
(NEET-I 2016)

9. In photosynthesis, the light-independent reactions take place at
(a) photosystem II (b) stromal matrix
(c) thylakoid lumen (d) photosystem I.
(2015)

10. Chromatophores take part in
(a) movement (b) respiration
(c) photosynthesis (d) growth.
(2015)

11. A process that makes important difference between C_3 and C_4 plants is
(a) transpiration (b) glycolysis
(c) photosynthesis (d) photorespiration.
(2012)

12. The correct sequence of cell organelles during photorespiration is
(a) chloroplast, Golgi-bodies, mitochondria
(b) chloroplast, rough endoplasmic reticulum, dictyosomes
(c) chloroplast, mitochondria, peroxisome
(d) chloroplast, vacuole, peroxisome. *(2012)*

13. Read the following four statements (A – D).
(A) Both photophosphorylation and oxidative phosphorylation involve uphill transport of protons across the membrane.
(B) In dicot stems, a new cambium originates from cells of pericycle at the time of secondary growth.
(C) Stamens in flowers of *Gloriosa* and *Petunia* are polyandrous.
(D) Symbiotic nitrogen fixers occur in free-living state also in soil.
How many of the above statements are right?
(a) Two (b) Three
(c) Four (d) One
(Mains 2012)

14. CAM helps the plants in
(a) conserving water (b) secondary growth
(c) disease resistance (d) reproduction.
(2011)

15. In kranz anatomy, the bundle sheath cells have
(a) thin walls, many intercellular spaces and no chloroplasts
(b) thick walls, no intercellular spaces and large number of chloroplasts
(c) thin walls, no intercellular spaces and several chloroplasts
(d) thick walls, many intercellular spaces and few chloroplasts. *(Mains 2011)*

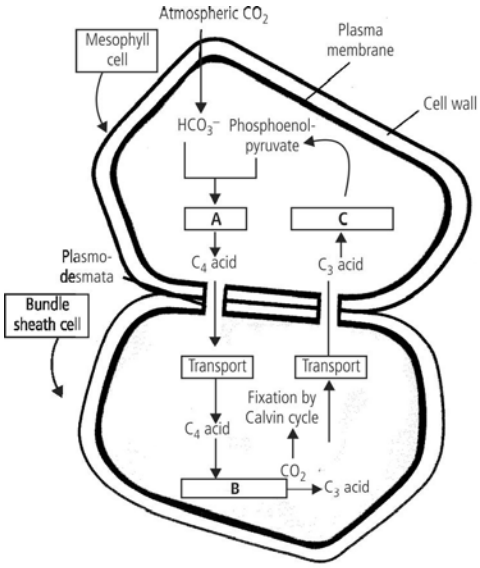
16. Which one of the following is essential for photolysis of water?
(a) Manganese (b) Zinc
(c) Copper (d) Boron
(Mains 2011)

17. PGA as the first CO_2 fixation product was discovered in photosynthesis of
(a) bryophyte (b) gymnosperm
(c) angiosperm (d) alga. *(2010)*

18. C_4 plants are more efficient in photosynthesis than C_3 plants due to
(a) higher leaf area
(b) presence of larger number of chloroplasts in the leaf cells
(c) presence of thin cuticle
(d) lower rate of photorespiration. *(2010)*

19. Read the following four statements, (i), (ii), (iii) and (iv) and select the right option having both correct statements.
Statements :
(i) Z scheme of light reaction takes place in presence of PSI only.
(ii) Only PSI is functional in cyclic photophosphorylation.
(iii) Cyclic photophosphorylation results into synthesis of ATP and $NADPH_2$.
(iv) Stroma lamellae lack PSII as well as NADP.
(a) (ii) and (iv) (b) (i) and (ii)
(c) (ii) and (iii) (d) (iii) and (iv)
(Mains 2010)

20. Study the pathway given below:



In which of the following options correct words for all the three blanks A, B and C are indicated?

	A	B	C
(a)	Decarboxylation	Reduction	Regeneration
(b)	Fixation	Transamination	Regeneration
(c)	Fixation	Decarboxylation	Regeneration
(d)	Carboxylation	Decarboxylation	Reduction

(Mains 2010)

21. Kranz anatomy is one of the characteristics of the leaves of
(a) potato (b) wheat
(c) sugarcane (d) mustard.
(Mains 2010)

22. Cyclic photophosphorylation results in the formation of
(a) ATP and NADPH
(b) ATP, NADPH and O_2
(c) ATP
(d) NADPH. *(2009)*

23. Stroma in the chloroplasts of higher plant contains
(a) light-dependent reaction enzymes
(b) ribosomes
(c) chlorophyll
(d) light-independent reaction enzymes. *(2009)*

24. Electrons from excited chlorophyll molecule of photosystem II are accepted first by
(a) quinone (b) ferredoxin
(c) cytochrome-*b* (d) cytochrome-*f*. *(2008)*

25. The C_4 plants are photosynthetically more efficient than C_3 plants because
(a) the CO_2 efflux is not prevented
(b) they have more chloroplasts
(c) the CO_2 compensation point is more
(d) CO_2 generated during photorespiration is trapped and recycled through PEP carboxylase. *(2008)*

26. In leaves of C_4 plants malic acid synthesis during CO_2 fixation occurs in
(a) bundle sheath (b) guard cells
(c) epidermal cells (d) mesophyll cells. *(2008)*

27. In the leaves of C_4 plants, malic acid formation during CO_2 fixation occurs in the cells of
(a) bundle sheath (b) phloem
(c) epidermis (d) mesophyll. *(2007)*

28. The first acceptor of electrons from an excited chlorophyll molecule of photosystem II is
(a) iron-sulphur protein
(b) ferredoxin
(c) quinone
(d) cytochrome. *(2007)*

29. During photorespiration, the oxygen consuming reaction(s) occur in
(a) stroma of chloroplasts
(b) stroma of chloroplasts and mitochondria
(c) stroma of chloroplasts and peroxisomes
(d) grana of chloroplasts and peroxisomes. *(2006)*

30. In photosystem I, the first electron acceptor is
(a) an iron-sulphur protein
(b) ferredoxin
(c) cytochrome
(d) plastocyanin. *(2006)*

31. As compared to a C_3-plant, how many additional molecules of ATP are needed for net production of one molecule of hexose sugar by C_4-plants?
(a) Two (b) Six
(c) Twelve (d) Zero *(2005)*

32. Photosynthetic Active Radiation (PAR) has the following range of wavelengths.
(a) 340-450 nm (b) 400-700 nm
(c) 500-600 nm (d) 450-950 nm *(2005)*

33. Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 levels because
(a) effective pumping of CO_2 into bundle sheath cells
(b) RuBisCo in C_4 plants has higher affinity for CO_2
(c) four carbon acids are the primary initial CO_2 fixation products
(d) the primary fixation of CO_2 is mediated *via* PEP carboxylase. *(2005)*

34. In C_3 plants, the first stable product of photosynthesis during the dark reaction is
(a) malic acid
(b) oxaloacetic acid
(c) 3-phosphoglyceric acid
(d) phosphoglyceraldehyde. *(2004)*

35. Plants adapted to low light intensity have
(a) larger photosynthetic unit size than the sun plants
(b) higher rate of CO_2 fixation than the sun plants
(c) more extended root system
(d) leaves modified to spines. *(2004)*

36. Which fractions of the visible spectrum of solar radiations are primarily absorbed by carotenoids of the higher plants?
(a) Blue and green (b) Green and red
(c) Red and violet (d) Violet and blue *(2003)*

37. Which one of the following is wrong in relation to photorespiration?
(a) It occurs in chloroplast
(b) It occurs in day time only
(c) It is a characteristic of C_4 plants
(d) It is a characteristic of C_3 plants *(2003)*

38. In sugarcane plant $^{14}CO_2$ is fixed to malic acid, in which the enzyme that fixes CO_2 is
(a) ribulose biphosphate carboxylase
(b) phosphoenol pyruvic acid carboxylase
(c) ribulose phosphate kinase
(d) fructose phosphatase. *(2003)*

39. Stomata of CAM plants
(a) are always open
(b) open during the day and close at night
(c) open during the night and close during the day
(d) never open. *(2003)*

40. Which element is located at the centre of the porphyrin ring in chlorophyll ?
(a) Calcium (b) Magnesium
(c) Potassium (d) Manganese *(2003)*

41. Which one of the following concerns photophosphorylation ?
(a) $ADP + AMP \xrightarrow{\text{Light energy}} ATP$
(b) $ADP + \text{Inorganic } PO_4 \xrightarrow{\text{Light energy}} ATP$
(c) $ADP + \text{Inorganic } PO_4 \longrightarrow ATP$
(d) $AMP + \text{Inorganic } PO_4 \xrightarrow{\text{Light energy}} ATP$ *(2003)*

42. Which of the following absorb light energy for photosynthesis?
(a) Chlorophyll (b) Water molecule
(c) O_2 (d) RuBP *(2002)*

43. In photosynthesis energy from light reaction to dark reaction is transferred in the form of
(a) ADP (b) ATP
(c) RuDP (d) chlorophyll. *(2002)*

44. Which pigment absorbs the red and far-red light?
(a) Cytochrome (b) Phytochrome
(c) Carotenoids (d) Chlorophyll *(2002)*

45. What is true for photolithotrophs?
(a) Obtain energy from radiations and hydrogen from organic compounds
(b) Obtain energy from radiations and hydrogen from inorganic compounds
(c) Obtain energy from organic compounds
(d) Obtain energy from inorganic compounds *(2001)*

46. Which pigment system is inactivated in red drop?
(a) PS-I and PS-II (b) PS-I
(c) PS-II (d) None of the above *(2001)*

47. Which pair is wrong?
(a) C_3-maize
(b) C_4-kranz anatomy
(c) Calvin cycle-PGA
(d) Hatch and Slack cycle - OAA *(2001)*

48. Which is the first CO_2 acceptor enzyme in C_4 plants?
(a) RuDP carboxylase (b) Phosphoric acid
(c) RuBisCO (d) PEP- carboxylase *(2000)*

49. For assimilation of one CO_2 molecule, the energy required in form of ATP and $NADPH_2$ are
(a) 2 ATP and 2 $NADPH_2$
(b) 5 ATP and 3 $NADPH_2$
(c) 3 ATP and 2$NADPH_2$
(d) 18 ATP and 12 $NADPH_2$. *(2000)*

50. For the synthesis of one glucose molecule the Calvin cycle operates for
(a) 2 times (b) 4 times
(c) 6 times (d) 8 times. *(2000)*

51. The first step for initiation of photosynthesis will be
(a) photolysis of water
(b) excitement of chlorophyll molecules due to absorption of light
(c) ATP formation
(d) glucose formation. *(2000)*

52. Carbon dioxide acceptor in C_3-plants is
(a) PGA (b) PEP
(c) RuDP (d) none of these. *(1999)*

53. The rate of photosynthesis is higher in
(a) very high light (b) continuous light
(c) red light (d) green light. *(1999)*

54. Chlorophyll *a* molecule at its carbon atom 3 of the pyrrole ring II has one of the following
(a) carboxylic group (b) magnesium
(c) aldehyde group (d) methyl group. (*1997*)

55. The core metal of chlorophyll is
(a) Ni (b) Cu
(c) Fe (d) Mg. *(1997)*

56. $NADPH_2$ is generated through
(a) photosystem II
(b) anaerobic respiration
(c) glycolysis
(d) photosystem I. *(1997)*

57. 'The law of limiting factors' was proposed by
(a) Leibig (b) Hatch and Slack
(c) Blackman (d) Arnon. *(1996)*

58. What will be the number of Calvin cycles to generate one molecule of hexose?
(a) 8 (b) 9
(c) 4 (d) 6 *(1996)*

59. Photorespiration is favoured by
(a) high temperature and low O_2
(b) high humidity and temperature
(c) high O_2 and low CO_2
(d) high CO_2 and low O_2. *(1996)*

60. In C_4 plants, CO_2 combines with
(a) phosphoenol pyruvate
(b) phosphoglyceraldehyde
(c) phosphoglyceric acid
(d) ribulose diphosphate. *(1996)*

61. In C_4 plants, CO_2 fixation is done by
(a) sclerenchyma
(b) chlorenchyma and hypodermis
(c) mesophyll cells
(d) guard cells. *(1996)*

62. The primary acceptor, during CO_2 fixation in C_3 plants, is
(a) phosphoenolpyruvate (PEP)
(b) ribulose 1, 5-diphosphate (RuDP)
(c) phosphoglyceric acid (PGA)
(d) ribulose monophosphate (RMP). *(1995)*

63. The CO_2 fixation during C_4 pathway occurs in the chloroplast of
(a) guard cells
(b) bundle sheath cells
(c) mesophyll cells
(d) spongy parenchyma. *(1995)*

64. Which of the following pigments acts as a reaction-centre during photosynthesis?
(a) Carotene (b) Phytochrome
(c) P_{700} (d) Cytochrome *(1994)*

65. During light reaction of photosynthesis, which of the following phenomenon is observed during cyclic phosphorylation as well as non-cyclic phosphorylation?
(a) Release of O_2
(b) Formation of ATP
(c) Formation of NADPH
(d) Involvement of PS I and PS II pigment systems *(1994)*

66. A photosynthesising plant is releasing ^{18}O more than the normal. The plant must have been supplied with
(a) O_3 (b) H_2O with ^{18}O
(c) CO_2 with ^{18}O (d) $C_6H_{12}O_6$ with ^{18}O. *(1993)*

67. Maximum solar energy is trapped by
(a) planting trees
(b) cultivating crops
(c) growing algae in tanks
(d) growing grasses. *(1993)*

68. The carbon dioxide acceptor in Calvin cycle/ C_3-plants is
(a) phosphoenol pyruvate (PEP)
(b) ribulose 1, 5-diphosphate (RuDP)
(c) phosphoglyceric acid (PGA)
(d) ribulose monophosphate (RMP). *(1993)*

69. Which one is a C_4-plant?
(a) Papaya (b) Pea
(c) Potato (d) Maize/corn *(1993)*

70. Chlorophyll *a* occurs in
(a) all photosynthetic autotrophs
(b) in all higher plants
(c) all oxygen liberating autotrophs
(d) all plants except fungi. *(1992)*

71. Photosystem II occurs in
(a) stroma
(b) cytochrome
(c) grana
(d) mitochondrial surface. *(1992)*

72. The enzyme that catalyses carbon dioxide fixation in C_4 plants is
(a) RuBP carboxylase
(b) PEP carboxylase
(c) carbonic anhydrase
(d) carboxydismutase. *(1992)*

73. The first carbon dioxide acceptor in C_4-plants is
(a) phosphoenol-pyruvate
(b) ribulose 1, 5-diphosphate
(c) oxaloacetic acid
(d) phosphoglyceric acid. *(1992, 1990)*

74. Ferredoxin is a constituent of
(a) PS I (b) PS II
(c) Hill reaction (d) P_{680}. *(1991)*

75. During monsoon, the rice crop of eastern states of India shows lesser yield due to limiting factor of
(a) CO_2 (b) light
(c) temperature (d) water. *(1991)*

76. Which technique has helped in investigation of Calvin cycle?
(a) X-ray crystallography
(b) X-ray technique
(c) Radioactive isotope technique
(d) Intermittent light *(1991)*

77. Dark reactions of photosynthesis occur in
(a) granal thylakoid membranes
(b) stromal lamella membranes
(c) stroma outside photosynthetic lamellae
(d) periplastidial space. *(1991)*

78. Photosynthetic pigments found in the chloroplasts occur in
(a) thylakoid membranes
(b) plastoglobules
(c) matrix
(d) chloroplast envelope. *(1991)*

79. Kranz anatomy is typical of
(a) C_4 plants (b) C_3 plants
(c) C_2 plants (d) CAM plants. *(1990)*

80. A very efficient converter of solar energy with net productivity of 204 kg/m^2 or more is the crop
(a) wheat (b) sugarcane
(c) rice (d) bajra. *(1989)*

81. In C_4 plants, Calvin cycle operates in
(a) stroma of bundle sheath chloroplasts
(b) grana of bundle sheath chloroplasts
(c) grana of mesophyll chloroplasts
(d) stroma of mesophyll chloroplasts. *(1989)*

82. The substrate for photorespiration is
(a) phosphoglyceric acid
(b) glycolate
(c) serine
(d) glycine. *(1989)*

83. The size of chlorophyll molecule is
(a) head 15 × 15 Å, tail 25 Å
(b) head 20 × 20 Å, tail 25 Å
(c) head 15 × 15 Å, tail 20 Å
(d) head 10 × 12 Å, tail 25 Å. *(1989)*

84. $NADP^+$ is reduced to NADPH in
(a) PS I
(b) PS II
(c) Calvin cycle
(d) noncyclic photophosphorylation. *(1988)*

85. Carbon dioxide joins the photosynthetic pathway in
(a) PS I (b) PS II
(c) light reaction (d) dark reaction. *(1988)*

Answer Key

1.	(b)	**2.**	(a)	**3.**	(c)	**4.**	(d)	**5.**	(d)	**6.**	(d)	**7.**	(d)	**8.**	(b)	**9.**	(b)	**10.**	(c)
11.	(d)	**12.**	(c)	**13.**	(a)	**14.**	(a)	**15.**	(b)	**16.**	(a)	**17.**	(d)	**18.**	(d)	**19.**	(a)	**20.**	(c)
21.	(c)	**22.**	(c)	**23.**	(d)	**24.**	(a)	**25.**	(b)	**26.**	(d)	**27.**	(d)	**28.**	(c)	**29.**	(c)	**30.**	(a)
31.	(c)	**32.**	(b)	**33.**	(d)	**34.**	(c)	**35.**	(a)	**36.**	(d)	**37.**	(c)	**38.**	(b)	**39.**	(c)	**40.**	(b)
41.	(b)	**42.**	(a)	**43.**	(b)	**44.**	(b)	**45.**	(b)	**46.**	(c)	**47.**	(a)	**48.**	(d)	**49.**	(c)	**50.**	(c)
51.	(b)	**52.**	(c)	**53.**	(c)	**54.**	(d)	**55.**	(d)	**56.**	(d)	**57.**	(c)	**58.**	(d)	**59.**	(c)	**60.**	(a)
61.	(c)	**62.**	(b)	**63.**	(c)	**64.**	(c)	**65.**	(b)	**66.**	(b)	**67.**	(c)	**68.**	(b)	**69.**	(d)	**70.**	(c)
71.	(c)	**72.**	(b)	**73.**	(a)	**74.**	(a)	**75.**	(b)	**76.**	(c)	**77.**	(c)	**78.**	(a)	**79.**	(a)	**80.**	(b)
81.	(a)	**82.**	(b)	**83.**	(c)	**84.**	(d)	**85.**	(d)										

EXPLANATIONS

1. (b) : C_4 plants respond to higher temperature with enhanced photosynthesis while C_3 plants have lower temperature optimum.

2. (a)

3. (c) : Photorespiration is the light dependent process of oxygenation of ribulose biphosphate (RuBP) and release of carbon dioxide by the photosynthetic organs of a plant. It leads to oxidation of considerable amount of photosynthetic products to CO_2 and H_2O without the production of useful energy. Photorespiration occurs only in C_3 plants because at high temperature and high oxygen concentration RuBP carboxylase changes to RuBP oxygenase. Photorespiration is absent in C_4 plants. Peroxisome and mitochondria are required for completing the process.

4. (d) **5. (d)**

6. (d) : Emerson *et al.* (1957) found that if light of shorter wavelengths was provided at the same time as the longer red wavelengths, photosynthesis was even faster than the sum of the two rates with either colour alone. This synergism or enhancement became known as the Emerson enhancement effect. The two separate groups of pigments or photosystems cooperate in photosynthesis and that such long red wavelengths are absorbed only by one photosystem, called photosystem I (PS I). The second photosystem, photosystem II (PS II), absorbs wavelengths shorter than 690 nm, and for maximum photosynthesis wavelengths absorbed by both systems must function together. The two photosystems normally cooperate to cause photosynthesis at all wavelengths shorter than 690 nm, because both photosystems absorb those wavelengths. The importance of Emerson's work is that it suggested the presence of two distinct photosystems.

7. (d)

8. (b) : Anthocyanins are water soluble pigments, which commonly occur in membrane enclosed vacuoles. They are responsible for colour of fruits and flower petals.

9. (b) : The light-independent reactions (dark or Blackman's reactions) of photosynthesis take place in stroma or matrix of chloroplasts. These reactions are enzymatic reactions which catalyse assimilation of CO_2 into carbohydrates.

10. (c) : Chromatophores are the internal membrane systems of photosynthetic forms which possess photosynthetic pigments. They occur in photoautotrophic bacteria, *e.g.*, purple bacteria and green bacteria.

11. (d) : *Refer to answer 3.*

12. (c) : *Refer to answer 3.*

13. (a) : Polyandrous condition (having large and indefinite number of stamens) is present in *Gloriosa* (family liliaceae) and *Petunia* (family solanaceae).

Nitrogen fixation is the conversion of inert atmospheric nitrogen into utilisable compounds of nitrogen like nitrate, ammonia, amino acids, etc. Biological nitrogen fixation is performed by free living and symbiotic bacteria and cyanobacteria. Symbiotic nitrogen fixers occur in association with roots of higher plants. For *e.g., Rhizobium* is nitrogen fixing bacterial symbiont of papilionaceous roots and *Frankia* is symbiont in root nodules of several non-leguminous plants like *Casuarina*. Both *Rhizobium* and *Frankia* live free as aerobes in the soil and develop the ability to fix nitrogen only as symbionts when they become anaerobic.

14. (a) : Crassulacean acid metabolism (CAM) is photosynthesis by the C_4 pathway in which carbon-dioxide is taken up during the night, when the plant's stomata are open and fixed into malic acid. During the day, when the stomata are closed, carbon dioxide is released from malic acid for use in the Calvin cycle. This is important for plants that live in arid conditions as it enables them to keep their stomata closed during the day to reduce water loss from evaporation. Crassulacean acid metabolism is common in succulent plants of desert regions, including cacti and spurges and in certain ferns.

15. (b) : The C_4 plants are adapted to dry tropical regions and have greater productivity of biomass. They have special type of leaf anatomy known as Kranz anatomy. In this type of anatomy the bundle sheath cells form several layers around the vascular bundles; they are characterised by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.

16. (a) : Manganese (Mn^{2+}) is used for photolysis of water to produce oxygen and electrons during light reaction of photosynthesis. It is the phenomenon of breaking up of water into hydrogen and oxygen in the illuminated chloroplast. It acts as an essential cofactor.

17. (d) : Calvin, Benson and their colleagues in California, U.S.A. fed *Chlorella* and *Scenedesmus* with radioactive ^{14}C in carbon dioxide. Radioactive carbon, ^{14}C has a half life of 5568 years. Therefore, the path of CO_2 fixation can be easily traced with its help. Algal suspension, illuminated and carrying out photosynthesis with normal carbon dioxide, was supplied $^{14}CO_2$. The alga was killed at intervals in near boiling methanol. It immediately stopped photosynthesis activity due to denaturation of enzymes. Alcohol was evaporated and after crushing the alga, the product was made into paste. The paste was placed on paper chromatogram and the different compounds were separated by two dimensional chromatography. The radioactive compounds were identified by comparing their position on the chromatogram with standard chemicals. Calvin and co-workers found that after three seconds, radioactivity appeared in phosphoglyceric acid or PGA. Phosphoglyceric acid is, therefore, the first stable product of photosynthesis.

18. (d) : Rate of net photosynthesis in C_3 plants is 15-35 mg $CO_2/dm^2/hr$ while in C_4 plants it 40-80 mg $CO_2/dm^2/hr$. This variation in rate is due to photorespiration. Photorespiration is an inhibitory process which decreases the rate of photosynthesis. In excess of oxygen RuBP carboxylase converts to RuBP oxygenase. As a result glycolate synthesis is enhanced and leads to begin photorespiration. Photorespiration is negligible or absent in C_4 plants and present only in C_3 plants. So C_4 plants are photosynthetically more efficient.

19. (a) : Z scheme involves both PSI and PSII to transfer electron excited by light starting from PSII uphill to the acceptor, down to the electron transport chain to PSI, which further comprise of excitation of electrons, transfer to another acceptor and finally down hill to $NADP^+$ causing reduction of it to $NADPH + H^+$. Stroma lamella contains PSI only.

20. (c) : A – Fixation of CO_2 by PEP carboxylase
B – Decarboxylation
C – Regeneration

21. (c) : In kranz anatomy, the mesophyll is undifferentiated and its cells occur in concentric layers around vascular bundles. Vascular bundles are surrounded by large sized bundle sheath cells which are arranged in a wreath-like manner in one to several layers. C_4 plants, both monocots and dicots, such as sugarcane, maize, sorghum have kranz anatomy in leaf.

22. (c) : In cyclic photophosphorylation, 2 molecules of ATP are synthesised which are used in dark reaction. Cyclic photophosphorylation is not concerned with photolysis of water. So O_2 is not evolved and NADPH is also not produced.

23. (d) : The dark reactions of photosynthesis is purely enzymatic and slower than the primary photochemical reaction. It takes place in stroma portion of the chloroplast and is independent of light *i.e.*, it can occur either in presence or in absence of light provided that assimilatory power is available.

24. (a) : The electrons released during photolysis of water are picked up by P_{680} photocentre of photosystem II. The electron extruded by the photocentre of photosystem II picked up by the quencher phaeophytin. From here the electron passes over a series of carriers in a downhill journey losing its energy at every step. The major carriers are plastoquinone (PQ), cytochrome $b - f$ complex and plastocyanin (PC). While passing over cytochrome complex, the electron loses sufficient energy for the creation of proton gradient and synthesis of ATP from ADP and inorganic phosphate. The process is called photophosphorylation (noncyclic).

25. (b) : C_4 plants are photosynthetically more efficient than C_3 plants because C_4 plant contain two types of chloroplast *i.e.*, bundle sheath chloroplast and mesophyll chloroplast. So such plants operate a dicarboxylic acid cycle in addition to Calvin cycle. CO_2 acceptor molecule (PEP) is present in large bundle sheath cell which has higher efficiency in picking up CO_2. Thus, photosynthesis continues even at low CO_2 concentration and the rate of photorespiration is also negligible.

26. (d) : C_4 plants show kranz anatomy *i.e.* the mesophyll is undifferentiated and its cells occur in concentric layers around vascular bundle, which is surrounded by large sized bundle sheath cells, in a wreath like manner. In this type of plants, the initial fixation of CO_2 occur in mesophyll cell. The primary acceptor (phosphoenol pyruvate) combines with CO_2 to form oxaloacetic acid which later reduces to malic acid. Malic acid is then translocated to bundle sheath cell for further decarboxylation.

27. (d)

28. (c) : Type I photosystems use ferredoxin like iron-sulphur cluster proteins as terminal electron acceptors, while type II photosystems ultimately shuttle electrons to a quinone terminal electron acceptor. One has to note that both reaction centres

types are present in chloroplasts of plants and cyanobacteria, working together to form an unique photosynthetic chain able to extract electrons from water, evolving oxygen as a byproduct.

29. (c)

30. (a) : In light reaction of photosynthesis two types of photosystems are involved. PS-I consists of plenty of chlorophyll-*a* and very less quantity of chlorophyll-*b*. These pigments absorb light energy and transfer it to the reaction centre - P_{700}. After absorbing adequate amount of light energy electron gets excited from P_{700} molecule and moves to iron-sulphur protein complex, designated as A (Fe-S). It gets reduced after accepting electrons. It later gives these electron to ferredoxin and gets oxidized again.

31. (c) : In C_4 plants the cost of concentrating CO_2 within the bundle sheath cell is 2ATP per CO_2.

Energetics of the C_4 photosynthetic carbon cycle–

$PEP + H_2O + NADPH + CO_2 \rightarrow Malate + NADP^+ + iP$
$Malate + NADP^+ \rightarrow Pyruvate + NADPH + CO_2$
$Pyruvate + iP + ATP \rightarrow PEP + AMP + iPP$
$iPP + H_2O \rightarrow 2iP$
$AMP + ATP \rightarrow 2ADP$
Net: CO_2 (mesophyll) $\rightarrow$ CO_2 (bundlesheath) + $2ADP + 2iP$ $+ ATP + 2H_2O$

In C_4 plants 12 ATP molecules are required for producing one hexose sugar. In the bundle sheath cells C_3 cycle operates which requires 18ATP and $12NADPH_2$ molecules. So total 30 ATP and 12 $NADPH_2$ molecules are required in C_4 cycle.

Whereas in C_3 cycle 18 ATP and $12NADPH_2$ molecules are required.

32. (b) : Wavelengths between 400 and 700 nm, which comprise the visible range of electromagnetic spectrum are capable of causing photosynthesis. These are called photosynthetically active radiations. Chlorophyll *a* and *b* absorb too much light in the blue and red region of spectrum of light. Carotenoids mostly absorb is the blue region of the spectrum.

33. (d)

34. (c) : The Calvin cycle is also known as C_3 cycle because CO_2 reduction is cyclic process and first stable product in this cycle is a 3-C compound (*i.e.*, 3-phosphoglyceric acid or 3-PGA).

In this cycle, CO_2 acceptor molecule is RuBP or RuDP (*i.e.*, Ribulose 1, 5-biphosphate or Ribulose 1, 5-diphosphate). There occurs covalent bonding of CO_2 to RuBP and the enzyme catalyzing this reaction is RuBP-carboxylase/oxygenase (RuBisCO).

35. (a) : To absorb more sunlight (quantitatively), the plants growing in low light conditions have larger photosynthetic unit size. It means that they have more number of chlorophyll molecules per reaction center. to trap more light energy available to them.

36. (d) : Carotenoids of higher plants are fat soluble compound that includes carotenes and xanthophylls. Most of them absorb light of violet and blue range. Green light is absorbed in less amount.

37. (c) : *Refer to answer 3.*

38. (b) : C_4 pathway was first reported in members of family Gramineae (grasses) like sugarcane, maize, sorghum, etc.

In C_4 plants PEPCo (PEP carboxylase) is the key enzyme used to fix CO_2 in C_4 plants.Oxaloacetic acid is a 4-C compound and is the first stable product so this pathway is known as C_4 cycle.

Phosphoenol pyruvic acid + Carbon dioxide $\xrightarrow{\text{PEP-carboxylase}}$ Oxaloacetic acid

39. (c) : Stomata of most plants open at sunrise and close in darkness to allow the entry of CO_2 needed for photosynthesis during the daytime.

Certain succulents that are native to hot, dry conditions (*e.g.*, cacti, *Kalanchoe*, and *Bryophyllum*) act in an opposite manner. They open their stomata at night, fix carbon dioxide into organic acids in the dark, and close their stomata during the day. This is an appropriate way to absorb CO_2 through open stomata at night, when transpiration stress is low, and conserve water during the heat of the day. These plants show Crassulacean Acid Metabolism (CAM).

40. (b) : Chlorophyll is the green pigment present in plants and some photosynthetic bacteria.

The empirical formula of chlorophyll-*a* molecule is $C_{55}H_{72}O_5N_4Mg$. It consist of a porphyrin head and a phytol tail. Porphyrin is a cyclic tetrapyrrole structure, having a magnesium atom in the centre. Tail consists of phytol alcohol and it is attached with one of the pyrrole rings.

41. (b) : The light dependent production of ATP from ADP + P*i* in the chloroplasts is called photophosphorylation.

Photophosphorylation is of 2 types –

Cyclic photophosphorylation – It involves only PS-I, water is not utilized and so no oxygen is evolved. Here two ATP molecules are produced.

Non-cyclic photophosphorylation – It involves both PS-I and PS-II, water is utilized and so oxygen is evolved. Here one ATP molecule and one $NADPH_2$ molecule are produced.

42. (a) : Photosynthesis occurs in chloroplasts that contain photosynthetic pigments - chlorophylls, carotenoids etc. The light energy required for photosynthesis comes from sunlight. The sunlight travels in the form of small particles called photons. Each photon has a quantum of energy. This quantum of energy is absorbed by a single antenna chlorophyll and then migrates from one molecule to the other till it reaches the reaction center of photosystems. The reaction center is also P_{700} chlorophyll molecule that releases electron as a result of transferred energy. This electron is transferred between various acceptors and generates ATP and $NADPH_2$ in the light reaction of photosynthesis.

43. (b) : Photosynthesis consists of light dependent phase and light independent phase or dark reaction. Light dependent phase occurs in grana fraction of chloroplast. It involves cyclic and non-cyclic photophosphorylation where assimilatory powers (ATP and $NADPH_2$) are produced. In dark reaction, which occurs in stroma fraction of chloroplast, actual reduction of CO_2 to carbohydrates takes place using the assimilatory powers (ATP and $NADPH_2$) produced in the light dependent phase.

It needs 18 ATP and 12 $NADPH_2$ molecules to produce one molecule of glucose.

44. (b) : Phytochrome has a light absorbing or light detecting portion (the chromophore) attached to small protein of about 1,24,000 daltons. Phytochrome occurs in 2 forms, *i.e.*, P_R and P_{FR} (*i.e.*, red light and far red light absorbing forms) and these 2 forms are interconvertible.

Cytochromes are electron transferring proteins. They contain iron porphyrin or copper porphyrin as prosthetic groups. Chlorophyll is the fundamental green pigment of photosynthesis. It is localized in the chloroplasts. Carotenoids are lipid compounds and they are yellow, orange, purple etc. in colour. These are found in higher plants red algae, green algae, fungi and photosynthetic bacteria.

45. (b) : Photolithotrophs are those plants that obtain energy from radiation and hydrogen from inorganic compounds.

46. (c) : Emerson and Lewis worked on *Chlorella* and calculated the quantum yield for different wavelengths.

Emerson observed that rate of photosynthesis declines in the red region of the spectrum. This decline in photosynthesis is called "Red drop". It was observed that the quantum yield falls when the light of wavelengths more than 680 or 690 nm are supplied. As the PS-II P_{680} is driven by red light, so it remains inactive during red drop.

47. (a) : *Refer to answer 38.*

48. (d) : *Refer to answer 38.*

49. (c) : Photosynthesis is actually oxidation reduction process in which water is oxidised and CO_2 is reduced to carbohydrates. The reduction of CO_2 to carbohydrates needs assimilatory powers, *i.e.*, ATP and $NADPH_2$.

The process of photosynthesis involves two steps–

(i) Light dependent phase or photochemical reaction.

(ii) Light independent phase or dark reaction.

In Calvin cycle, CO_2 acceptor molecule is RuBP or RuBP. The enzyme catalyzing this reaction is RuBP-carboxylase/oxygenase (RuBisCO). As Calvin cycle takes in only one carbon (as CO_2) at a time, so it takes six turns of the cycle to produce a net gain of six carbons (*i.e.*, hexose or glucose). In this cycle, for formation of one mole of hexose sugar (Glucose), 18 ATP and 12 $NADPH_2$ are used.

For 6 molecules of CO_2 it needs 18 ATP and 12 $NADPH_2$ molecules so for assimilation of one molecule of CO_2 it needs 3 ATP and 2 $NADPH_2$ molecules.

50. (c) : *Refer to answer 49.*

51. (b) : The process of photosynthesis involves two steps–

(i) Light dependent phase or photochemical reaction.

(ii) Light independent these or dark reaction.

Light reaction occurs in grana fraction of chloroplast and in this reaction are included those activities, which are dependent on light.

The grana of chloroplasts contains many collaborating molecules of pigment. A quantum of light is absorbed by a single antenna chlorophyll, then it migrates from one molecule to the other till it reaches the reaction center. This quantum of light is used for generating ATP and NADPH, which is later consumed in dark reactions produce sugars by fixing CO_2 molecules.

52. (c) : An enzyme ribulose biphosphate carboxylase catalyses the dark reaction, pertaining to the addition of CO_2 to Ribulose-1-5-diphosphate. It is found in abundance in leaves and it is believed that

it is the single most abundant protein on earth. It is clear that the first acceptor of CO_2 is Ribulose 1-5 diphosphate and the first product formed after fixation of CO_2 is 3-phosphoglyceric acid.

53. (c) : Plants can use a small portion of light which falls upon them. Chlorophyll-*a* and chlorophyll-*b* absorb too much light in the blue and red region. Carotenoids absorb light mostly in the blue region of spectrum of light. In monochromatic lights, maximum photosynthesis occurs in red light, followed by blue light and poor photosynthesis in green light. Under very high light intensity solarization phenomenon occurs. It involves photooxidation of different cellular components including chlorophyll.

54. (d) : The empirical formula of chlorophyll *a* molecule is $C_{55}H_{72}O_5N_4Mg$. It has tadpole like configuration. It consists of a porphyrin head and a phytol tail. Porphyrin is a cyclic tetrapyrol structure, having a magnesium atom in the centre. In chlorophyll *a*, a methyl group (CH_3) is attached to the third carbon in the porphyrin head.

55. (d) : *Refer to answer 54.*

56. (d) : Non-cyclic photophosphorylation involves both PS-I and PS-II. Here electrons are not cycled back and are used in the reduction of NADP to $NADPH_2$. The electrons generated by PSII are passed over a series of electron carriers in a downhill journey and handed over to reaction centre of PSI. PSI again passes the electrons to $NADP^+$ which combines with H^+ ions to form NADPH.

57. (c) : Blackman (1905) gave the law of limiting factors which states that when a process is conditioned as to its rapidity by a number of separate factors, the rate of the process is limited by the pace of the slowest process. It is the factor which is present in minimum amount.

58. (d) : *Refer to answer 49.*

59. (c) : *Refer to answer 3.*

60. (a) : *Refer to answer 38.*

61. (c) : The C_4 plants have a characteristic leaf anatomy called kranz anatomy. Here two types of chloroplasts are present - bundle sheath chloroplasts and mesophyll chloroplasts. In C_4 plants, there are two carboxylation reactions which occur first in mesophyll chloroplasts and then in bundle sheath chloroplasts. CO_2 acceptor molecule in mesophyll chloroplasts is PEP (Phospho-enol pyruvate) and not Ribulose 1, 5-biphosphate. Further it has enzyme PEP-carboxylase for initial CO_2 fixation. RuBP-carboxylase is absent in mesophyll chloroplasts but is present in bundle sheath chloroplasts. The first product formed is oxaloacetic acid and hence it is known as C_4 cycle. Bundle sheath cells fix CO_2 through C_3 cycle.

62. (b) : *Refer to answer 34.*

63. (c) : *Refer to answer 61.*

64. (c) : During photosynthesis a portion of light energy absorbed by chlorophyll and carotenoids is eventually stored as chemical energy via the formation of chemical bonds. This conversion of energy from one form to another is a complex process that depends on cooperation between many pigment molecules and a group of electron transfer proteins. The majority of pigments serve as an antenna complex, collecting light and transfusing energy to the reaction center complex.

There are two photochemical complexes, known as photosystem I and II. PSII absorbs far red light of wavelengths greater than 680 nm and PSI absorbs red light of wavelengths greater than 700 nm. Both these complexes are involved in light reactions of photosynthesis.

65. (b) : *Refer to answer 41.*

66. (b) : Water molecule breaks up into hydrogen and oxygen in the illuminated chloroplasts. This is called photolysis of water. If a photosynthesising plant is releasing ^{18}O more than the normal, the plant must have been supplied with H_2O with ^{18}O.

67. (c) : Maximum solar energy is trapped by growing algae in tanks. The light spectrum of red and blue light are most effective in performing photosynthesis for growing algae.

68. (b) : In Calvin cycle, CO_2 is accepted by Ribulose - 1, 5 - diphosphate (RuDP) already present in the cells and a 6-carbon addition compound is formed which is unstable. It soon gets converted into 2 molecules of 3-phosphoglyceric acid due to hydrolysis and dismutation. Phosphoenol pyruvate (PEP) and Phosphoglyceric acid (PGA) are formed in glycolysis.

69. (d)

70. (c) : Chlorophyll-*a* occur in all photo-synthesizing plants except bacteria. Chlorophyll-*a* is the only one common to all organisms that possess chlorophyll (the only one in blue green algae) and is believed to be specifically required. In a few photosynthetic bacteria other kinds of chlorophyll, bacteriochlorophylls, occur.

71. (c) : Photosystem II has almost equal number of chlorophyll *a* and chlorophyll *b* molecules. It is dark

green in colour and located mostly in the appressed parts of grana thylakoids towards the inner surface of membranes.

72. (b) : *Refer to answer 38.*

73. (a) : The primary acceptor of CO_2 is a 3 carbon compound phosphoenol pyruvic acid. Addition of CO_2 to any compound is called carboxylation. In C_4 cycle, CO_2 combines with phosphoenol pyruvic acid to form oxaloacetic acid, with the help of enzyme phosphoenol pyruvate carboxylase (PEPCo). The oxaloacetic acid breaks up into pyruvic acid and CO_2 which combines with RuBP to form PGA as in Calvin cycle.

74. (a) : In photosystem-I, the ejected electron is trapped by FRS (ferrodoxin reducing substance) which is an unknown oxidation - reduction system. The electron is now transferred to a non-heme iron protein called ferrodoxin (Fd) from which electron is transferred to $NADP^+$ intermediate protein electron carrier ferrodoxin-NADP reductase. So that $NADP^+$ is reduced to $NADPH + H^+$.

75. (b) : Rate of yield is dependent of light as photosynthesis is dependent on light. Maximum rate of photosynthesis occur when light is brightest (high light intensity). But during monsoon, the light is dim (low light intensity) and so this reduces rate of photosynthesis and hence yield.

76. (c) : By employing ^{14}C labelled carbon dioxide $^{14}CO_2$ in photosynthesis and observing the appearance of characteristic radiations in different reaction intermediates and product in different experiments. Calvin and his co-workers were able to formulate the complete metabolic path of carbon assimilation in the form of cycle which is called as Calvin cycle.

77. (c) : The dark reactions of photosynthesis is purely enzymatic and slower than the primary photochemical reaction. It takes place in stroma portion of the chloroplast and is independent of light *i.e.*, it can occur either in presence or in absence of light provided that assimilatory power is available.

78. (a) : Photosynthetic pigments are found in the thylakoid membrane of chloroplasts. The grana lamellae are paired to form sac like structures and form thylakoids. Chlorophylls and other photosynthetic pigments are confined to grana.

79. (a) : *Refer to answer 61.*

80. (b) : A very efficient converter of solar energy with net productivity of 2-4 kg/m^2 or more is sugarcane, maize which are C_4 plants. Others are C_3 plants.

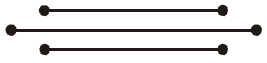
81. (a) : *Refet to answer 61.*

82. (b)

83. (c) : Chlorophyll are the magnesium porphyrin (head, 15 × 15 Å) compounds. The porphyrin ring consists of four pyrrole rings joined together by CH bridges. A long chain of C atoms called as phytol (tail; 20 Å) chain is attached to porphyrin ring.

84. (d) : *Refer to answer 56.*

85. (d) : The dark reactions or Blackman's reactions or biosynthetic phase involves three steps: (i) Fixation of CO_2, (ii) Reduction of CO_2 and (iii) Synthesis of other compound from glucose. It is independent of light. Pigment System I is relatively very weakly fluorescent while pigment system II is strongly fluorescent. Light energy absorbed by pigment in the two systems is ultimately trapped by the P_{700} and P_{680}. Light reaction is associated with the grana of the chloroplasts. It takes place in the presence of light only.



Chapter
14
Respiration in Plants

1. Which statement is wrong for Krebs' cycle?
(a) There is one point in the cycle where FAD^+ is reduced to $FADH_2$.
(b) During conversion of succinyl CoA to succinic acid, a molecule of GTP is synthesised.
(c) The cycle starts with condensation of acetyl group (acetyl CoA) with pyruvic acid to yield citric acid.
(d) There are three points in the cycle where NAD^+ is reduced to $NADH + H^+$.
(NEET 2017)

2. Which of the following biomolecules is common to respiration-mediated breakdown of fats, carbohydrates and proteins?
(a) Glucose-6-phosphate
(b) Fructose 1, 6-bisphosphate
(c) Pyruvic acid
(d) Acetyl CoA *(NEET-II 2016)*

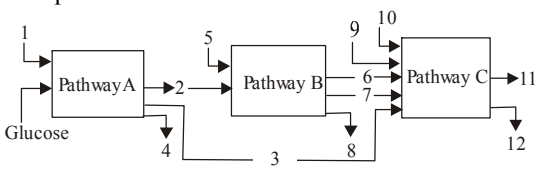
3. Oxidative phosphorylation is
(a) formation of ATP by transfer of phosphate group from a substrate to ADP
(b) oxidation of phosphate group in ATP
(c) addition of phosphate group to ATP
(d) formation of ATP by energy released from electrons removed during substrate oxidation. *(NEET-II 2016)*

4. Cytochromes are found in
(a) cristae of mitochondria
(b) lysosomes
(c) matrix of mitochondria
(d) outer wall of mitochondria.
(2015 Cancelled)

5. In which one of the following processes CO_2 is not released?
(a) Aerobic respiration in plants
(b) Aerobic respiration in animals
(c) Alcoholic fermentation
(d) Lactate fermentation *(2014)*

6. Which of the metabolites is common to respiration-mediated breakdown of fats, carbohydrates and proteins?
(a) Pyruvic acid
(b) Acetyl CoA
(c) Glucose - 6 - phosphate
(d) Fructose 1, 6 - bisphosphate *(NEET 2013)*

7. The three boxes in this diagram represent the three major biosynthetic pathways in aerobic respiration. Arrows represent net reactants or products.



Arrows numbered 4, 8 and 12 can all be
(a) H_2O (b) FAD^+ or $FADH_2$
(c) NADH (d) ATP.
(NEET 2013)

8. In mitochondria, protons accumulate in the
(a) outer membrane
(b) inner membrane
(c) intermembrane space
(d) matrix. *(Mains 2011)*

9. The energy-releasing metabolic process in which substrate is oxidised without an external electron acceptor is called
(a) glycolysis
(b) fermentation
(c) aerobic respiration
(d) photorespiration. *(2010, 2008)*

10. Aerobic respiratory pathway is appropriately termed
(a) parabolic (b) amphibolic
(c) anabolic (d) catabolic. *(2009)*

11. The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that adenosine triphosphate (ATP) is formed because

(a) a proton gradient forms across the inner membrane
(b) there is a change in the permeability of the inner mitochondrial membrane toward adenosine diphosphate (ADP)
(c) high energy bonds are formed in mitochondrial proteins
(d) ADP is pumped out of the matrix into the intermembrane space. *(2008)*

12. The overall goal of glycolysis, Krebs' cycle and the electron transport system is the formation of
(a) ATP in one large oxidation reaction
(b) sugars
(c) nucleic acids
(d) ATP in small stepwise units. *(2007)*

13. All enzymes of TCA cycle are located in the mitochondrial matrix except one which is located in inner mitochondrial membranes in eukaryotes and in cytosol in prokaryotes. This enzyme is
(a) isocitrate dehydrogenase
(b) malate dehydrogenase
(c) succinate dehydrogenase
(d) lactate dehydrogenase. *(2007)*

14. How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy available in the high energy phosphate bond of one mole of ATP is 12 kcal?
(a) 1 (b) 2
(c) 30 (d) 57 *(2006)*

15. During which stage in the complete oxidation of glucose are the greatest number of ATP molecules formed from ADP?
(a) Glycolysis
(b) Krebs' cycle
(c) Conversion of pyruvic acid to acetyl CoA
(d) Electron transport chain *(2005)*

16. In glycolysis, during oxidation electrons are removed by
(a) ATP
(b) glyceraldehyde-3-phosphate
(c) NAD^+
(d) molecular oxygen. *(2004)*

17. In alcohol fermentation
(a) triose phosphate is the electron donor while acetaldehyde is the electron acceptor
(b) triose phosphate is the electron donor while pyruvic acid is the electron acceptor
(c) there is no electron donor
(d) oxygen is the electron acceptor. *(2003)*

18. In which one of the following do the two names refer to one and the same thing ?
(a) Krebs' cycle and Calvin cycle
(b) Tricarboxylic acid cycle and citric acid cycle
(c) Citric acid cycle and Calvin cycle
(d) Tricarboxylic acid cycle and urea cycle *(2003)*

19. How many ATP molecules are produced by aerobic oxidation of one molecule of glucose?
(a) 2 (b) 4
(c) 38 (d) 34 *(2002)*

20. Organisms which obtain energy by the oxidation of reduced inorganic compounds are called
(a) photoautotrophs
(b) chemoautotrophs
(c) saprozoic
(d) coproheterotrophs. *(2002)*

21. Cytochrome is
(a) metallo flavo protein
(b) Fe containing porphyrin pigment
(c) glycoprotein
(d) lipid. *(2001)*

22. Net gain of ATP molecules, during aerobic respiration, is
(a) 40 molecules (b) 48 molecules
(c) 36 molecules (d) 38 molecules. *(1999)*

23. Which one of the following statements about cytochrome P_{450} is wrong?
(a) It is a coloured cell.
(b) It is an enzyme involved in oxidation reactions.
(c) It has an important role in metabolism.
(d) It contains iron. *(1998)*

24. Which of the following is the key intermediate compound linking glycolysis to the Krebs' cycle?
(a) Malic acid (b) Acetyl CoA
(c) NADH (d) ATP *(1997)*

25. In Krebs' cycle, the FAD precipitates as electron acceptor during the conversion of
(a) fumaric acid to malic acid
(b) succinic acid to fumaric acid
(c) succinyl CoA to succinic acid
(d) α-ketoglutarate to succinyl CoA. *(1997)*

26. The end product of fermentation are
(a) O_2 and C_2H_5OH
(b) CO_2 and acetaldehyde
(c) CO_2 and O_2
(d) CO_2 and C_2H_5OH. *(1997)*

27. The correct sequence of electron acceptor in ATP synthesis is
(a) Cyt. *b*, *c*, a_3, *a* (b) Cyt. *c*, *b*, *a*, a_3
(c) Cyt. *a*, *a*, *b*, *c* (d) Cyt. *b*, *c*, *a*, a_3. *(1997)*

28. Which of the following products are obtained by anaerobic respiration from yeast?
(a) Beer and wine (b) Alcohols
(c) CO_2 (d) All of these *(1996)*

29. At the end of glycolysis, six carbon compound ultimately changes into
(a) ethyl alcohol (b) acetyl Co-A
(c) pyruvic acid (d) ATP. *(1996)*

30. When one molecule of ATP is disintegrated, what amount of energy is liberated?
(a) 8 kcal (b) 38 kcal
(c) 7 kcal (d) 4.5 kcal *(1996)*

31. Poisons like cyanide inhibit Na^+ efflux and K^+ influx during cellular transport. This inhibitory effect is reversed by an injection of ATP. This demonstrates that
(a) ATP is the carrier protein in the transport system
(b) energy for Na^+-K^+ exchange pump comes from ATP
(c) ATP is hydrolysed by ATPase to release energy
(d) Na^+-K^+ exchange pump operates in the cell. *(1994)*

32. The ultimate respiratory substrate, yielding maximum number of ATP molecules, is
(a) glycogen
(b) ketogenic amino acid
(c) glucose
(d) amylose. *(1994)*

33. When yeast ferments glucose, the products obtained are
(a) ethanol and CO_2
(b) methanol and CO_2
(c) ethanol and water
(d) water and CO_2. *(1994)*

34. The 1992 Nobel Prize for medicine was awarded to Edmond H. Fischer and Edwin J. Krebs for their work concerning
(a) reversible protein phosphorylation as a biological regulation mechanism
(b) isolation of the gene for a human disease
(c) human genome project
(d) drug designing involving inhibition of DNA synthesis of the pathogen. *(1994)*

35. The first phase in the breakdown of glucose, in animal cell, is
(a) fermentation (b) Krebs' cycle
(c) glycolysis (d) E.T.S. *(1994)*

36. Plants, but not animals, can convert fatty acids to sugars by a series of reactions called
(a) photosynthesis (b) Kreb's cycle
(c) glycolysis (d) glyoxylate cycle. *(1994)*

37. Life without air would be
(a) reductional
(b) free from oxidative damage
(c) impossible
(d) anaerobic. *(1993)*

38. Out of 38 ATP molecules produced per glucose, 32 ATP molecules are formed from NADH/$FADH_2$ in
(a) respiratory chain
(b) Krebs' cycle
(c) oxidative decarboxylation
(d) EMP. *(1993)*

39. End product of citric acid cycle/Krebs' cycle is
(a) citric acid (b) lactic acid
(c) pyruvic acid (d) $CO_2 + H_2O$. *(1993)*

40. Apparatus to measure rate of respiration and R.Q. is
(a) auxanometer (b) potometer
(c) respirometer (d) manometer. *(1992)*

41. When one glucose molecule is completely oxidised, it changes
(a) 36 ADP molecules into 36 ATP molecules
(b) 38 ADP molecules into 38 ATP molecules
(c) 30 ADP molecules into 30 ATP molecules
(d) 32 ADP molecules into 32 ATP molecules. *(1992)*

42. Oxidative phosphorylation is production of
(a) ATP in photosynthesis
(b) NADPH in photosynthesis
(c) ATP in respiration
(d) NADH in respiration. *(1992)*

43. At a temperature above 35ºC
(a) rate of photosynthesis will decline earlier than that of respiration
(b) rate of respiration will decline earlier than that of photosynthesis
(c) there is no fixed pattern
(d) both decline simultaneously. *(1992)*

44. End products of aerobic respiration are
(a) sugar and oxygen
(b) water and energy
(c) carbon dioxide, water and energy
(d) carbon dioxide and energy. *(1992)*

45. Link between glycolysis, Krebs' cycle and β-oxidation of fatty acid or carbohydrate and fat metabolism is
(a) oxaloacetic acid (b) succinic acid
(c) citric acid (d) acetyl CoA. *(1992)*

46. Out of 36 ATP molecules produced per glucose molecule during respiration
(a) 2 are produced outside glycolysis and 34 during respiratory chain
(b) 2 are produced outside mitochondria and 34 inside mitochondria
(c) 2 during glycolysis and 34 during Krebs cycle
(d) all are formed inside mitochondria. *(1992)*

47. Terminal cytochrome of respiratory chain which donates electrons to oxygen is
(a) Cyt *b* (b) Cyt *c*
(c) Cyt a_1 (d) Cyt a_3. *(1992)*

48. Connecting link between glycolysis and Krebs' cycle before pyruvate entering Krebs' cycle is changed to
(a) oxaloacetate (b) PEP
(c) pyruvate (d) acetyl CoA. *(1990)*

49. EMP can produce a total of
(a) 6 ATP (b) 8 ATP
(c) 24 ATP (d) 38 ATP. *(1990)*

50. R.Q. is ratio of
(a) CO_2 produced to substrate consumed
(b) CO_2 produced to O_2 consumed
(c) oxygen consumed to water produced
(d) oxygen consumed to CO_2 produced. *(1990)*

51. End product of glycolysis is
(a) acetyl CoA
(b) pyruvic acid
(c) glucose 1-phosphate
(d) fructose 1-phosphate. *(1990)*

52. R.Q. is
(a) C/N (b) N/C
(c) CO_2/O_2 (d) O_2/CO_2. *(1988)*

53. $NADP^+$ is reduced to NADPH in
(a) HMP (b) Calvin Cycle
(c) glycolysis (d) EMP. *(1988)*

Answer Key

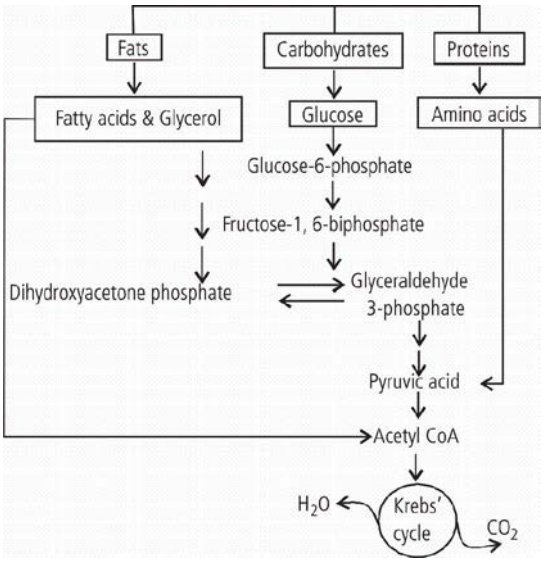
1.	(c)	**2.**	(d)	**3.**	(d)	**4.**	(a)	**5.**	(d)	**6.**	(b)	**7.**	(d)	**8.**	(c)	**9.**	(b)	**10.**	(b)
11.	(a)	**12.**	(d)	**13.**	(c)	**14.**	(d)	**15.**	(d)	**16.**	(c)	**17.**	(a)	**18.**	(b)	**19.**	(c)	**20.**	(b)
21.	(b)	**22.**	(c)	**23.**	(a)	**24.**	(b)	**25.**	(b)	**26.**	(d)	**27.**	(d)	**28.**	(d)	**29.**	(c)	**30.**	(c)
31.	(b)	**32.**	(c)	**33.**	(a)	**34.**	(a)	**35.**	(c)	**36.**	(d)	**37.**	(d)	**38.**	(a)	**39.**	(d)	**40.**	(c)
41.	(b)	**42.**	(c)	**43.**	(a)	**44.**	(c)	**45.**	(d)	**46.**	(b)	**47.**	(d)	**48.**	(d)	**49.**	(b)	**50.**	(b)
51.	(b)	**52.**	(c)	**53.**	(a)														

EXPLANATIONS

1. (c) : Krebs' cycle starts with condensation of acetyl group (acetyl CoA) with oxaloacetate to form a tricarboxylic, 6-carbon compound called citric acid.

2. (d) : Carbohydrates are usually first converted into glucose before they are used for respiration. Fats are broken down into glycerol and fatty acids first. If fatty acids were to be respired they would first be degraded to acetyl CoA and enter the pathway. Glycerol would enter the pathway after being converted to 3-phosphoglyceraldehyde (PGAL). The proteins are degraded by proteases to individual amino acids (after deamination) and depending on their structure enter the pathway within the Krebs' cycle or as pyruvate or acetyl CoA. Thus, acetyl CoA is the common metabolite of all the three (carbohydrates, proteins and fats).

The given flowchart shows these interrelationships:



3. (d) : Oxidative phosphorylation is the synthesis of energy rich ATP molecules with the help of energy liberated during oxidation of reduced co-enzymes (NADH, $FADH_2$) produced in respiration.

The enzyme required for this synthesis is called ATP synthase. It is located in F_1 or head piece of $F_0 - F_1$ or elementary particles present in the inner mitochondrial membrane. F_1 particle is capable of ATP synthesis.

ATP synthase becomes active in ATP formation only when there is a proton gradient having higher concentration of H^+ or protons on the F_0 side as compared to F_1 side.

This higher concentration creates an electric potential across the mitochondrial membrane. The proton gradient and membrane electric potential together form proton motive force (PMF). The flow of protons through the F_0 channel which induces F_1 particle to function as ATP synthase. The energy of the proton gradient is used in attaching a phosphate radicle to ADP by high-energy bond. This produces ATP.

4. (a) : Cytochrome is a group of proteins, each with an iron containing haeme group. They are a part of electron transport chain in mitochondria (present in cristae) and chloroplasts (in thylakoids).

5. (d) : Anaerobic respiration or fermentation can be of two types, *i.e.,* lactate fermentation and ethanol fermentation. Lactate fermentation produces lactic acid only as pyruvic acid produced in glycolysis is directly reduced by NADH to form lactic acid and no CO_2 is produced. Alcoholic (ethanol) fermentation involves conversion of pyruvate to acetaldehyde, hence, CO_2 is released.

6. (b) : *Refer to answer 2.*

7. (d) : In the given diagram, pathway A represents glycolysis, pathway B represents Krebs' cycle and pathway C represents oxidative phosphorylation. Arrows numbered 4, 8 and 12 can all be ATP.

8. (c) : In respiration, protons accumulate in the intermembrane space of the mitochondria when electrons move through the ETS.

9. (b) : Fermentation is the process of deriving energy from the oxidation of organic compounds such as carbohydrates and using an endogenous electron acceptor not external or exogenous, which is usually an organic compound, as opposed to respiration where electrons are donated to an exogenous electron acceptor, such as oxygen *via* an electron transport chain.

10. (b) : A biochemical pathway that serves both anabolic and catabolic process is known as amphibolic pathway. The aerobic respiration involves both catabolism of carbohydrates and fatty acids and the synthesis of anabolic precursors for amino acid synthesis, various intermediatory metabolic products and secondary metabolites. Thus it is called as amphibolic pathway rather than a catabolic pathway.

11. (a) : The chemiosmotic coupling hypothesis of oxidative phosphorylation proposed by Mitchell, explains the process of ATP formation and states that

it is linked to development of a proton gradient across a membrane. ATP synthase, required for ATP synthesis is located in F_1 particles present in the inner mitochondrial membrane and becomes active only when there is high concentration of proton on F_0 side as compared to F_1 side. The flow of proton through F_0 channel induces F_1 particle to function as ATP synthase and the energy of proton gradient produces ATP by attaching a phosphate radical to ADP.

12. (d) : Respiration is an energy liberating enzymatically controlled multistep catabolic process of step wise breakdown of organic substances (hexose sugar) inside the living cells. Aerobic respiration includes the 3 major process, glycolysis, Krebs' cycle and electrons transport chain. The substrate is completely broken down to form CO_2 and water. A large amount of energy is released stepwise in the form of ATP.

13. (c) : Mitochondrion is the organelle which bears various enzymes participating in Krebs' cycle. Each mitochondrion is covered by double membrane. The inner membrane is selectively permeable and forms foldings called cristae. The inner membrane bears oxysomes, enzymes of fatty acids, succinate dehydrogenase (of Krebs' cycle) and electron transport system. All other enzymes of Krebs' cycle are present in the mitochondrial matrix.

14. (d) : One mole of ATP liberates 12 kcal of energy. So 686 kcal will be liberated by 686/12 = 57.1 ATP molecules.

15. (d) : The last step of aerobic respiration is the oxidation of reduced coenzymes, *i.e.*, $NADH_2$ and $FADH_2$ by molecular oxygen through FAD, ubiquinone, Cyt *b*, Cyt *c*, Cyt c_1, Cyt *a* and Cyt a_3. By oxidation of 1 molecule of $NADH_2$, 3 ATP molecules are produced and by oxidation of 1 molecule of $FADH_2$, 2 ATP molecules are produced.

In glycolysis 2 ATP molecules are produced from ADP. Further $2NADH_2$ produced, give $2 \times 3 = 6$ ATP, on oxidative phosphorylation. Similarly in Krebs' cycle 2 ATP molecules are produced. So the greatest number of ATP molecules are produced in the electron transport chain.

16. (c) : During glycolysis, NAD (Nicotinamide adenine dinucleotide) removes electrons from 1, 3-diphosphoglyceric acid using diphospho-glyceraldehyde dehydrogenase. NAD changes to $NADH_2$ and this is either utilized as such in anaerobic respiration or in the presence of oxygen.

17. (a) : When oxygen is not available (anaerobic condition) yeast and some other microbes convert pyruvic acid into ethyl alcohol. It is a two step process. In the first step pyruvic acid is decarboxylated to yield acetaldehyde and CO_2.

Pyruvic acid is a 3-C compound and acts as electron donor while acetaldehyde is the electron acceptor.

$$CH_3COCOOH \xrightarrow[\text{carboxylase}]{\text{pyruvic}} CH_3CHO + CO_2$$

In the second step acetaldehyde is reduced to ethyl alcohol by $NADH_2$ formed in the glycolysis.

$$CH_3CHO + NADH_2 \xrightarrow[\text{dehydrogenase}]{\text{Alcoholic}} C_2H_5OH + NAD$$

18. (b) : The reactions of Krebs' cycle were worked out by Sir Hans Kreb, hence the name Krebs' cycle. It involves many 3-C compounds such as citric acid, cis-aconitic acid and iso-citric acid etc., so it is also called TCA cycle or tricarboxylic acid cycle. It involves formation of citric acid as its first product so it is called citric acid cycle. It involves production of 24 ATP molecules.

19. (c) : Energy gain in one complete cycle of aerobic respiration is :

Glycolysis (or EMP) $\rightarrow 2\text{ ATP} + 2NADH_2 = 8\text{ ATP}$

$\downarrow$ ETS

6 ATP

Intermediate step $= 2\ NADH_2 \xrightarrow[ETS]{} = 6\text{ ATP}$

Krebs' cycle $= 6\ NADH_2 + 2\ FADH_2 + 2\text{ ATP} = 24\text{ ATP}$

ETS $\downarrow$ $\downarrow$ ETS

18 ATP 4 ATP

Total = 38 ATP

In aerobic respiration complete oxidation of one glucose molecule produces 38 ATP molecules. But the number of ATP molecules so produced may vary depending upon the mode of entry of $NADH_2$ in the mitochondria.

If the electrons of $NADH_2$ are accepted by malate then each molecule of $NADH_2$ yields 3 ATP molecules and the total would be 38 ATP molecules. But if the electrons of $NADH_2$ are accepted by FAD it yields only 2 ATP molecules making the total of 36 ATP molecules. This type of shuttle occurs in most of the eukaryotic cells.

20. (b) : Chemoautotrophs are organisms that are capable of manufacturing their organic food utilizing chemical energy released in oxidation of some inorganic substances. The process of manufacture of food in such organisms is called chemosynthesis. It includes some aerobic bacteria. Photoautotroph obtain energy for their synthesis of food from light.

Fungi living on dead or decaying plant or animal remains and also growing on dung of herbivores are saprophytes.

21. (b) : Cytochromes are electron transferring proteins often regarded as enzymes. They contain iron porphyrin or copper porphyrin as prosthetic groups. Cytochrome *a*, *b* and *c* are harmo-chromogens widely occurring in cells and acting as oxygen carriers during cellular respiration.

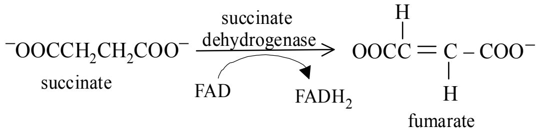
22. (c) : *Refer to answer 19.*

23. (a) : Cytochrome P_{450} is a host of enzymes that use iron to oxidise, often as part of the body's strategy to dispose of potentially harmful substances making them more water soluble. These are found in plants, animals and microbes and are involved in a variety of oxidative reaction in cells. These catalyse a variety of reactions including epoxidation, *N*-dialkylation,*o*-dialkylation,*s*-oxidation and hydroxylation. A typical cytochrome P_{450} catalysed reactions is

$NADPH + H^+ + O_2 + RH \rightarrow NADP^+ + H_2O + R - OH$

24. (b) : During glycolysis pyruvic acid is produced from glucose and is oxidatively decarboxylated to form acetyl CoA. This formation of acetyl CoA from pyruvic acid needs a multienzyme complex and 5 essential cofactors, *i.e.* lipoic acid, CoA, Mg^{2+}, NAD and TPP (thiamine pyrophosphate). It results in production of 2 molecules of CO_2 and 2 molecules of $NADH_2$. This acetyl CoA enters mitochondria and is completely oxidised during Krebs' cycle. Thus acetyl CoA acts as the linker of glycolysis and Krebs' cycle.

25. (b) : During Krebs' cycle when succinic acid is oxidised to fumaric acid then the precipitation of FAD as electron acceptor occurs. It is the only Krebs' cycle oxidation that does not employ a pyridine nucleotide. In this, succinate is dehydrogenated by succinate dehydrogenase. This enzyme removes two hydrogen ions and two electrons from succinate and these are then used to reduce FAD to $FADH_2$.



26. (d) : *Refer to answer 17.*

27. (d) : Last step of aerobic respiration is oxidation of reduced co-enzymes, *i.e.*, $NADH_2$ and $FADH_2$ by molecular oxygen through FAD, CoQ (ubiquinone), Cyt. *b*, Cyt. c_1, Cyt. *c*, Cyt. *a* and Cyt a_3. Two hydrogen atoms or electrons move from $NADH_2$ and travel through this ETS chain and finally combine with half molecule of O_2 to form water.

During this electron transport FAD and Fe of different cytochromes are successively reduced and oxidised and at certain points, enough energy is released which is used to bind ADP with Pi to form ATP.

28. (d) : In the absence of O_2, fermentation or anaerobic respiration occurs. In this process pyruvic acid forms ethyl alcohol and CO_2.

29. (c) : Glycolysis or EMP pathway is the breakdown of glucose to two molecules of pyruvic acid through a series of enzyme mediated reaction releasing energy. Pyruvic acid is a 3-carbon compound. In glycolysis net gain of 2ATP and 2 $NADH_2$ molecules occurs.

It can be represented in equation form as –

$$C_6H_{12}O_6 + 2ADP + 2Pi + 2NAD \rightarrow 2CH_3COCOOH + 2\ ATP + 2\ NADH_2$$

30. (c) : ATP is adenosine triphosphate. It was discovered by Lohmann in 1929. It consists of a purine, adenine, a pentose sugar (ribose) and a row of three phosphates out of which the last two are attached by high energy bonds. The last phosphate bond yields an energy equivalent of 7 kcal.

31. (b) : Active transport is uphill movement of materials across the membrane where the solute particles move against their chemical concentration or electrochemical gradient. Hence the transport requires energy in the form of ATP. Metabolic inhibitors like cyanide inhibit absorption of solutes by lowering the rate of respiration. Consequently less ATP are formed. However, by adding ATP, active transport is facilitated.

It occurs in plants as in climacteric fruits and under cold stress. ATP synthesis does not occur. Reducing power present in reduced coenzymes is oxidised to produce heat energy. Therefore, the heat liberation pathway of terminal oxidation is cyanide resistant.

In normal aerobic respiration, the effect of cyanide poisoning can be minimised by immediate supply of ATP.

32. (c) : Glucose is the chief respiratory substrate which fields maximum number of ATP molecules. Glucose is the most common substate in glycolysis. Any other carbohydrate is first converted into glucose. During glycolysis it changes to pyruvic acid and net gain is of 2 ATP and 2 $NADH_2$ molecules. And later on during Krebs cycle 30 molecules of ATP are produced. So a total of 38 ATP molecules are produced from 1 mol of glucose during aerobic respiration.

33. (a) : *Refer to answer 17.*

34. (a) : The 1992 Nobel prize for medicine was awarded to Edmond H. Fischer and Edwin J. Krebs for their work concerning reversible protein phosphorylation as biological regulation mechanism.

The winners of 1992 Noble prize in Physiology and Medicine discovered a 'life switch" that turns on and off a variety of biological functions of the cell, including the breakdown of fats and the generation of chemical energy. The prize - winning discovery is known as "reversible protein phosphorylation".

35. (c) : Glycolysis is the first step of glucose breakdown in both animals and plants. During glycolysis 6-carbon glucose molecule is converted into 2 molecules of 2 carbon pyruvic acid. In this process net gain of 2 ATP and 2 $NADH_2$ occurs. It is a common pathway for both aerobic and anaerobic modes of respiration.

36. (d) : Kornberg and Krebs (1957) gave glyoxylate cycle in *Pseudomonas* bacteria. It involves conversion of insoluble fats into soluble sugars. This occurs in germinating fatty seeds because plants are not able to transport fats from the endosperm to the root and shoot tissues of the germinating seedling, so they must convert stored lipids to a more mobile form of carbon, generally sucrose.

37. (d) : Anaerobic respiration (absence of oxygen) takes place in anaerobic bacteria and in plant seeds. Anaerobic respiration occurs in the organism which can live without oxygen. In this respiration, only glycolysis takes place due to the absence of oxygen.

38. (a) : During respiratory chain, complete degradation of one glucose molecule produced 38 ATP molecules. NAD and FAD is reduced to NADH/$FADH_2$.

39. (d) : The end product of glycolysis is pyruvic acid whereas acetyl CoA is the connecting link between glycolysis and Krebs' cycle. The TCA cycle was first described by Krebs, 1937 as a cyclic process in which acetyl coA is oxidised to CO_2 and water. Acetyl CoA combines with oxalo acetic acid to form citric acid. After a series of cyclic reactions OAA is recycled back.

40. (c) : Respirometer is an instrument used for measuring R.Q. and rate of respiration. The apparatus consists of a graduated tube attached at right angles to a bulbous respiratory chamber in its upper end. Desired plant material whose R.Q. is to be determined is placed in the respiratory chamber.

41. (b) : *Refer to answer 19.*

42. (c) : In electron transport system the hydrogen donated by succinate is accepted by FAD which is reduced to $FADH_2$. This hydrogen dissociate into electrons and protons and then passes through a series of carriers involving the phenomenon of oxidation and reduction. During this flow, ATP synthesis occurs at different steps and the phenomenon is called as oxidative phosphorylation.

43. (a) : The plants can perform photosynthesis on a range of temperature, while some cryophytes can do photosynthesis at 35°C. Usually the plants can perform photosynthesis between 10°C - 40°C. The optimum temperature ranges between 25°C - 30°C. At high temperature the enzymes are denatured and hence the photosynthetic rate declines.

44. (c) : *Refer to answer 12.*

45. (d) : Krebs' cycle is intimately related with fat metabolism. Dihydroxy acetone phosphate produced in glycolysis may be converted into glycerol *via* glycerol - 3 - phosphate and vice-versa. Glycerol is important constituents of fats. After β-oxidation, fatty acids give rise to active 2-C units, the acetyl-CoA which may enter the Krebs' cycle. Thus, Acetyl-CoA is a link between glycolysis, Krebs' cycle and β-oxidation of fatty acid or carbohydrate and fat metabolism.

46. (b) : During respiration, 36 ATP molecules are produced per glucose molecule. 2 molecules of ATP are produced outside mitochondria *i.e.*, during glycolysis and other 34 molecules of ATP are produced inside mitochondria from Krebs' cycle.

47. (d) : Cytochrome a_3 helps in transfer of electron to oxygen. The oxygen has great affinity to accept the electrons and in presence of protons a water molecule is formed.

48. (d) : *Refer to answer 39.*

49. (b) : *Refer to answer 19.*

50. (b) : The ratio of the volume of CO_2 released to volume of O_2 absorbed in the respiratory process is termed as the respiratory ratio or Respiratory Quotient.

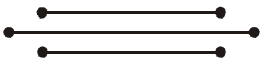
$$\text{R. Q.} = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ absorbed}}$$

Value of R.Q. varies from one respiratory substrate to another, *e.g.,* R.Q. of carbohydrates is equal to 1, R.Q. of lipids and proteins are less than 1, that of organic acid is greater than 1.

51. (b) : *Refer to answer 29.*

52. (c) : *Refer to answer 50.*

53. (a) : HMP pathway generates NADPH molecules which are used as reductants in biosynthetic process under conditions when NADPH molecules are not generated by photosynthesis. It is, therefore, important in non-photosynthetic tissues such as in differentiating tissues, generating seeds and during periods of darkness. Production of NADPH is not linked to ATP generation in pentose phosphate pathway.



Chapter
15

Plant Growth and Development

1. Fruit and leaf drop at early stages can be prevented by the application of
(a) ethylene (b) auxins
(c) gibberellic acid (d) cytokinins.
(NEET 2017)

2. You are given a tissue with its potential for differentiation in an artificial culture. Which of the following pairs of hormones would you add to the medium to secure shoots as well as roots?
(a) IAA and gibberellin
(b) Auxin and cytokinin
(c) Auxin and abscisic acid
(d) Gibberellin and abscisic acid
(NEET-II 2016)

3. Phytochrome is a
(a) flavoprotein (b) glycoprotein
(c) lipoprotein (d) chromoprotein.
(NEET-II 2016)

4. The *Avena* curvature is used for bioassay of
(a) IAA (b) ethylene
(c) ABA (d) GA_3.
(NEET-I 2016)

5. Auxin can be bioassayed by
(a) potometer
(b) lettuce hypocotyl elongation
(c) *Avena* coleoptile curvature
(d) hydroponics. *(2015)*

6. What causes a green plant exposed to the light, on only one side, to bend towards the source of light as it grows?
(a) Light stimulates plant cells on the lighted side to grow faster.
(b) Auxin accumulates on the shaded side, stimulating greater cell elongation there.
(c) Green plants need light to perform photosynthesis.
(d) Green plants seek light because they are phototropic.
(2015 Cancelled)

7. Typical growth curve in plants is
(a) stair-steps shaped (b) parabolic
(c) sigmoid (d) linear.
(2015 Cancelled)

8. Dr. F. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly-cut coleoptile stumps. Of what significance is this experiment?
(a) It made possible the isolation and exact identification of auxin.
(b) It is the basis for quantitative determination of small amounts of growth-promoting substances.
(c) It supports the hypothesis that IAA is auxin.
(d) It demonstrated polar movement of auxins.
(2014)

9. A few normal seedlings of tomato were kept in a dark room. After a few days they were found to have become white-coloured like albinos. Which of the following terms will you use to describe them?
(a) Mutated (b) Embolised
(c) Etiolated (d) Defoliated
(2014)

10. Which one of the following growth regulators is known as 'stress hormone'?
(a) Abscisic acid (b) Ethylene
(c) GA_3 (d) Indole acetic acid
(2014)

11. During seed germination its stored food is mobilized by
(a) ABA (b) gibberellin
(c) ethylene (d) cytokinin.
(NEET 2013)

12. The pineapple which under natural condition is difficult to blossom has been made to produce fruits throughout the year by application of

(a) NAA, 2, 4-D (b) Phenyl acetic acid
(c) Cytokinin (d) IAA, IBA.
(Karnataka NEET 2013)

13. Through their effects on plant growth regulators, what do the temperature and light control in the plants?
(a) Apical dominance (b) Flowering
(c) Closure of stomata (d) Fruit elongation
(Mains 2012)

14. Which one of the following generally acts as an antagonist to gibberellins?
(a) Zeatin (b) Ethylene
(c) ABA (d) IAA
(Mains 2012)

15. Vernalization stimulates flowering in
(a) zamikand (b) turmeric
(c) carrot (d) ginger.
(Mains 2012)

16. Phototropic curvature is the result of uneven distribution of
(a) gibberellin (b) phytochrome
(c) cytokinins (d) auxin. *(2010)*

17. Photoperiodism was first characterised in
(a) tobacco (b) potato
(c) tomato (d) cotton. *(2010)*

18. Coiling of garden pea tendrils around any support is an example of
(a) thigmotaxis (b) thigmonasty
(c) thigmotropism (d) thermotaxis.
(2010)

19. One of the commonly used plant growth hormone in tea plantations is
(a) ethylene
(b) abscisic acid
(c) zeatin
(d) indole-3-acetic acid. *(Mains 2010)*

20. Root development is promoted by
(a) abscisic acid (b) auxin
(c) gibberellin (d) ethylene.
(Mains 2010)

21. One of the synthetic auxin is
(a) IAA (b) GA
(c) IBA (d) NAA. *(2009)*

22. Which one of the following acids is a derivative of carotenoids?
(a) Indole-3-acetic acid
(b) Gibberellic acid
(c) Abscisic acid
(d) Indole butyric acid *(2009)*

23. Importance of day length in flowering of plants was first shown in
(a) cotton (b) *Petunia*
(c) *Lemna* (d) tobacco. *(2008)*

24. Senescence as an active developmental cellular process in the growth and functioning of a flowering plant, is indicated in
(a) annual plants
(b) floral parts
(c) vessels and tracheid differentiation
(d) leaf abscission. *(2008)*

25. The wavelength of light absorbed by P_r form of phytochrome is
(a) 680 nm (b) 720 nm
(c) 620 nm (d) 640 nm. *(2007)*

26. Which one of the following pairs, is not correctly matched?
(a) Gibberellic acid - Leaf fall
(b) Cytokinin - Cell division
(c) IAA - Cell wall elongation
(d) Abscissic acid - Stomatal closure *(2007)*

27. Opening of floral buds into flowers, is a type of
(a) autonomic movement of variation
(b) paratonic movement of growth
(c) autonomic movement of growth
(d) autonomic movement of locomotion.
(2007)

28. An enzyme that can stimulate germination of barley seeds is
(a) invertase (b) α-amylase
(c) lipase (d) protease. *(2006)*

29. Farmers in a particular region were concerned that pre-mature yellowing of leaves of a pulse crop might cause decrease in the yield. Which treatment could be most beneficial to obtain maximum seed yield?
(a) Application of iron and magnesium to promote synthesis of chlorophyll
(b) Frequent irrigation of the crop
(c) Treatment of the plants with cytokinins along with a small dose of nitrogenous fertilizer
(d) Removal of all yellow leaves and spraying the remaining green leaves with 2, 4, 5-trichlorophenoxy acetic acid *(2006)*

30. How does pruning help in making the hedge dense?
(a) It releases wound hormones.
(b) It induces the differentiation of new shoots from the rootstock.
(c) It frees axillary buds from apical dominance.
(d) The apical shoot grows faster after pruning. *(2006)*

31. Treatment of seeds at low temperature under moist conditions to break its dormancy is called
(a) stratification (b) scarification
(c) vernalization (d) chelation. *(2006)*

32. The ability of the Venus Flytrap to capture insects is due to
(a) specialized "muscle-like" cells
(b) chemical stimulation by the prey
(c) a passive process requiring no special ability on the part of the plant
(d) rapid turgor pressure changes. *(2005)*

33. Cell elongation in internodal regions of the green plants takes place due to
(a) indole acetic acid (b) cytokinins
(c) gibberellins (d) ethylene. *(2004)*

34. One set of the plant was grown at 12 hours day and 12 hours night period cycles and it flowered while in the other set night phase was interrupted by flash of light and it did not produce flower. Under which one of the following categories will you place this plant?
(a) Long day (b) Darkness neutral
(c) Day neutral (d) Short day *(2004)*

35. Coconut milk factor is
(a) an auxin (b) a gibberellin
(c) abscisic acid (d) cytokinin. *(2003)*

36. *Nicotiana sylvestris* flowers only during long days and *N.tabacum* flowers only during short days. If raised in the laboratory under different photoperiods, they can be induced to flower at the same time and can be cross-fertilized to produce self-fertile offspring. What is the best reason for considering *N.sylvestris* and *N.tabacum* to be separate species ?
(a) They cannot interbreed in nature
(b) They are reproductively distinct
(c) They are physiologically distinct
(d) They are morphologically distinct *(2003)*

37. Plants deficient of element zinc, show its effect on the biosynthesis of plant growth hormone
(a) auxin (b) cytokinin
(c) ethylene (d) abscisic acid. *(2003)*

38. Differentiation of shoot is controlled by
(a) high auxin : cytokinin ratio
(b) high cytokinin : auxin ratio
(c) high gibberellin : auxin ration
(d) high gibberellin : cytokinin ratio. *(2003)*

39. Seed dormancy is due to the
(a) ethylene (b) abscisic acid
(c) IAA (d) starch. *(2002)*

40. Dwarfness can be controlled by treating the plant with
(a) cytokinin (b) gibberellic acid
(c) auxin (d) antigibberellin. *(2002, 1992)*

41. Which plant is LDP?
(a) Tobacco (b) *Glycine max*
(c) *Mirabilis jalapa* (d) Spinach *(2001)*

42. Which of the following prevents the fall of fruits?
(a) GA_3 (b) NAA
(c) Ethylene (d) Zeatin *(2001)*

43. Hormone responsible for senescence is
(a) ABA (b) auxin
(c) GA (d) cytokinin *(2001)*

44. Which hormone breaks dormancy of potato tuber?
(a) Gibberellin (b) IAA
(c) ABA (d) Zeatin *(2001)*

45. If the apical bud has been removed then we observe
(a) more lateral branches
(b) more axillary buds
(c) plant growth stops
(d) flowering stops. *(2000)*

46. By which action a seed coat becomes permeable to water
(a) scarification (b) stratification
(c) vernalization (d) all of the above. *(2000)*

47. Which hormone is responsible for fruit ripening?
(a) Ethylene (b) Auxin
(c) Ethyl chloride (d) Cytokinin *(2000)*

48. ABA is involved in
(a) shoot elongation
(b) increased cell division
(c) dormancy of seeds
(d) root elongation. *(1999)*

49. The closing and opening of the leaves of *Mimosa pudica* is due to
(a) seismonastic movement
(b) chemonastic movement
(c) thermonastic movement
(d) hydrotropic movement. *(1999)*

50. A plant hormone used for inducing morphogenesis in plant tissue culture is
(a) cytokinins (b) ethylene
(c) abscisic acid (d) gibberellins. *(1998)*

51. The response of different organisms to the environmental rhythms of light and darkness is called
(a) vernalization (b) photoperiodism
(c) phototaxis (d) phototropism. *(1998)*

52. Which combination of gases is suitable for fruit ripening?
(a) 80 % CH_4 and 20% CO_2
(b) 80% CO_2 and 20% O_2
(c) 80% C_2H_4 and 20% CO_2
(d) 80% CO_2 and 20% CH_2 *(1998)*

53. Phytochrome becomes active in
(a) red light (b) green light
(c) blue light (d) none of these. *(1998)*

54. Which one among the following chemicals is used for causing defoliation of forest trees?
(a) Malic hydrazide (b) 2, 4-D
(c) Amo-1618 (d) Phosphon D *(1998)*

55. A pigment which absorbs red and far-red light is
(a) cytochrome (b) xanthophyll
(c) phytochrome (d) carotene. *(1997)*

56. What will be the effect on phytochrome in a plant subjected to continuous red light?
(a) Phytochrome synthesis will increase
(b) Level of phytochrome will decrease
(c) Phytochrome will be destroyed
(d) First (b) then (a) *(1997)*

57. If a tree flowers thrice in a year (Oct., Jan. and July) in Northern India, it is said to be
(a) photo and thermo-insensitive
(b) photo and thermo-sensitive
(c) photosensitive but thermo-insensitive
(d) thermosensitive but photo-insensitive. *(1997)*

58. Gibberellic acid induces flowering
(a) in short day plants under long day conditions
(b) in day-neutral plants under dark conditions
(c) in some gymnospermic plants only
(d) in long day plants under short day conditions. *(1997)*

59. The twining of tendrils around a support is a good example of
(a) phototropism (b) chemotropism
(c) nastic movements (d) thigmotropism. *(1995)*

60. The closure of lid of pitcher in pitcher plant, is due to
(a) paratonic movement
(b) autonomous movement
(c) turgor movement
(d) tropic movement. *(1995)*

61. The movement of auxin is largely
(a) centripetal (b) basipetal
(c) acropetal (d) both (a) and (c). *(1994)*

62. If the growing plant is decapitated, then
(a) its growth stops
(b) leaves become yellow and fall down
(c) axillary buds are inactivated
(d) axillary buds are activated. *(1994)*

63. Removal of apical bud results in
(a) formation of new apical bud
(b) elongation of main stem
(c) death of plant
(d) formation of lateral branching. *(1993)*

64. The regulator which retards ageing/senescence of plant parts is
(a) cytokinin (b) auxin
(c) gibberellin (d) abscisic acid. *(1993)*

65. The hormone produced during adverse environmental conditions is
(a) benzyl aminopurine
(b) bichlorophenoxy acetic acid
(c) ethylene
(d) abscisic acid. *(1993)*

66. Klinostat is employed in the study of
(a) osmosis
(b) growth movements
(c) photosynthesis
(d) respiration. *(1993)*

67. Which is produced during water stress that brings stomatal closure?
(a) Ethylene (b) Abscisic acid
(c) Ferulic acid (d) Coumarin *(1993)*

68. Flowering dependent on cold treatment is
(a) cryotherapy (b) cryogenics
(c) cryoscopy (d) vernalisation. *(1992)*

69. Bananas can be prevented from over-ripening by
(a) maintaining them at room temperature
(b) refrigeration
(c) dipping in ascorbic acid solution
(d) storing in a freezer. *(1992)*

70. Apical dominance is caused by
(a) abscisic acid in lateral bud
(b) cytokinin in leaf tip
(c) gibberellin in lateral buds
(d) auxin in shoot tip. *(1992)*

71. In short day plants, flowering is induced by
(a) photoperiod less than 12 hours
(b) photoperiod below a critical length and uninterrupted long night
(c) long night
(d) short photoperiod and interrupted long night. *(1992)*

72. Cytokinins
(a) promote abscission
(b) influence water movement
(c) help retain chlorophyll
(d) inhibit protoplasmic streaming. *(1992)*

73. Which is employed for artificial ripening of banana fruits?
(a) Auxin (b) Coumarin
(c) Ethylene (d) Cytokinin *(1992)*

74. Abscisic acid causes
(a) stomatal closure (b) stem elongation
(c) leaf expansion (d) root elongation. *(1991)*

75. The hormone responsible for apical dominance is
(a) IAA (b) GA
(c) ABA (d) Florigen. *(1991)*

76. A chemical believed to be involved in flowering is
(a) gibberellin (b) kinetin
(c) florigen (d) IBA. *(1991)*

77. Twining of tendrils is due to
(a) thigmotropism (b) seismonasty
(c) heliotropism (d) diageotropism. *(1991)*

78. Hormone primarily connected with cell division is
(a) IAA (b) NAA
(c) cytokinin/zeatin (d) gibberellic acid. *(1991, 1988)*

79. Highest auxin concentration occurs
(a) in growing tips
(b) in leaves
(c) at base of plant organs
(d) in xylem and phloem. *(1990)*

80. Phytohormones are
(a) chemical regulating flowering
(b) chemical regulating secondary growth
(c) hormones regulating growth from seed to adulthood
(d) regulators synthesised by plants and influencing physiological processes. *(1990)*

81. Abscisic acid controls
(a) cell division
(b) leaf fall and dormancy
(c) shoot elongation
(d) cell elongation and wall formation. *(1990)*

82. Phototropic and geotropic movements are linked to
(a) gibberellins (b) enzymes
(c) auxin (d) cytokinins. *(1990)*

83. Which of the following movement is not related to auxin level?
(a) Bending of shoot towards light
(b) Movement of root towards soil
(c) Nyctinastic leaf movements
(d) Movement of sunflower head tracking the sun *(1990)*

84. Which of the following hormones can replace vernalisation?
(a) Auxin (b) Cytokinin
(c) Gibberellins (d) Ethylene *(1989)*

85. Leaf fall can be prevented with the help of
(a) abscisic acid (b) auxins
(c) florigen (d) cytokinins.
(1989)

86. Mowing grass lawn facilitates better maintenance because
(a) wounding stimulates regeneration
(b) removal of apical dominance and stimulation of intercalary meristem
(c) removal of apical dominance
(d) removal of apical dominance and promotion of lateral meristem. *(1989)*

87. Which one increases in the absence of light?
(a) Uptake of minerals
(b) Uptake of water
(c) Elongation of internodes
(d) Ascent of sap *(1989)*

88. Cut or excised leaves remain green for long if induced to root or dipped in
(a) gibberellins (b) cytokinins
(c) auxins (d) ethylene.
(1988)

89. Gibberellins promote
(a) seed germination (b) seed dormancy
(c) leaf fall (d) root elongation.
(1988)

90. Phytochrome is involved in
(a) phototropism (b) photorespiration
(c) photoperiodism (d) geotropism.
(1988)

91. Movement of leaves of sensitive plant, *Mimosa pudica* are due to
(a) thermonasty (b) seismonasty
(c) hydrotropism (d) chemonasty.
(1988)

Answer Key

1.	(b)	**2.**	(b)	**3.**	(d)	**4.**	(a)	**5.**	(c)	**6.**	(b)	**7.**	(c)	**8.**	(a)	**9.**	(c).	**10.**	(a)
11.	(b)	**12.**	(a)	**13.**	(b)	**14.**	(c)	**15.**	(c)	**16.**	(d)	**17.**	(a)	**18.**	(c)	**19.**	(d)	**20.**	(d)
21.	(c,d)	**22.**	(c)	**23.**	(d)	**24.**	(c)	**25.**	(a)	**26.**	(a)	**27.**	(c)	**28.**	(b)	**29.**	(c)	**30.**	(c)
31.	(c)	**32.**	(d)	**33.**	(c)	**34.**	(d)	**35.**	(d)	**36.**	(a)	**37.**	(a)	**38.**	(b)	**39.**	(b)	**40.**	(b)
41.	(d)	**42.**	(b)	**43.**	(a)	**44.**	(a)	**45.**	(a)	**46.**	(a)	**47.**	(a)	**48.**	(c)	**49.**	(a)	**50.**	(a)
51.	(b)	**52.**	(c)	**53.**	(d)	**54.**	(b)	**55.**	(c)	**56.**	(d)	**57.**	(a)	**58.**	(d)	**59.**	(d)	**60.**	(a)
61.	(b)	**62.**	(d)	**63.**	(d)	**64.**	(a)	**65.**	(d)	**66.**	(b)	**67.**	(b)	**68.**	(d)	**69.**	(c)	**70.**	(d)
71.	(b)	**72.**	(c)	**73.**	(c)	**74.**	(a)	**75.**	(a)	**76.**	(c)	**77.**	(a)	**78.**	(c)	**79.**	(a)	**80.**	(d)
81.	(b)	**82.**	(c)	**83.**	(c)	**84.**	(c)	**85.**	(d)	**86.**	(b)	**87.**	(c)	**88.**	(b)	**89.**	(a)	**90.**	(c)
91.	(b)																		

EXPLANATIONS

1. (b) : In low concentrations, auxins such as 2, 4-D(2,4- Dichlorophenoxy acetic acid) is useful in preventing, pre-harvest fruit drop and leaf drop.

2. (b) : Cytokinin and auxin are two plant hormones that are supplied to the tissue culture medium in definite proportions. They bring about cell division and differentiation of callus. A low auxin to cytokinin ratio promotes shoot formation whereas a high auxin to cytokinin ratio promotes rooting of callus.

3. (d) : Phytochrome is a chromoprotein, plant pigment that can detect the presence or absence of light and is involved in regulating many processes that are linked to day length (photoperiod), such as seed germination and initiation of flowering. It consists of a light detecting portion, called a chromophore, linked to a small protein and exists in two inter-convertible forms with different physical properties.

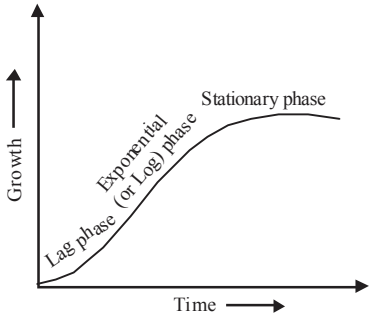
4. (a) : *Avena* curvature test is a test based on the experiments of Went (1928) which can measure auxin upto 300 mg/litre. Indole 3-Acetic Acid (IAA) is a universal natural auxin and *Avena* curvature test may serve as an accurate bioassay for this plant hormone.

5. (c) : Auxin bioassay is a quantitative test as it measures concentration of auxin to produce the effect and the amount of the effect. *Avena* Curvature is based upon experiments of Went (1928). 10° curvature is produced by auxin concentration of 150 mg/litre at 25°C and 90% relative humidity. The test can measure auxin upto 300 mg/litre. Auxin from a shoot tip or any other plant organ is allowed to diffuse in a standard size agar block (generally $2 \times 2 \times 1$ mm). Auxin can also be dissolved directly in agar. 15– 30 mm long oat coleoptile grown in dark is held vertically over water. 1 mm tip of coleoptile is removed without injuring the primary leaf. After 3 hours a second decapitation is carried out for a distance of 4 mm. Primary leaf is now pulled loose and agar block supported against it at the tip of decapitated coleoptile. After 90–110 minutes, the coleoptile is found to have bent. The curvature is measured. It can also be photographed and the curvature known from shadow graph.

6. (b) : Auxins induce cell elongation. In a differentially illuminated plant, they accumulate in the shaded part, causing elongation of the cells in the shaded part. This unequal elongation on two sides causes the plant to curve or bend towards the light source *i.e.*, phototropic curvature.

7. (c) : Geometric growth cannot be sustained for long in natural condition. Limited nutrient availability slows down the growth. It leads to a stationary phase or even a decline. Plotting the growth against time, gives a typical sigmoid or S-curve. Sigmoid curve of growth is typical of most organisms in their natural environment including plants.

An idealised sigmoid growth curve is drawn below:



8. (a)

9. (c) : Etiolation is the abnormal form of growth observed when plants grow in darkness or severely reduced light. Such plant characteristically have branched leaves and shoots, excessively long shoots and reduced leaves and root systems.

10. (a) : Abscisic acid prepares plants to cope with stress conditions like drought etc. by inducing stomatal closure and other reactions. Hence it is named stress hormone.

11. (b) : Gibberellins are plant growth substances chemically related to terpenes and occurring naturally in plants and fungi. They promote elongation of stems, *e.g.*, bolting in cabbage plants, and the mobilization of food reserves in germinating seeds and are influential in inducing flowering and fruit development.

12. (a) : NAA (α-Naphthalene acetic acid) and 2,4 D (2, 4 dichlorophenoxy acetic acid) are synthetic auxins. Normally, auxins inhibit flowering. In lettuce, it delays flowering and the plants can be kept in their vegetative phase for longer periods of time. In litchi and pineapple, however, application of auxin promotes flowering.

13. (b) : Light and temperature may affect flowering in plants in various ways. The effect of photoperiods or daily duration of light hours (and dark periods) on

flowering is called photoperiodism. For example, in short day plants flowering occurs when day length is below critical period, *e.g.*, dahlia, rice etc. In long day plants, flowering occurs when day length is above critical period, *e.g.*, spinach, lettuce etc. In short-long day plants, short photoperiod is required for floral initiation and long photoperiod is required for blossoming and *vice-versa* for long-short day plants.

14. (c) : Abscisic acid or ABA is an antagonist to gibberellins. This is discussed in the table given below:

Abscisic acid	**Gibberellic acid**
It inhibits growth.	It promotes growth.
It promotes the dormancy of seeds, of buds and tubers.	It overcomes the natural dormancy seeds, tubers etc.
It inhibits the synthesis of RNA and proteins.	It promotes the of RNA and synthesis proteins.
Causes abscission of flowers and fruits.	Promotes development of fruits.
Promotes leaf senescence.	Prevents leaf senescence.
Promotes stomatal closure.	Promotes stomatal opening.
Prevents amylase activity	Promotes amylase activity during seed germination.

15. (c) : Carrot is a biennial plant that requires stimulus of low temperature for flowering. It remains vegetative during the warm season and bears flowers and fruits only during winter.

It can be made to flower in one growing season by providing low temperature treatment to young plants or seedlings which is referred to as vernalization. Hence, vernalization stimulates flowering in carrot.

16. (d) : Phototropic curvature is the result of uneven distribution of auxin. Charles Darwin and his son Francis Darwin observed that the coleoptiles of canary grass responded to unilateral illmination by growing towards the light source (phototropism). After a series of experiments, it was concluded that the tip of coleoptile contain auxin that caused the bending of the entire coleoptile in relation to the direction of light.

17. (a) : Photoperiodism is the response to duration and timings of light and dark period. It was first studied by W.W. Garner and H.A. Allard (1920) in tobacco. They observed that Maryland Mammoth variety of tobacco could be made to flower in Summer by reducing the light hours with artificial darkening.

18. (c) : The growth movement in response to touch, or contact of a foreign body, in plants is called thigmotropism or thigmotropic movement. The stems and tendrils of the climbers are positively thigmotropic in their response. The coiling of garden pea tendrils around any support is an example of thigmotropism. Thigmonastic (haptonastic) movements are induced by some external stimuli. For example tentacles of *Drosera* leaf curve and the lamina lobes of *Dionaea* fold on coming in contact with an insect.

19. (d) : Indole-3-acetic acid (also called auxin) is a phytohormone which is generally produced by the growing apices of the stems and roots, from where they migrate to the regions of their action. It is observed that the growing apical bud inhibits the growth of the lateral (axillary) bud. (apical dominance). Since apical meristem is the site of auxin synthesis, it is the physiological effect of the auxin which results in the phenomenon of apical dominance. When shoot tips is removed it usually results in the growth of lateral buds.

This phenomenon is widely applied in tea plantations and hedge-making because as in tea plantation and industries, the apical bud is plucked for tea processing which results in more lateral buds thus enhancing plantation and further industrial purposes.

20. (d) : Ethylene promotes root growth and root hair formation. In low concentration ethylene is used for initiation of roots and also of lateral roots.

21. (c, d) : Many auxins have been synthesized which have similar properties with natural auxin and some examples of synthetic auxins are indole-3-butyric acid (IBA), naphthalene acetic acid (NAA), 2,4-dichloro-phenoxy acetic acid (2,4-D), 2,4,5-trichloro-phenoxyacetic acid (2,4,5 -T).

22. (c) : Biosynthesis of abscisic acid (ABA) in most plants occur indirectly by degradation of certain carotenoids present in chloroplasts or other plastids. The biosynthetic pathway follow mevalonic acid pathway for their synthesis. The sites of synthesis are fruits, tissues, leaves, roots and seeds.

23. (d) : The effect of photoperiods or daily duration of light hours (and dark periods) on the growth and development of plants, especially flowering, is called photoperiodism. Photoperiodism was first studied by Garner and Allard (1920). They observed that 'Maryland Mammoth' variety of tobacco could be made to flower in summer by reducing the light hours with artificial darkening. It could be made to remain vegetative in winter by providing extra light.

24. (c) : Senescence is the process of ageing which is caused by cellular breakdown, increased metabolic failure, increased entropy etc. It occurs in the period between reproductive maturity and death. Cell division followed by cell enlargement and differentiation, precede the actual separation. Senescence of cell in distal region lead to lignification of cell wall. Tylose formation in tracheary element and callose deposition in sieve elements which occur in advance of abscission (*i.e.* senescence) finally, lead to actual separation. Thus, vessels and tracheid (trachery elements) differentiation indicates senescence.

25. (a) : Phytochrome is the photoreceptor pigment that controls flowering. It has two forms as P_r and P_{fr}. P_r is bluish phytochrome and it absorbs light at 660 to 680 nm of wavelength. P_{fr} is (far red) yellowish green and absorbs light at 730 nm of wavelength.

26. (a) : Gibberellic acid is a simple weakly acidic plant growth hormone which promotes cell elongation of both leaves and stems in general and internodal length of genetically dwarf plants in particular. It is in general a growth promoting hormone and does not inhibit growth. So leaf abscission is not associated with gibberellic acid but with abscisic acid.

27. (c) : Movement may be of two types, movement of locomotion and movement of curvature. Movement of curvature is movement of individual parts in relation to other parts. Curvature movement may be growth movements and turgor movements. Growth movements are caused by differential growth in different part of an organ. Opening of floral buds into flowers is such a type of growth movement. Mostly floral bud opening shows thermonastic movement *i.e.* opening and closing are controlled by temperature. Sometimes movements are controlled by presence or absence of light, *e.g.*, *Oxalis*.

28. (b) : The process by which the dormant embryo of seed resumes active growth and forms a seedling is known as germination.

The initial step in germination process is the uptake of water and rehydration of the seed tissues by the process of imbibition. The first visible sign of germination is the emergence of the radicle from the seed. But this event is preceded by a series of biochemical reactions.

Imbibition of water causes the embryo within seed to produce α- and β-amylases. These enzymes hydrolyze the starch stored in endosperm into glucose which is necessary for use both as a respiratory substrate and as a source of carbon skeletons of the molecules needed for growth.

29. (c) : Nitrogen is the fourth most abundant element. Chief source of nitrogen for plants is nitrates of Ca and K. It is important for plants as it is a component of nucleic acids, proteins chlorophyll and cytochromes. Deficiency of nitrogen causes poor root development, lower respiration rate, chlorosis of older leaves etc. Cytokinins are also very important for plant development. They are associated with the control of apical dominance, fruit development, root growth, cambial activity. So a nitrogenous fertilizer like NPK and cytokinins are most beneficial to the plant.

30. (c) : Prunning is the process of cutting shoot tips to promote lateral growth of branches. Removal of shoot tips involves removal of apical buds. In the shoot tips auxins are produced. Auxins are growth promoting phytohormones. They cause apical dominance by promoting the growth of apical buds and suppressing the growth of axillary buds. So when the auxins produced in the shoot tips are removed by decapitation it results in lateral growth and plants thus show bushy appearance. This is because of a relatively high concentration of auxin in the apical bud than in the lateral buds.

31. (c) : Vernalization is the method of promoting flowering by exposing young plants to cold treatment *e.g.*, winter verieties of wheat, barley, oats and rye are given artificial cold treatment and planted in spring in areas of very harsh winters such as Soviet Union to promote flowering in them.

In most cereals optimum temperature for vernalization is 4ºC. Receptive organ to chilling is the apical meristem. Chelation is the process by which certain micronutrients are treated to keep them readily available to a plant once they are introduced into the soil.

Stratification is a process by which seeds are pretreated to simulated winter conditions so that germination may occur. The degradation of the seed coat is called scarification. This process permits water to pass through the sead coat so that embryo can begin metabolism.

32. (d) : Thigmonastic movements are exhibited by some insectivorous plants such as *Dionaea*, venus fly trap, *Drosera* etc. These plants have tentacles, which are sensitive to the stimulus of touch. In the case of the venus flytrap turgor pressure changes occur in which hydrogen ions are rapidly pumped into the walls of cells on the outside of each leaf in response to the action potentials from the trigger hairs. The protons apparently loosen the cell walls so rapidly that the tissue actually becomes flaccid so that cells

quickly absorb water, causing the outside of each leaf to expand and the trap to snap shut.

33. (c) : Gibberellins play a role in the elongation of internodes in 'rosette' plants. Before reproductive stage there is too much elongation of internodes but there is less leaf formation. An elongated internode without leaves in called a "bolt" like structure and the process is called "bolting" flowering takes place after bolting.

Gibberellins induce cell division and cell elongation, when bolting takes place.

34. (d) : Plants require a day length or light period for flowering, this light period is called as photoperiod. It was first studied by Garner and Allard (1920).

Short day plants (SDP's) flower in photoperiods less than critical day length, *e.g.*, *Nicotiana tabacum, Glycine max (Soybean), Xanthium strumarium*. Further these plants require long uninterrupted dark period and hence are called long night plants.

Long day plants (LDP's) flower in photoperiod more than critical day length, *e.g.*, *Hyocyamus niger* (Henbane), radish, *Beta*, spinach, *Plantago*, etc.

Day neutral plants flower in any photoperiod, *e.g.*, tomato, maize, cucumber, etc.

35. (d) : Many experiments were done to sustain the proliferation of normal stem tissues in culture. The growth of culture was most dramatic when the liquid endosperm of coconut, also known as coconut milk, was added to the culture medium. This finding indicated that coconut milk contains a substance or substances that stimulate mature cells to enter and remain in the cell division cycle.

Eventually coconut milk was shown to contain the cytokinin zeatin, but this finding was not obtained until several years after the discovery of the cytokinins. The first cytokinin to be discovered was the synthetic analog kinetin.

36. (a) : According to biological species concept a species is a natural inbreeding or panmictic species or group of natural populations which have essentially similar morphological traits, they are genetically distinct and reproductively isolated from others. Since under laboratory conditions *N. tabacum* and *N. sylvestris* can produce self-fertile offspring so they are not reproductively isolated. They are considered as separate species because since their flowering periods are different so cross pollination is not possible between them naturally. This makes them different species.

37. (a) : Zinc is available to the plants for absorption in the divalent form. It occurs in the form of minerals as hornblende, magnetite, biotite etc., from where it is released by weathering. It is involved in the synthesis of Indole-acetic acid in plants. It is an activator in the enzyme tryptophan synthetase. Tryptophan is the precursor of Indole-acetic acid.

38. (b) : The major physiological function of cytokinin is to enhance cell division. In tissue culture the undifferentiated mass of cells formed in the culture tubes is called callus.

The callus may remain in the undifferentiated condition or differentiation may take place in this. If it is differentiated, then root and shoot may be formed.

Skoog and miller had reported that cytokinins induce shoot formation and auxins induce root formation (figure).

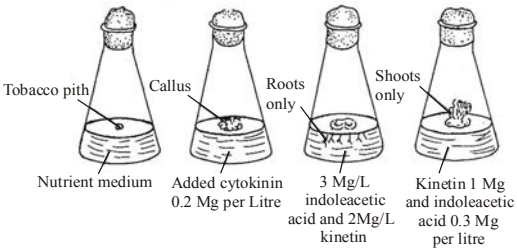


Fig. : The experiment to demonstrate the effect of auxins and cytokinins on the growth and the differentiation of tissues in culture.

Later however it was proved experimentally that –

(i) High cytokinins/auxin ratio - Differentiation of shoot.
(ii) Low cytokinins/auxin ratio-Differentiation of root.
(iii) Intermediate cytokinins/auxin ratio - Differentiation of both root and shoot.
(iv) Intermediate cytokinins/low auxin - Callus formation.

39. (b) : Viable seeds of some plants are unable to germinate even after getting all the necessary conditions. This inability of viable seeds to germinate even under favorable conditions, is called dormancy of seeds. This is considered to be due to some barriers or blocks inside the seeds.

Some common causes of seed dormancy are :

(i) Mechanically hard seed coat, which does not allow proper growth of embryo inside it, *e.g.*, *Brassica campestris*.

(ii) Presence of impermeable (impervious) seed coat to H_2O, *e.g.* many seeds of legumes.

(iii) Presence of impermeable seed coat to oxygen, *e.g. Xanthium* (cocklebur).

(iv) Presence of germination inhibitors like ABA (abscisic acid) and phenolics, etc., in seed coat or fruit pulp, *e.g.*, in tomoto, inhibitor is present in fruit pulp. Seed coats may contain relatively high concentrations of growth inhibitors that can suppress germination of the embryo. Abscisic acid (ABA) is a common germination inhibitor present in the seed coats. Repeated washing and heavy rainfall removes such substances from the seed coat.

40. (b) : Giberellins helps in the reversal of dwarfism in many genetically dwarf plants. External supply of Gibberellic acid causes rapid elongation of growth. *E.g.*, rosette plant of sugarbeet when treated with GA_3 undergoes marked longitudinal growth of axis.

41. (d) : *Refer to answer 34.*

42. (b) : α-Naphthalene acetic acid (NAA) is a synthetic or exogenous auxin. It prevent the formation of abscission layer, which is a layer of dead cells in the petiole and pedicel that causes fall of leaf or fruit. NAA prevents formation of this layer and so it prevents fall of leaf or fruit.

43. (a) : Abscisic acid is a growth inhibiting phytohormone. It induces senescence in leaves by promoting the degradation of chlorophyll and proteins. Auxin is a growth promoting phytohomone that results in cell division, cell enlargement and apical dominance. Cytokinin is a growth promoting phytohormone that causes cell division, morphogenesis and seedling growth. Gibberellins are growth promoting phytohormone that results in overcoming seed dormancy and bolting.

44. (a): Gibberellin is the hormone that breaks seed/bud dormancy. The tubers of potato reproduce vegetatively to give rise to new plants. So the dormancy of these tubers can be overcome by applying gibberellins.

45. (a) : Apical dominance is the phenomenon by which presence of apical bud does not allow the nearby lateral buds to grow. When apical bud is removed, the lateral buds sprout.

46. (a) : Scarification means the application of those methods by which the hard seed coat is ruptured or softened so that it becomes permeable to water, gases and the embryo can expand. There are two methods of scarification as mechanical scarification and chemical scarification. This helps in overcoming seed dormancy.

47. (a) : Ethylene is largely a growth inhibiting phytohormone but is also involved in some growth promotion activities. It has been established that ethylene is a fruit ripening hormone. Ethylene stimulates all the biochemical changes which take place at the time of fruit ripening.

48. (c) : Abscisic acid (ABA) is a growth inhibiting phytohormone. Abscisic acid is found in vascular plants, some mosses, some fungi and some green algae.

If ABA is applied exogenously, seed germination is inhibited. It has been suggested that ABA inhibits the synthesis of some enzymes, for germination. These enzymes are synthesised under the direction of nucleic acids. A view has been expressed that the translation of a particular messenger RNA is inhibited by ABA and the result is that protein synthesis is blocked.

49. (a) : Nastic movements occur in response to a stimulus. It is independent of its direction. They are shown by bifacial organs (leaves, sepals, petals) and are in response to diffused external stimulus.

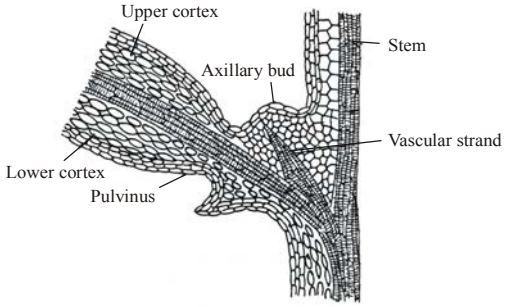


Fig. : Seismonastic movement

Seismonastic movements are due to shock or touch stimulus. Such movements are shown by *Mimosa pudica*. The leaf of *Mimosa* is compound having four pinna and each pinna is having many pinnules. If a terminal pinnule is touched, the whole leaf droops down. This is due to fact that at the bases of pinnules, pinna and whole leaf, swollen structure called pulvinus is present and drooping is due to loss of turgidity of lower portion of pulvinus.

50. (a) : Cytokinins are growth promoting phytohomones. Cytokinin plays an important part in organ formation (morphogenesis) with auxin. Different auxin/cytokinin ratio decides the development of root shoot ratio. The major physiological function of cytokinins is to enhance cell division. If cytokinin to auxin ratio is low, then root formation takes place but if the ratio of cytokinin to auxin is high, then, there is formation of meristematic cells in the callus.

51. (b) : Photoperiodism is the response of plants to relative length of light and darkness. Phototaxis is plant movement where the stimulus is light. Phototropism is tropism in which stimulus is light. Vernalization is

application of cold treatment to plants to effect flowering.

52. (c) : In most of the plants, there is a sharp rise in respiration rate near the end of the development of fruit, which sets in progress those changes, which are involved in ripening of fruit. The ripening on demand can be induced in these fruits by exposing them to normal air containing about 1 ppm of ethylene.

Suitable combination of gases in atmosphere for fruit ripening is 80% ethylene (C_2H_4) and 20% CO_2.

53. (d) : Phytochrome is a bright blue or bluish green pigment which was first of all isolated from plasma membrane of alga *Mougeotias*. It is a photoreceptive pigment. Phytochrome has a light absorbing or light detecting portion (the chromophore) attached to small protein of about 1,24,000 daltons. Phytochrome occurs in 2 forms, *i.e.*, P_R and P_{FR} (*i.e.*, red light and far red light absorbing forms) and these 2 forms are interconvertible.

$$P_R \underset{\text{Far red light}}{\overset{\text{Red light}}{\rightleftharpoons}} P_{FR}$$

It is involved in the perception of photoperiodic stimuli controlling flowering and other morpho-genetic phenomenon in plants.

54. (b) : 2,4-D is a famous herbicide or weedicide which especially kills broad leaved weeds. It kills weeds perhaps by over stimulated root growth. Other auxins like 2, 4, 5 -T have also been used as defoliants during early sixties.

55. (c) : *Refer to answer 53.*

56. (d) : When continous red light is given the level of P_R decreases as most of it is converted to P_{FR} form. When the concentration of P_R reaches below a critical value, it starts synthesis of more phytochromes in the P_R form so that there is an equilibrium betweem synthesis and destruction of P_R form.

57. (a) : Flower formation is a transitional phase in the life eycle of plant. During flowering, vegetative shoot apex is converted into reproductive shoot apex.

The physiological mechanism for flowering is controlled by 2 factors : photoperiod or light period, *i.e.*, photoperiodism and low temperature, *i.e.*, vernalization.

58. (d) : Gibberellins are growth promoting phytohormones. Some of plants species flower only if the light period exceeds a critical length, and others flower only if this period is shorter than some critical length. Gibberellins can substitute for the long-day requirement in some species, showing an interaction with light.

59. (d) : Thigmotropism involves nastic movements resulting from touch. It occurs in tendrils which coil around support and help the plant in climbing.

Phototropism is a paratonic movement in response to unidirectional light stimulus.

Chemotropism is a directional paratonic movement that occurs in response to a chemical stimulus.

60. (a) : Plants have the capacity of changing their position, in response to external or internal stimuli which are known as plant movements. The movements which occur due to internal stimuli are called autonomic movements and those that occur due to external stimuli are called paratonic movements.

Nepenthes (pitcher plant) is an insectivorous plant. In this the leaf lamina is modified to form a pitcher and leaf apex forms a coloured lid. When the insect enter the pitcher it is an external stimuli, so the closure of the lid is paratonic movement.

61. (b) : Auxin is a growth promoting phytohormone. It moves mainly from the apical to the basal end (basipetally). This type of unidirectional transport is termed polar transport. Auxin is the only plant growth hormone known to be transported polarly. Recently it has been recognized that a significant amount of auxin transport also occur acropetally (from basal end to the apical end) in the root.

62. (d) : Decapitating a growing plant means removing shoot apex of the plant. Auxin, a growth promoting phytohormone present in apex inhibits the growth of axillary buds so that only the apex continues to grow. When the apex containing auxin is removed or decapitation is done, then axillary buds show their growth, this is because the apical dominance is removed. This practice of removal of apical dominance is applied in tea gardens, hedges, rose gardens etc.

63. (d) : *Refer to answer 62.*

64. (a) : Richmond and Lang, 1967 observed that degradation of protein and chlorophyll was delayed in the detached leaves, if there was cytokinin in the medium. The senescence in the detached leaves was controlled by cytokinin first by keeping the stomata open thus allowing more CO_2 to enter. This suppresses the action of ethylene which promotes senescence.

65. (d) : Abscisic acid is a hormone which is produced during adverse environmental condition. It also causes the closure of stomata under conditions of water stress as also under high concentration of CO_2 in the guard cells. ABA plays an important role in plants during water stress and drought conditions.

The concentration of ABA increases in the leaves of plants facing such stresses, hence it is called as a stress hormone.

66. (b) : Klinostat is used to study growth movements. Klinostat comprises a disc with pot which are rotated by an axial rod with the help of a motor. Auxin get uniformly distributed on all sides and, hence the stem grows horizontally forward.

67. (b) : Abscisic acid is produced during water stress that brings stomatal closure. Abscisic acid is a stress hormone and it is produced during water scarcity, when the transpiration rate exceeds absorption, the plant faces water stress condition. As a result, incipient wilting occurs. Under water stress condition ABA increases which induces stomatal closure.

68. (d) : In several plants, particularly bienniales and perennials, light does not seem to be the only factor controlling the process of flowering. Temperature, particularly the low temperature treatment induce flowering. Vernalization means ability of low temperature to convert winter cereal into spring cereal as a result of satisfaction of their low temperature requirement.

69. (c) : In artificial ripening of banana, uncontrolled application of ethylene gas may cause over ripening of banana. It can be prevented from over-ripening by dipping in ascorbic acid solution.

70. (d) : According to Thimann and co-workers, auxin is responsible for the dominance of apical bud. The apical dominance is due to interaction between auxin and cytokinin. If the auxin concentration is higher than cytokinin, the apical bud will dominate the growth.

71. (b) : No flowering takes place if the dark period is less than the critical day length. The flowering is inhibited if weak intensity of light is given during the dark period. If the dark period is interrupted mid way by even a single flash of light, no flowering takes place. If this flash is given in the beginning or near the end of the dark phase, they produce flowers.

72. (c) : *Refer to answer 64.*

73. (c) : Ethylene is a hormone which is used for ripening of fruit. In case of unripe banana, it can be made to ripe before proper time if they are kept in ethylene atmosphere. Uncontrolled application of this gas may spoil the fruits. Ethylene is produced in mature but unripe fruits and then it initiates a chain of reactions that finally lead to ripening.

74. (a) : Absisic acid is a hormone produced during adverse environmental condition. It also causes the closure of stomata under conditions of water stress as also under high concentration of CO_2 in the guard cells. Abscisic acid inhibits the K^+ uptake by guard cells and promotes the leakage of malic acid. It results in reduction of osmotically active solutes so that the guard cells become flaccid and stomata get closed.

75. (a) : In vascular plants especially the taller ones, if the apical bud is intact and growing of the lateral bud remains suppressed, removal of apical bud causes fast growth of lateral buds. This influence of apical bud in suppressing the growth of lateral buds is termed as apical dominance.
Indole-3-acetic acid (IAA) is a natural auxin which is responsible for apical dominance.
GA is Giberrellic acid causes rapid elongation growth.
ABA (abscisic acid) is a powerful growth inhibitor.
Florigen is a chemical involved in flowering.

76. (c) : Chailakhyan in 1937 gave the view that flower hormone namely florigen is synthesized in the leaves under favourable photoperiodic conditions. This hormone is transmitted to the growing point where the flowering occurs.

77. (a) : *Refer to answer 59.*

78. (c) : Cytokinin has a very specific effect on cell division (cytokinesis), hence the name cytokinin. They contain kinetin and related compound generally called as kinins chemically, cytokinins are degradation product of adenine, ATP, NAD and NADP. Cytokinins are essential for cytokinesis though chromosome doubling can occur in their absence. Cytokinins bring about division even in permanent cells.

79. (a) : Auxins are well known to promote elongation of stem and coleoptile. However when exogenous auxin is given to intact plants this is not observed because the required amount of auxin is already present in plants. When the apex of shoot is removed, then the exogenous application of auxin promotes growth, this clearly indicates that growing apex, having meristematic cells, is the site where endogenous auxins are present in sufficient amount, once the apex is removed the source of auxin is also removed.

80. (d) : Growth hormones or phytohormones are defined as organic substances which are synthesized in minute quantities in one part of the plant body and transported to another part where they influence specific physiological processes. Phytohormones are chemical substances which are synthesized by plants and are naturally occurring.

81. (b) : Before a leaf fall, a special zone of cells is formed at the base of the pedicel or petiole. This zone is called as abscission zone. It is delimited by a protection layer on the stem side and a separation layer on the organ side. The leaf is ultimately separated and phenomenon is called abscission. ABA is also a growth inhibitor. It regulates the dormancy of seeds and buds perhaps by inhibiting the growth process. The ABA level decreases in the whole seed as their dormancy is broken.

82. (c) : Auxin regulates some of the important plant growth movements like photoropism and geotropism. Phototropism means growth of plants in response to light and geotropism means growth of plants towards gravity.

83. (c) : Nyctinastic leaf movement is not related to auxin level. It is a movement of leaves of many species from nearly horizontal leaves during the day and nearly vertical at night. This movement are controlled by biological clock, while the bending of shoot towards light, movement of root towards soil and movement of sunflower head tracking the sun are the conditions related to auxins.

84. (c) : Gibberellin is a hormone that replaces vernalisation. Vernalization is a period of cold treatment for plants, usually perennials or trees. Some plants won't bloom without it. In vernalization plants are exposed to low temperature in order to stimulate flowering or to enhance seed production. The biennials form their vegetative body in the first year. Then they pass through a winter season and then produce flowers and fruits in the second year. By exogenous application of gibberellins many biennials can be induced to behave as annuals and they no more require the natural chilling treatment for their flowering.

85. (d) : Cytokinins delay senescence of leaves and other organs by mobilisation of nutrients. Abscissic acid promotes abscission of flowers and fruits. Its excessive presence stops protein and RNA synthesis in the leaves and hence stimulates their senescence.

86. (b) : Mowing grass lawn facilitates better maintenance because of removal of apical dominance and stimulation of intercalary meristem.

87. (c) : Stem elongation takes place in the absence of light due to etiolation. But uptake of minerals, uptake of water and ascent of sap all this process are related to photosynthesis which takes place only in the presence of light.

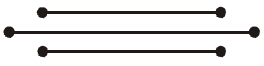
88. (b) : Cytokinin are plant growth hormones which are basic in nature. Cytokinins induce formation of new leaves chloroplasts in leaves, which inturn keeps the leaves green for a longer duration of time. Cytokinins applied to marketed vegetables can keep them fresh for several days. Shelf life of cut shoots and flowers is prolonged by employing the hormones.

89. (a) : Gibberellins promote seed germination. Gibberellins are weakly acidic growth hormones having ring structure and which cause cell elongation of intact plants in general and increased internodal length of genetically dwarfed plants. Giberellins are synthesized in the apical shoot buds, root tips and developing seeds.

During seed germination, especially of cereals gibberrellin stimulates the production of some messenger RNAs and then hydrolytic enzymes like amylases, lipases, proteases. The enzymes solubilize the reserve food of the seed.

90. (c) : Phytochrome is a photoreceptor molecule which mediates several developmental and morphogenetic responses of plants to light. This is called photoperiodism. Borthwick, Hendicks and Parker in 1952, discovered phytochrome, which is a pigment that received light and existed in two inter convertible forms: active form and inactive form.

91. (b) : *Refer to answer 49.*



Chapter 16

Digestion and Absorption

1. Which cells of 'Crypts of Lieberkuhn' secrete antibacterial lysozyme?
(a) Paneth cells (b) Zymogen cells
(c) Kupffer cells (d) Argentaffin cells
(NEET 2017)

2. Which of the following options best represents the enzyme composition of pancreatic juice?
(a) Amylase, Pepsin, Trypsinogen, Maltase
(b) Peptidase, Amylase, Pepsin, Rennin
(c) Lipase, Amylase, Trypsinogen, Procarboxypeptidase
(d) Amylase, Peptidase, Trypsinogen, Rennin
(NEET 2017)

3. A baby boy aged two years is admitted to play school and passes through a dental check-up. The dentist observed that the boy had twenty teeth. Which teeth were absent?
(a) Canines (b) Pre-molars
(c) Molars (d) Incisors
(NEET 2017)

4. Which hormones do stimulate the production of pancreatic juice and bicarbonate?
(a) Angiotensin and epinephrine
(b) Gastrin and insulin
(c) Cholecystokinin and secretin
(d) Insulin and glucagon
(NEET-II 2016)

5. Which of the following guards the opening of hepatopancreatic duct into the duodenum?
(a) Pyloric sphincter (b) Sphincter of Oddi
(c) Semilunar valve (d) Ileocaecal valve
(NEET-I 2016)

6. In the stomach, gastric acid is secreted by the
(a) peptic cells
(b) acidic cells
(c) gastrin secreting cells
(d) parietal cells. (*NEET-I 2016*)

7. The enzyme that is not present in succus entericus is
(a) nucleosidase (b) lipase
(c) maltase (d) nuclease. *(2015)*

8. The primary dentition in human differs from permanent dentition in not having one of the following type of teeth.
(a) Molars (b) Incisors
(c) Canines (d) Premolars
(2015)

9. Gastric juice of infants contains
(a) pepsinogen, lipase, rennin
(b) amylase, rennin, pepsinogen
(c) maltase, pepsinogen, rennin
(d) nuclease, pepsinogen, lipase.
(2015 Cancelled)

10. Which of the following statements is not correct?
(a) Oxyntic cells are present in the mucosa of stomach and secrete HCl.
(b) Acini are present in the pancreas and secrete carboxypeptidase.
(c) Brunner's glands are present in the submucosa of stomach and secrete pepsinogen.
(d) Goblet cells are present in the mucosa of intestine and secrete mucus.
(2015 Cancelled)

11. The initial step in the digestion of milk in humans is carried out by
(a) lipase (b) trypsin
(c) rennin (d) pepsin.
(2014)

12. Fructose is absorbed into the blood through mucosa cells of intestine by the process called
(a) active transport
(b) facilitated transport
(c) simple diffusion
(d) co-transport mechanism. *(2014)*

13. Select the correct match of the digested products in humans given in column I with their absorption site and mechanism in column II.

	Column I	Column II
(a)	Glycerol, fatty acids	Duodenum, move as chylomicrons
(b)	Cholesterol, maltose	Large intestine, active absorption
(c)	Glycine, glucose	Small intestine, active absorption
(d)	Fructose, Na^+	Small intestine, passive absorption

(NEET 2013)

14. A healthy person eats the following diet- 5 gm raw sugar, 4 gm albumin, 10 gm pure buffalo ghee adultrated with 2 gm vegetable ghee (hydrogenated vegetable oil) and 5 gm lignin. How many calories he is likely to get?
(a) 126 (b) 164
(c) 112 (d) 144
(Karnataka NEET 2013)

15. Which enzymes are likely to act on the baked potatoes eaten by a man, starting from the mouth and as it moves down the alimentary canal?
(a) Pancreatic amylase → Salivary amylase → Lipases
(b) Disaccharidase like maltase → Lipases → Nucleases
(c) Salivary amylase → Pancreatic amylase → Disaccharidases
(d) Salivary maltase → Carboxy peptidase → Trypsinogen
(Karnataka NEET 2013)

16. Anxiety and eating spicy food together in an otherwise normal human, may lead to
(a) indigestion (b) jaundice
(c) diarrhoea (d) vomiting.
(2012)

17. For its activity, carboxypeptidase requires
(a) zinc (b) iron
(c) niacin (d) copper.
(Mains 2012)

18. Where do certain symbiotic microorganisms normally occur in human body?
(a) Caecum
(b) Oral lining and tongue surface
(c) Vermiform appendix and rectum
(d) Duodenum *(Mains 2012)*

19. Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of
(a) epiglottis (b) diaphragm
(c) neck (d) tongue. *(2011)*

20. The purplish red pigment rhodopsin contained in the rods type of photoreceptor cells of the human eye, is a derivative of
(a) vitamin B_1 (b) vitamin C
(c) vitamin D (d) vitamin A. *(2011)*

21. One of the constituents of the pancreatic juice which is poured into the duodenum in humans is
(a) trypsinogen (b) chymotrypsin
(c) trypsin (d) enterokinase.
(Mains 2011)

22. Which one of the following correctly represents the normal adult human dental formula?
(a) $\frac{3}{3}, \frac{1}{1}, \frac{3}{2}, \frac{1}{1}$ (b) $\frac{2}{2}, \frac{1}{1}, \frac{3}{2}, \frac{3}{3}$
(c) $\frac{2}{2}, \frac{1}{1}, \frac{2}{2}, \frac{3}{3}$ (d) $\frac{3}{3}, \frac{1}{1}, \frac{3}{3}, \frac{3}{3}$
(Mains 2011)

23. Carrier ions like Na^+ facilitate the absorption of substances like
(a) amino acids and glucose
(b) glucose and fatty acids
(c) fatty acids and glycerol
(d) fructose and some amino acids. *(2010)*

24. If for some reason our goblet cells are non-functional, this will adversely affect
(a) production of somatostatin
(b) secretion of sebum from the sebaceous glands
(c) maturation of sperms
(d) smooth movement of food down the intestine. *(2010)*

25. If for some reason the parietal cells of the gut epithelium become partially non-functional, what is likely to happen?
(a) The pancreatic enzymes and specially the trypsin and lipase will not work efficiently.
(b) The pH of stomach will fall abruptly.
(c) Steapsin will be more effective.
(d) Proteins will not be adequately hydrolysed by pepsin into proteoses and peptones.
(Mains 2010)

26. Jaundice is a disorder of
(a) excretory system (b) skin and eyes
(c) digestive system (d) circulatoy system.
(Mains 2010)

27. When breast feeding is replaced by less nutritive food low in proteins and calories; the infants below the age of one year are likely to suffer from
(a) rickets (b) kwashiorkor
(c) pellagra (d) marasmus.
(2009)

28. A young infant may be feeding entirely on mother's milk which is white in colour but the stools which the infant passes out is quite yellowish. What is this yellow colour due to?
(a) Bile pigments passed through bile juice
(b) Undigested milk protein casein
(c) Pancreatic juice poured into duodenum
(d) Intestinal juice *(2009)*

29. Which one of the following statements is true regarding digestion and absorption of food in humans?
(a) Fructose and amino acids are absorbed through intestinal mucosa with the help of carrier ions like Na^+.
(b) Chylomicrons are small lipoprotein particles that are transported from intestine into blood capillaries.
(c) About 60% of starch is hydrolysed by salivary amylase in our mouth.
(d) Oxyntic cells in our stomach secrete the proenzyme pepsinogen. *(2009)*

30. Which one of the following pairs of food components in humans reaches the stomach totally undigested ?
(a) Starch and fat
(b) Fat and cellulose
(c) Starch and cellulose
(d) Protein and starch *(2009)*

31. Which one of the following is the correct matching of the site of action on the given substrate, the enzyme acting upon it and the end product?
(a) Small intestine : Proteins $\xrightarrow{\text{Pepsin}}$ amino acids
(b) Stomach : Fats $\xrightarrow{\text{Lipase}}$ micelles
(c) Duodenum : Triglycerides $\xrightarrow{\text{Trypsin}}$ monoglycerides
(d) Small intestine : Starch $\xrightarrow{\alpha\text{-Amylase}}$ disaccharide (maltose)
(2008)

32. What will happen if the secretion of parietal cells of gastric glands is blocked with an inhibitor?
(a) In the absence of HCl secretion, inactive pepsinogen is not converted into the active enzyme pepsin.
(b) Enterokinase will not be released from the duodenal mucosa and so trypsinogen is not converted to trypsin.
(c) Gastric juice will be deficient in chymosin.
(d) Gastric juice will be deficient in pepsinogen. *(2008)*

33. Which one of the following is a fat-soluble vitamin and its related deficiency disease?
(a) Retinol - Xerophthalmia
(b) Cobalamine - Beri-beri
(c) Calciferol - Pellagra
(d) Ascorbic acid - Scurvy *(2007)*

34. Examination of blood of a person suspected of having anaemia shows large, immature, nucleated erythrocytes without haemoglobin. Supplementing his diet with which of the following is likely to alleviate his symptoms?
(a) Iron compounds
(b) Thiamine
(c) Folic acid and cobalamine
(d) Riboflavin *(2006)*

35. Secretin and cholecystokinin are digestive hormones. They are secreted in
(a) pyloric stomach (b) duodenum
(c) ileum (d) oesophagus.
(*2005*)

36. Epithelial cells of the intestine involved in food absorption have on their surface
(a) pinocytic vesicles
(b) microvilli
(c) zymogen granules
(d) phagocytic vesicles. *(2005)*

37. A patient is generally advised to specially consume more meat, lentils, milk and eggs in diet only when he suffers from
(a) scurvy (b) kwashiorkar
(c) rickets (d) anaemia. *(2005)*

38. Which group of three of the following five statements (1-5) contain all three correct statements regarding beri-beri?
1. A crippling disease prevalent among the native population of sub-Saharan Africa
2. A deficiency disease caused by lack of thiamine (vitamin B_1)

3. A nutritional disorder in infants and young children when the diet is persistently deficient in essential protein
4. Occurs in those countries where the staple diet is polished rice
5. The symptoms are pain from neuritis, paralysis, muscle wasting, progressive oedema, mental deterioration and finally heart failure.

(a) 2, 4 and 5 (b) 1, 2 and 4
(c) 1, 3 and 5 (d) 2, 3 and 5 *(2005)*

39. The richest sources of vitamin B_{12} are
(a) goat's liver and *Spirulina*
(b) chocolate and green gram
(c) rice and hen's egg
(d) carrot and chicken's breast. *(2004)*

40. Duodenum has characteristic Brunner's gland which secrete two hormones called
(a) kinase, estrogen
(b) secretin, cholecystokinin
(c) prolactin, parathormone
(d) estradiol, progesterone. *(2004)*

41. Which one of the following pairs is not correctly matched?
(a) Vitamin B_{12} - Pernicious anaemia
(b) Vitamin B_6 - Convulsions
(c) Vitamin B_1 - Beri-beri
(d) Vitamin B_2 - Pellagra *(2004)*

42. Which one of the following pairs is not correctly matched ?
(a) Vitamin C - Scurvy
(b) Vitamin B_2 - Pellagra
(c) Vitamin B_{12} - Pernicious anaemia
(d) Vitamin B_6 - Beri-beri *(2003)*

43. During prolonged fastings, in what sequence are the following organic compounds used up by the body ?
(a) First carbohydrates, next fats and lastly proteins
(b) First fats, next carbohydrates and lastly proteins
(c) First carbohydrates, next proteins and lastly lipids
(d) First proteins, next lipids and lastly carbohydrates *(2003)*

44. Stool of a person is whitish grey coloured due to malfunction of which of the following organ?
(a) Pancreas (b) Spleen
(c) Kidney (d) Liver *(2002)*

45. Hydrolytic enzymes which act on low pH are called as
(a) proteases (b) α-amylases
(c) hydrolases (d) peroxidases. *(2002)*

46. Continuous bleeding from an injured part of body is due to deficiency of
(a) vitamin A (b) vitamin B
(c) vitamin K (d) vitamin E. *(2002)*

47. Which one of the following is correctly matched?
(a) Vitamin E - Tocopherol
(b) Vitamin D - Riboflavin
(c) Vitamin B - Calciferol
(d) Vitamin A - Thiamine *(2001)*

48. Essential amino acid is
(a) phenylalanine (b) glycine
(c) aspartic acid (d) serine. *(2000)*

49. Which food should be eaten during deficiency of rhodopsin in eyes?
(a) Carrot and ripe papayas
(b) Guava, banana
(c) Mango and potato
(d) None of the above *(2000)*

50. In mammals milk is digested by the action of
(a) rennin (b) amylase
(c) intestinal bacteria (d) invertase. *(2000)*

51. A person who is eating boiled potato, his food contains the component
(a) cellulose which is digested by cellulase
(b) starch which is not digested
(c) lactose which is not digested
(d) DNA which can be digested by pancreatic DNase. *(2000)*

52. Which part of body secretes the hormone secretin?
(a) Stomach (b) Oesophagus
(c) Ileum (d) Duodenum *(1999)*

53. To which of the following families do folic acid and pantothenic acid belong?
(a) Vitamin C (b) Vitamin B complex
(c) Vitamin K (d) Vitamin A *(1999)*

54. Which of the following is mismatched?
(a) Vitamin A - Xerophthalmia
(b) Vitamin D - Rickets
(c) Vitamin K - Beri-beri
(d) Vitamin C - Scurvy *(1999)*

55. Which of the following carries glucose from digestive tract to liver?
(a) Pulmonary vein (b) Hepatic artery
(c) Hepatic portal vein (d) None of these
(1999)

56. Brunner's glands are present in
(a) stomach (b) oesophagus
(c) ileum (d) duodenum. *(1999)*

57. Which one of the following is a protein deficiency disease?
(a) Kwashiorkar (b) Night blindness
(c) Eczema (d) Cirrhosis *(1998)*

58. The layer of cells that secrete enamel of tooth is
(a) osteoblast (b) odontoblast
(c) dentoblast (d) ameloblast.
(1998)

59. Which one of the factors are required for the maturation of erythrocytes ?
(a) Vitamin B_{12} (b) Vitamin C
(c) Vitamin D (d) Vitamin A
(1998)

60. In vertebrates, lacteals are found in
(a) oesophagous (b) ear
(c) ileum (d) ischium. *(1998)*

61. Which one of the following vitamins can be synthesized by bacteria inside the gut?
(a) D (b) K
(c) B_1 (d) C *(1997)*

62. If pancreas is removed, the compound which remain undigested is
(a) proteins (b) carbohydrates
(c) fats (d) all of these.
(1997)

63. What is common among amylase, rennin and trypsin?
(a) These are produced in stomach.
(b) These act at a pH lower than 7.
(c) These all are proteins.
(d) These all are proteolytic enzymes. *(1997)*

64. Choose the correct enzyme - substrate pair.
(a) Carbohydrate - Lipase
(b) Maltase - Lactose
(c) Rennin - Caesin
(d) Protein - Amylase *(1996)*

65. Pellagra disease is caused by the deficiency of
(a) niacin (b) tocopherol
(c) riboflavin (d) folic acid. *(1996)*

66. High cholesterol patients are advised to use
(a) ghee, butter and oils
(b) groundnut oil, margarine and vegetable oils
(c) fatty oil and butter
(d) cheese, dalda and ghee. (*1996*)

67. The haemorrhagic disease of new born is caused due to the deficiency of
(a) vitamin K (b) vitamin B_{12}
(c) vitamin A (d) vitamin B_1.
(1995)

68. A polysaccharide which is synthesized and stored in liver cells is
(a) arabinose (b) glycogen
(c) lactose (d) galactose. *(1995)*

69. The vitamin C or ascorbic acid prevents
(a) scurvy (b) antibody synthesis
(c) rickets (d) pellagra. *(1995)*

70. Calcium deficiency in the body occurs in the absence of
(a) vitamin C (b) vitamin D
(c) vitamin B (d) vitamin E. *(1994)*

71. Which of the following is the function of enterogastrone?
(a) It inhibits the secretion of gastric juice.
(b) It stimulates the secretion of digestive juices in the stomach.
(c) It stimulates the flow of pancreatic juice.
(d) It regulates the flow of bile. *(1994)*

72. Prolonged deficiency of nicotinic acid causes
(a) pellagra (b) xerophthalmia
(c) osteomalacia (d) anaemia.
(1994)

73. Which of the following is correct pairing of site of action and substrate of rennin?
(a) Mouth - Starch
(b) Small intestine - Protein
(c) Stomach - Casein
(d) Stomach - Fat *(1994)*

74. Which of the following pair is characterised by swollen lips, thick pigmented skin of hands and legs and irritability?
(a) Thiamine – Beri-beri
(b) Protein – Kwashiorkor
(c) Nicotinamide – Pellagra
(d) Iodine – Goitre *(1993)*

75. Most of the fat digestion occurs in
(a) rectum (b) stomach
(c) duodenum (d) small intestine.
(1993)

76. Vitamin K is required for
(a) change of prothrombin into thrombin
(b) synthesis of prothrombin
(c) change of fibrinogen to fibrin
(d) formation of thromboplastin. *(1993)*

77. Secretion of gastric juice is stopped by
(a) gastrin
(b) pancreozymin
(c) cholecystokinin
(d) enterogastrone. *(1993)*

78. Kupffer's cells occur in
(a) spleen (b) kidney
(c) brain (d) liver. *(1993)*

79. Brunner's glands occur in
(a) submucosa of duodenum
(b) submucosa of stomach
(c) mucosa of oesophagus
(d) mucosa of ileum. *(1992)*

80. Pancreas produces
(a) three digestive enzymes and one hormone
(b) three types of digestive enzymes and two hormones
(c) two digestive enzymes and one hormone
(d) three digestive enzymes and no hormone. *(1991)*

81. Where is protein digestion accomplished?
(a) stomach (b) ileum
(c) rectum (d) duodenum. *(1991)*

82. Pancreatic juice and hormones of pancreas are produced by
(a) same cells
(b) same cells at different times
(c) statment is wrong
(d) different cells. *(1990)*

83. In man the zymogen or chief cells are mainly found in
(a) cardiac part of stomach
(b) pyloric part of stomach
(c) duodenum
(d) fundic part of stomach. *(1990)*

84. Emulsification of fat is carried out by
(a) bile pigments (b) bile salts
(c) HCl (d) pancreatic juice. *(1990)*

85. Secretin stimulates production of
(a) saliva (b) gastric juice
(c) bile (d) pancreatic juice. *(1990)*

86. Release of pancreatic juice is stimulated by
(a) enterokinase (b) cholecystokinin
(c) trypsinogen (d) secretin. *(1989)*

87. Wharton's duct is associated with
(a) sublingual salivary gland
(b) parotid salivary gland
(c) submaxillary salivary gland
(d) Brunner's glands. *(1988)*

88. Duct leading from parotid gland and opening into vestibule is
(a) Haversian duct (b) Stenson's duct
(c) Wolffian duct (d) infra-orbital duct. *(1988)*

89. Lamina propria is connected with
(a) acini (b) liver
(c) Graafian follicle (d) intestine. *(1988)*

Answer Key

1.	(a)	**2.**	(c)	**3.**	(b)	**4.**	(c)	**5.**	(b)	**6.**	(d)	**7.**	(d)	**8.**	(d)	**9.**	(a)	**10.**	(c)
11.	(c)	**12.**	(b)	**13.**	(c)	**14.**	(d)	**15.**	(c)	**16.**	(a)	**17.**	(a)	**18.**	(a)	**19.**	(a)	**20.**	(d)
21.	(a)	**22.**	(c)	**23.**	(a)	**24.**	(d)	**25.**	(d)	**26.**	(c)	**27.**	(d)	**28.**	(a)	**29.**	(a)	**30.**	(b)
31.	(d)	**32.**	(a)	**33.**	(a)	**34.**	(c)	**35.**	(b)	**36.**	(b)	**37.**	(b)	**38.**	(a)	**39.**	(a)	**40.**	(b)
41.	(d)	**42.**	(b,d)	**43.**	(a)	**44.**	(d)	**45.**	(a)	**46.**	(c)	**47.**	(a)	**48.**	(a)	**49.**	(a)	**50.**	(a)
51.	(d)	**52.**	(d)	**53.**	(b)	**54.**	(c)	**55.**	(c)	**56.**	(d)	**57.**	(a)	**58.**	(d)	**59.**	(a)	**60.**	(c)
61.	(c)	**62.**	(d)	**63.**	(c)	**64.**	(c)	**65.**	(a)	**66.**	(b)	**67.**	(a)	**68.**	(b)	**69.**	(a)	**70.**	(b)
71.	(a)	**72.**	(a)	**73.**	(c)	**74.**	(c)	**75.**	(d)	**76.**	(b)	**77.**	(d)	**78.**	(d)	**79.**	(a)	**80.**	(b)
81.	(b)	**82.**	(d)	**83.**	(d)	**84.**	(b)	**85.**	(d)	**86.**	(b,d)	**87.**	(c)	**88.**	(b)	**89.**	(d)		

EXPLANATIONS

1. (a) : Paneth cells, present in the bottom of crypts of Lieberkuhn, are rich in zinc and contain acidophilic granules. There is evidence that these cells secrete antibacterial lysozyme. Zymogen cells or peptic cells are present in stomach and secrete pepsinogen. Kupffer cells are present in liver. They are phagocytic in nature and engulf disease causing microorganisms, dead cells, etc. Argentaffin cells, found in crypts of Lieberkuhn, synthesise hormone secretin and 5-hydroxytryptamine.

2. (c) : The pancreatic juice contains sodium bicarbonate, three proenzymes; trypsinogen, chymotrypsinogen and procarboxypeptidase and some enzymes such as elastase, pancreatic α-amylase, DNase, RNase and pancreatic lipase. It helps in the digestion of starch, proteins, fats and nucleic acids.

3. (b) : Boy aged two years will have milk teeth. Milk teeth of man include 8 incisors, 4 canines, 8 molar. Premolars are absent.

4. (c) : Cholecystokinin pancreozymin (CCK-PZ) is a hormone secreted from small intestine. It stimulates the gall bladder to release bile and pancreas to secrete and release digestive enzymes in the pancreatic juice. Hormone secretin is secreted from duodenum and releases bicarbonates in the pancreatic juice. It also increases secretion of bile and decreases gastric secretion and motility.

5. (b) : The sphincter of Oddi is a muscular valve that controls the flow of digestive juices (bile and pancreatic juice) through the hepatopancreatic duct into the duodenum.

6. (d) : Parietal cells are large cells present on the side walls of the gastric glands. They lie against the basement membrane. They secrete hydrochloric acid and Castle's intrinsic gastric factor that helps in the absorption of vitamin B_{12} in the ileum.

7. (d) : Succus entericus or intestinal juice (pH = 7.8) refers to the secretion of glands of small intestine. It contains many enzymes *viz* maltase, isomaltase, lipase, lactase, α-dextrinase, enterokinase, aminopeptidase, nucleotidase, nucleosidase, etc., for the digestion of carbohydrates, proteins, fats, nucleic acids etc. Enzyme nuclease is not a digestive enzyme. It is not present in any digestive juice.

8. (d) : Milk/primary teeth of man include 8 incisors, 4 canines and 8 molars (premolars are absent). Molars of milk teeth are shed off and premolars of permanent teeth take their place. The permanent teeth are 8 incisors, 4 canines, 8 premolars and 12 molars. Thus 12 teeth (8 premolars and 4 molars) are monophyodont (teeth which grow only once in life). Dental formulae of milk teeth and permanent teeth of human are given below.

$$\frac{2120}{2120} \times 2 = 20 \qquad \frac{2123}{2123} \times 2 = 32$$

Milk teeth Permanent teeth

9. (a) : The secretion of the cells of the gastric glands form gastric juice with pH 2 to 3.7. It contains two proenzymes, pepsinogen and prorennin and enzyme gastric lipase, mucous and hydrochloric acid. Rennin (chymosin) is responsible for clotting milk by acting on soluble milk protein caseinogen, and converting it into insoluble casein. This ensures that milk remains in stomach long enough to be acted on by protein digesting enzymes. Rennin's concentration is highest in young mammals (as their primary diet is milk) which reduces gradually with age.

10. (c) : The Brunner's glands are branched tubular glands which occur only in the duodenum. They secrete alkaline watery fluid, a little enzyme and mucus. They open into the crypts of Lieberkuhn.

11. (c) : Rennin is secreted by peptic cells present in epithelium of gastric glands. It is found in the gastric juice of human beings during infancy and in calf. In adults gastric juice is devoid of rennin. It converts milk protein casein into paracasein, leading to milk coagulation.

12. (b) : Fructose and mannose are absorbed through facilitated diffusion that is by the help of the carrier molecule. It is along the concentration gradient (higher concentration to low concentration).

13. (c) : Glycerol and fatty acids are absorbed in jejunum by diffusion into intestinal cells where they are converted into chylomicrons. Cholesterol is also absorbed by simple diffusion in small intestine. Maltose is broken into glucose and galactose which are absorbed by active transport into small intestine. Fructose is absorbed by facilitated diffusion. Amino acids are also absorbed in small intestine, some by active transport and some by facilitated diffusion.

14. (d) : Physiological value is the energy produced by 1 gm of food on oxidation in the body. For carbohydrates it is 4.0 Kcal/g, for proteins it is 4.0 Kcal/g and it is 9.0 Kcal/g for fats. Lignin is a

fibre that is present in plant cells but it does not produce energy. Hence,
5 g raw sugar will yield $5 \times 4.0 = 20.0$ Kcal
4 g albumin will yield $4 \times 4.0 = 16.0$ Kcal
(10 + 2) g of fat will yield $12 \times 9.0 = 108.0$ Kcal
Total yield = 144 Kcal.

15. (c) : Baked potatoes consist of starch which is a polysaccharide.

In oral cavity, the food is mixed with saliva. The saliva contains an enzyme called salivary amylase (also called ptyalin) which converts starch into maltose, isomaltose and small dextrins. Salivary amylase is activated in the saliva by the chloride ions.

$$\text{Starch} \xrightarrow[\text{amylase}]{\text{Salivary}} \text{Maltose} + \text{Isomaltose} + \alpha\text{- Dextrins}$$

The pancreatic juice (present in small intestine) contains starch digesting enzyme, called pancreatic amylase which converts starch into maltose, isomaltose and α-dextrins.

$$\text{Starch} \xrightarrow[\alpha\text{-amylase}]{\text{Pancreatic}} \text{Maltose} + \text{Isomaltose} + \alpha\text{- Dextrins}$$

Further, disaccharidases such as maltase (present in intestinal juice in small intestine) breakdown disaccharides such as maltose into (monosaccharides) or simpler sugars.

16. (a) : Indigestion is the condition in which the food is not properly digested leading to a feeling of fullness. The causes of indigestion are inadequate enzyme secretion, anxiety, food poisoning, over eating and spicy food.

17. (a) : Carboxypeptidase is an enzyme synthesized in pancreas and secreted into small intestine. It contains Zn (II) ions as a metal ion cofactor. This enzyme helps in protein digestion and becomes active in alkaline medium. It is mainly involved in the conversion of large peptides or polypeptides into dipeptides and amino acids.

18. (a)

19. (a) : This coughing would have been due to improper movement of epiglottis. Epiglottis is present in the laryngopharynx, which is the lowest part of pharynx. Laryngopharynx possess two apertures - anterior slit-like glottis and posterior gullet. Glottis leads into trachea or wind pipe, which is closed by bilobed leaf-like cartilage, the epiglottis, during the swallowing of food-bolus. Hence, during eating one may suddenly coughs due to opening of epiglottis and movement of some food particles in the trachea.

20. (d) : Vitamin A (retinol) is a fat-soluble vitamin that cannot be synthesized by mammals and other vertebrates and must be provided in the diet. It is a constituent of the visual pigment rhodopsin. Deficiency affects the eyes, causing night blindness.

21. (a) : Duodenum follows the stomach. It is somewhat C-shaped and about 25 cm. long. It receives the hepatopancreatic ampulla of the hepatopancreatic duct formed by the union of bile duct (from liver) and pancreatic duct (from pancreas) and whose opening is guarded by sphincter of Oddi. Pancreatic juice contains proenzymes—trypsinogen, chymotrypsinogen and procarboxypeptidase. In the presence of enterokinase (a protease of intestinal juice), inactive trypsinogen is converted to active trypsin. Trypsin then activates chymotrypsinogen and procarboxypeptidase into chymotrypsin and carboxypeptidase respectively. This enables simultaneous action of all pancreatic proteases for a rapid digestion of proteins. The bile provides alkaline medium for various reactions.

22. (c) : An adult human has 32 permanent teeth which are of four different types (heterodont dentition) namely, incisors (I), canine (C), premolars (PM) and molars (M). Arrangement of teeth in each half of the upper and lower jaw in the order I, C, PM, M is represented by a dental formula which in human is $\frac{2123}{2123}$.

23. (a) : The absorption of glucose and amino acids is mediated by carrier ions like Na^+. The concentration of Na^+ is higher in the intestinal lumen compared to mucosal cells. Na^+, therefore moves into the cells along its concentration gradient and simultaneously glucose is transported into the intestinal cells. Thus Na^+ diffuses into the cell and it drags glucose along with it. The intestinal Na^+ gradient is the immediate energy source. The mechanism for transport of amino acid is same as glucose.

Fructose absorption does not require energy and is independent of Na^+ transport.

24. (d) : The intestinal mucosal epithelium has goblet cells which secrete mucus. The mucus lubricates the food for an easy passage. Thus, if for some reason goblet cells become non-functional, it will adversely affect smooth movement of food down the intestine. It along with bicarbonates from the pancreas also protects the intestinal mucosa from acid as well as provide an alkaline medium for enzymatic activities.

25. (d) : Parietal or oxyntic cells secrete HCl (due to which pH of stomach is highly acidic) and intrinsic factor. Parietal glands also secrete pepsinogen to which hydrochloric acid acts to convert it into pepsin.

Pepsin in return causes digestion of protein. If parietal cells become non-functional it will directly affect protein digestion.

26. (c) : Jaundice is a disorder in which skin and eyes turn yellow due to the deposition of bile pigment. This happens when bile made in the liver fails to reach the intestine due to obstruction of the bile duct. As a result, the bile is absorbed into the blood instead of going to the duodenum and cause yellowing of eyes and skin.

27. (d) : Marasmus is common in infants under one year of age. It develops due to deficiency of proteins and calories. It can be cured by providing adequate proteins, fats and carbohydrates.

28. (a) : The yellow colour is due to the presence of bile pigments (bilirubin-yellow). Bile pigments are excretory products. Bile is a bitter-tasting greenish-yellow alkaline fluid produced by the liver, stored in the gall bladder, and secreted into the duodenum of vertebrates. It assists the digestion and absorption of fats by the action of bile salts, which chemically reduce fatty substances and decrease the surface tension of fat droplets so that they are broken down and emulsified.

29. (a) : Glucose and galactose are absorbed by active transport. Sodium pump of the cell membrane helps in it active take up. Fructose is absorbed by facilitated diffusion that involves a specific transmembrane carrier. Amino acids are absorbed by active transport coupled with active sodium transport. They also enter the blood stream.

30. (b) : Saliva contains no lipase. The stomach also lacks any fat-emulsifying agents. Fat is largely digested in the small intestine. Cellulose is not digested in human beings.

31. (d) : In small intestine the food meets two juices : pancreatic and intestinal juice. Pancreatic juice contains a carbohydrase, named pancreatic α amylase. This enzyme hydrolyses more starch and glycogen to dextrin and the latter to double sugar, maltose and isomaltose and 'limit' dextrins.

$$\text{Starch and glycogen} \xrightarrow[\text{amylase}]{\text{Pancreatic}} \text{maltose} + \text{isomaltose} + \text{'Limit' dextrins}$$

32. (a) : The parietal or acid or oxyntic cells of gastric glands secrete HCl (hydrochloric acid). In the presence of HCl, pepsinogen (proenzyme) which is an inactive precursor of pepsin enzyme, gets converted to an active form, *i.e.*, pepsin. The activated pepsin by autocatalysis activates more pepsinogen to pepsin. This pepsin enzyme is the principle protease or proteolytic enzyme of the stomach.

$$\underset{\text{(Inactive form)}}{\text{Pepsinogen}} \xrightarrow{\text{HCl}} \underset{\text{(Active form)}}{\text{Pepsin}}$$

So, in the absence of HCl secretion, inactive pepsinogen is not converted into the active enzyme pepsin.

33. (a) : Retinol (vitamin A) and calciferol are fat soluble vitamins but the pellagra is not the deficient disease of calciferol. Vitamin A cannot be synthesized by mammals and other vertebrates and must be provided in the diet. Green plants contain precursors of the vitamin, notably carotenes, that are converted to vitamin A in the intestinal wall and liver. The aldehyde derivative of vitamin A, *retinal*, is a constituent of the visual pigment rhodopsin. Deficiency affects the eyes, causing night blindness, xerophthalmia (dryness and thickening of the cornea), and eventually total blindness.

Pellagra is caused by the deficiency of vitamin B_3 or nicotinic acid or niacin.

Cobalamine and ascorbic acid (vitamin C) are water soluble vitamins. They are generally found together in the same foods with the exception of B_{12} (cobalamine). The deficient disorders related to cobalamine, vitamin C and calciferol are –

Cobalamine – Pernicious anaemia

Ascorbic acid (vitamin C) – Scurvy

Calciferol (vitamin D) – Rickets (in children) and osteomalacia in adults.

Beri-beri is caused by the deficiency of vitamin B_1 (Thiamine).

34. (c) : Anaemia is not a disease. It is a symptom of various diseases which may result from excessive blood loss, excessive blood cell destruction, or decreased blood cell formation. Folic acid is a part of coenzymes for protein and nucleic acid metabolism and is essential for growth and formation of RBCs. Its deficiency leads to anaemia, failure of RBCs to mature and sprue. Vitamin B_{12} or cyanocobalamin acts as a coenzyme for nucleic acid metabolism and is essential for formation of RBCs and myelin formation. Its deficiency leads to Pernicious (injurious) anaemia and malformation of RBCs.

35. (b) : Brunner's glands are present in the duodenum region of small intestine. They secretes two hormones secretin and cholecystokinin. Secretin is secreted by cells in the duodenum when they are exposed to the acidic contents of the emptying stomach. It stimulates the exocrine portion of the pancreas to secrete bicarbonate into the pancreatic

fluid (thus neutralizing the acidity of the intestinal contents).

Cholecystokinin (CCK), a mixture of peptides, is secreted by cells in the duodenum when they are exposed to food. It acts–

- on the gall bladder stimulating it to contract and force its contents of bile into the intestine.
- on the pancreas stimulating the release of pancreatic digestive enzymes into the pancreatic fluid.

CCK also acts on vagal neurons leading back to the medulla oblongata which give a satiety signal (*i.e.*, "that's enough food for now").

36. (b) : Microvilli are countless minute, closely - set projections from the free surface of the mucosal cells of the intestine. There may be about 500 microvilli on each cell. These are meant to increase the absorptive surface area of the intestine. Pinocytic vesicles are involved in intake of extracellular fluid. Phagocytic vesicles are involved in engulfing of large solid particles. Zymogen granules contain proteolytic enzymes in an inactive form.

37. (b) : Kwashiorkar is caused due to the deficiency of protein and meat, lentils, milk and eggs are rich sources of protein. Scurvy is caused due to deficiency of vitamin C whose sources are citrus fruit, tomatoes, peppers, leafy green vegetables. Deficiency of vitamin D (sources - milk, egg yolk and liver) leads to rickets. Anaemia is caused due to deficiency of folic acid (sources - yeast, liver, fish, green vegetables) or vitamin B_{12} (sources - liver, eggs, meat, fish) or iron (egg yolk, spinach).

38. (a) : Beri-beri which is caused due to the deficiency of vitamin B_1, is characterized by pain from neuritis, paralysis, muscle wasting, oedema, mental deterioration and finally heart failure. It occurs in those countries (coastal districts of A.P.) where the diet is based on polished rice, which lacks the thiamine-rich seed coat.

39. (a) : Goat's liver and *Spirulina* (a cyanobacterium) are the richest sources of vitamin B_{12}. Other sources are eggs, meat, fish etc.

40. (b) : *Refer to answer 35.*

41. (d) : Deficiency of vitamin B_2 leads to inflammation of eyes, sores on the lips and skin diseases. Pellagra is caused due to deficiency of nicotinic acid or vitamin B_3. It is characterised by dermatitis (skin inflammation), diarrhoea and dementia (nervous disorder).

42. (b, d)

43. (a) : During prolonged fasting, first carbohydrates are used up then fats and proteins are used at the last. Carbohydrate and fat metabolism can easily produce energy than protein and they follow a more or less simpler pathway to enter into TCA cycle. When all carbohydrates of the body are used up then fats are converted into carbohydrates and when all fats are used up then ultimately proteins of the body are converted into carbohydrates to be used up by the body.

44. (d) : Bilirubin and biliverdin are the pigments present in the bile juice secreted from liver. They provide yellowish brown colour to the stool. So, malfunction of liver leads to appearance of whitish grey stool.

45. (a) : Stomach has low pH due to secretion of HCl. Protease, an enzyme for digesting protein acts in low pH *i.e.* in stomach. Amylase is a starch (carbohydrate) digesting enzyme and carbohydrate digestion does not occur in stomach. All digestive enzymes are hydrolases. Peroxidase is an iron containing enzyme, found mainly in plants but also present in leucocytes and milk, that catalyses the dehydrogenation (oxidation) of various substances in the presence of hydrogen peroxide.

46. (c) : Vitamin K is necessary for the synthesis of prothrombin in the liver. Prothrombin is a factor which is required for blood clotting. Deficiency of vitamin K leads to slow rate of blood clotting. Vitamin A deficiency leads to night blindness, xerophthalmia and retarded growth. Vitamin B deficiency causes beri-beri, pellagra, anaemia etc. Deficiency of vitamin E leads to destruction of RBCs.

47. (a) : Vitamin E is known as tocopherol. It prevents breakage of red blood cells, may act as an antioxidant, prevents oxidation of certain materials and maintains normal membrane structure. Vitamin D and Vitamin A are known as calciferol and retinol respectively.

48. (a) : Essential amino acids are those amino acids that must be ingested in food for survival as they are not synthesized in the body. There are 7 essential amino acids. Glycine, aspartic acid and serine are non-essential amino acids as they can be synthesized in the body.

49. (a) : Deficiency of rhodopsin in eyes occurs due to deficiency of vitamin A. Carrot and ripe papayas are rich sources of vitamin A so these should be eaten in deficiency of rhodopsin in eye.

50. (a) : Rennin is the enzyme secreted by stomach. It hydrolyzes the soluble milk protein casein into paracasein and whey protein. Paracasein is

spontaneously precipitated in the presence of calcium as insoluble calcium paracaseinate, forming coagulated milk. Amylase degrade starch, glycogen and other polysaccharides. Plants contain both α and β-amylases found in pancreatic juice and also in saliva. Intestinal becteria help by digesting cellulose. Invertase acts on sucrose.

51. (d) : Boiled potatoes do not contain lactose; and cellulose which is present is not digested in man as he lacks cellulase. Starch is the major food component which is present in boiled potato and is broken down into maltose and isomaltose due to salivary amylase and is hence digested. DNA is broken down into purines, pyrimidines and sugars by pancreatic nuclease (such as DNase).

52. (d) : *Refer to answer 35.*

53. (b) : Vitamin B complex is a group of water soluble vitamins that characteristically serve as components of coenzymes. Plant and many micro-organisms can manufacture B-vitamins but dietary sources are essential for most animals. Heat and light tend to destroy B vitamins. The vitamin B complex consists of 8 different components - B_1, B_2, B_3, pantothenic acid, B_6, folic acid, biotin and B_{12}. Pantothenic acid functions as a part of coenzyme A in cell respiration while folic acid functions as part of coenzymes in protein and nucleic acid metabolism.

54. (c) : Deficiency of vitamin K causes haemorrhage, which is characterized by profuse bleeding. Beri beri is caused due to deficiency of vitamin B_1.

55. (c) : A system of veins leading from the digestive tract to capillaries in the liver of a vertebrate is known as hepatic portal system. Thus, absorbed products of digestion (except fat) go straight to the liver and not to the heart. Pulmonary vein conveys oxygenated blood from the lungs to the left atrium of the heart. Hepatic artery supply blood to the liver.

56. (d) : Brunner's glands are branched tubular glands and are confined to the duodenum. They secrete alkaline watery fluid that neutralizes the acidic chyme leaving the stomach, a little enzyme and mucus. They are named after swiss anatomist J.C. von Brunner.

57. (a) : Kwashiorkar is a protein deficiency disease. Its symptoms are underweight, stunted growth, poor brain development, loss of appetite, anaemia, protuding belly, slender legs and bulging eyes. Night blindness is the inability to see in dimlight or at night. It occurs due to deficiency of vitamin A. Eczema is a common itchy skin disease characterized by reddening and vesicle formation. Cirrhosis is a condition in which the liver responds to injury or death of some of its cell by producing interlacing strands of fibrous tissue between which are nodules of regenerating cells.

58. (d) : Tooth is mainly made of ivory like substance called dentine. In crown part of the tooth, dentine is covered by enamel (hardest substance in the body). Enamel is smooth, white being rich in minerals containing calcium, especially apatite and secreted by cells of ectodermal origin called ameloblasts of the oral epithelium and protects the underlying dentine of the tooth. The pulp cavity of tooth is lined by dentine forming cells called odontoblasts. Osteoblasts are the bone forming cells.

59. (a) : Vitamin B_{12} (also called cyanocobalamine) is essential for the formation and maturation of erythrocytes. Vitamin B_{12} is manufactured only by microorganisms and natural sources are entirely of animal origin. One form of vitamin B_{12} functions as a coenzyme in a number of reactions, including the oxidation of fatty acids and the synthesis of DNA. It also works in conjunction with folic acid in the synthesis of the amino acid methionine and it is required for normal production of red blood cells. Vitamin A is required for maintenance of epithelia, growth and is a part of visual pigments. Vitamin C play a role in collagen formation. Vitamin D facilitates absorption of calcium and phosphorus by intestine and their retention in the body and deposition in bones.

60. (c) : Ileum is the part of small intestine. Its mucosa is raised into numerous microscopic projections called the villi. The villi contain a minute blind ended lymph vessel lacteals. From the lacteals, the lipoprotein chylomicrons are carried into the blood stream directly *via* thoracic lymphatic duct.

61. (c) : Vitamin B_1 is synthesized by symbiotic bacteria living inside the gut. This is evidenced by the fact that vitamin B deficiency occurs on taking antibiotics which in addition to killing harmful bacteria also kill useful bacteria forming vitamin B_1.

62. (d) : Pancreas secretes pancreatic juice that acts on all type of foods. It contains pancreatic amylase for the digestion of carbohydrates; trypsinogen, chymotrypsinogen and procarboxypeptidases for the digestion of proteins, pancreatic lipase for the digestion of fats and nuclease for nucleic acid.

63. (c) : Amylase, rennin and trypsin are enzymes and as all enzymes are proteins so these three are also proteins.

64. (c) : Rennin is the enzyme that acts on casein which is a milk protein. It is secreted by the gastric glands in an inactive form prorennin which is activated by HCl. Rennin converts caesinogen into calcium paracaesinate in the presence of calcium ions. This ensures that milk remains in the stomach as long as possible. The largest amount of rennin are present in the stomach of young mammals. Carbohydrate, maltose and protein are acted upon by carbohydrase, maltase and protease respectively.

65. (a) : Niacin (nicotinic acid) is a vitamin that acts as a part of coenzymes (NAD, NADP) which serve as hydrogen acceptors and donors for many enzymes. Its deficiency in the body causes pellagra which is characterized by dermatitis (skin inflammation), diarrhoea and dementia (nervous disorder). Deficiency of tocopherol (vitamin E) leads to destruction of RBCs. Deficiency of riboflavin (vitamin B_2) causes inflammation of eyes, sores on the lips and skin diseases. Folic acid deficiency leads to anaemia and failure of RBCs to mature.

66. (b) : Cholesterol is a fat like material (a sterol) present in the blood and most tissues especially nervous tissue. Cholesterol is synthesized in the body from acetate, mainly in the liver and blood concentration is normally 140-300 mg/100 ml. It can exists as a free sterol or esterified with a long chain fatty acid. High cholesterol is harmful for the body. So, high cholesterol patients are advised to take groundnut oil, margarine and vegetable oils, as these contain polyunsaturated fatty acids that contain less cholesterol in them.

67. (a) : Haemorrhagic disease is characterized by profuse bleeding in the newborn. Deficiency of vitamin K, an anti-haemorrhagic factor causes delayed blood clotting in case of injuries.

68. (b) : The polysaccharide which is synthesized and stored in the liver is glycogen. When there is a need of energy in the body, the glycogen is converted into glucose which is released into the blood to be reached to the target cell.

69. (a) : Scurvy is characterized by bleeding gums and swollen joints as well as decreased resistance to common cold. This occurs due to the deficiency of vitamin C. Vitamin C is a water soluble vitamin with antioxidant properties that is essential in maintaining healthy connective tissues and the integrity of cell walls. It is essential for the synthesis of collagen. Rickets and pellagra are caused due to deficiency of vitamin D and vitamin B_3 respectively in the body.

70. (b) : Calcium is an important constituents of bones and teeth. It is present in the blood at a concentration of about 10 mg/100 ml, being maintained at this level by hormones - calcitonin and parathyroid hormone. Ca absorption is enhanced by vitamin D. Thus, deficiency of vitamin D hampers Ca absorption resulting in conditions such as rickets, osteoporosis and osteomalacia. A deficiency of calcium in the blood may lead to tetany.

71. (a) : Enterogastrone hormone is released from duodenum and it slows gastric contraction to delay emptying of stomach and stops secretion of gastric juice. Enterogastrone is released when the stomach contents pass into the small intestine.

72. (a) : *Refer to answer 65.*

73. (c) : *Refer to answer 64.*

74. (c) : Pellagra is a disease that occurs due to deficiency of vitamin nicotinamide. Its symptoms are swollen lips, diarrohea, thick pigmented skin of hands and legs and nervous disorder (irritability).

75. (d) : Fat is largely digested in the small intestine. Bile salts of the bile break down fat droplets into many small ones by reducing the surface tension of fat droplets. This process is called emulsification. This increases lipase action on fat.

76. (b) : Thromboplastin, a lipoprotein, helps in clot formation. Thromboplastin helps in the formation of an enzyme prothrombinase. This enzyme inactivates heparin and it also converts the inactive plasma protein prothrombin into its active form, thrombin. Both the changes require calcium ions. Thrombin converts fibrinogen molecule to insoluble fibrin. The fibrin monomers polymerize to form long, sticky fibres. The fibrin threads form a fine network over the wound and trap blood corpuscles (RBCs, WBCs, platelets) to form a crust, the clot.

77. (d) : Enterogastrone is secreted by duodenal epithelium and it slows gastric contractions to delay its emptying and also stops secretion of gastric juice. Gastrin stimulates secretion of gastric juice. Cholecystokinin stimulates release of enzymes in pancreatic juice and release of bile from gall bladder. Cholecystokinin is also known as pancreozymin.

78. (d) : Kupffer cells are specialized macrophages that dispose of old blood cells and particulate matter. Kupffer cells, named after Karl Wilhelm von Kupffer

(1829-1902), are found in the liver, attached to the walls of the sinusoids.

79. (a) : *Refer to answer 56.*

80. (b) : Pancreas secretes three types of digestive enzymes trypsinogen, chymotrypsinogen and procarboxypeptidase. These enzymes digest proteins. The two hormones secreted are insulin and glucagon that maintain glucose level in the blood.

81. (b) : Protein digestion starts in the stomach with the action of enzyme pepsin. Then in the duodenum it is carried out by the action of trypsin, chymotrypsin and carboxypeptidases. Then it is done by aminopeptidases and dipeptidases, enterokinases in jejunum and then it ends in the ileum.

82. (d) : The pancreas is a gland organ in the digestive and endocrine systems of vertebrates. It is both exocrine (secreting pancreatic juice containing digestive enzymes) and endocrine (producing several important hormones, including insulin, glucagon, and somatostatin). The beta cells produce insulin, alpha cells produce glucagon and delta cells produce somatostatin. There are two main types of exocrine pancreatic cells, responsible for two main classes of secretions. The centroacinar cells produce bicarbonate ions and basophilic cells secrete digestive enzymes.

83. (d) : Zymogen or chief cells are present in the fundic part of stomach. Chief cells are usually basal in location and secrete gastric digestive enzymes as proenzymes or zymogens; pepsinogen and prorennin.

84. (b) : Bile contains no enzyme, and has no chemical action on food. However, it has salts, namely, sodium glycocholate and sodium taurocholate. These salts reduce the surface tension of large fat droplets and break them into many small ones. This process is called emulsification. They also form thin coating around tiny fat droplets to keep them from coalescing. This increases lipase action on fats.

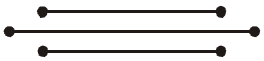
85. (d)

86. (b, d) : Cholecystokinin (in fact it is cholecystokinin pancreozymin) is a hormone which is secreted by small intestine and stimulates pancreas to secrete and release digestive enzymes in pancreatic juice. Secretin causes the release of bicarbonates in the pancreatic juice. Enterokinase is an enzyme that converts trypsinogen (a proenzyme) into trypsin.

87. (c) : The Wharton's ducts are associated with submaxillary glands that lie at the angles of the lower jaw. These ducts open under the tongue. Ducts of Rivinus are associated with sublingual salivary gland. Stenson's duct is associated with parotid gland. Brunner's glands are present in the intestine.

88. (b) : Parotid glands are the largest salivary glands. They lie on the sides of the face, just below and in front of the ears. The parotid ducts, also called Stenson's ducts, open into the vestibule opposite the upper second molar teeth.

89. (d) : It is the middle layer of 3 layered Mucosa (outer muscularis mucosa, middle lamina propria and inner simple colunar epithelium) of intestine. It is made up of a highly vascular connective tissue containing lymphatic nodules.



Chapter
17

Breathing and Exchange of Gases

1. Lungs are made up of air-filled sacs, the alveoli. They do not collapse even after forceful expiration, because of
(a) inspiratory reserve volume
(b) tidal volume
(c) expiratory reserve volume
(d) residual volume. *(NEET 2017)*

2. The partial pressure of oxygen in the alveoli of the lungs is
(a) equal to that in the blood
(b) more than that in the blood
(c) less than that in the blood
(d) less than that of carbon dioxide.
(NEET-II 2016)

3. Lungs do not collapse between breaths and some air always remains in the lungs which can never be expelled because
(a) there is a negative pressure in the lungs
(b) there is a negative intrapleural pressure pulling at the lung walls
(c) there is a positive intrapleural pressure
(d) pressure in the lungs is higher than the atmospheric pressure.
(NEET-II 2016)

4. Reduction in pH of blood will
(a) decrease the affinity of haemoglobin with oxygen
(b) release bicarbonate ions by the liver
(c) reduce the rate of heart beat
(d) reduce the blood supply to the brain.
(NEET-I 2016)

5. Name the chronic respiratory disorder caused mainly by cigarette smoking.
(a) Respiratory acidosis
(b) Respiratory alkalosis
(c) Emphysema
(d) Asthma *(NEET-I 2016)*

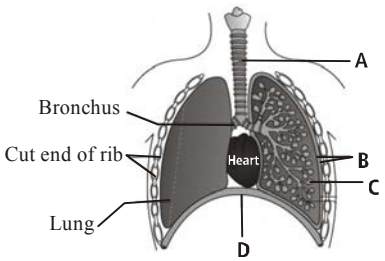
6. Asthma may be attributed to
(a) inflammation of the trachea
(b) accumulation of fluid in the lungs
(c) bacterial infection of the lungs
(d) allergic reaction of the mast cells in the lungs. *(NEET-I 2016)*

7. Name the pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls.
(a) Pneumonia (b) Asthma
(c) Pleurisy (d) Emphysema
(2015)

8. When you hold your breath, which of the following gas changes in blood would first lead to the urge to breathe?
(a) Falling CO_2 concentration
(b) Rising CO_2 and falling O_2 concentration
(c) Falling O_2 concentration
(d) Rising CO_2 concentration
(2015 Cancelled)

9. Approximately seventy percent of carbon-dioxide absorbed by the blood will be transported to the lungs
(a) as bicarbonate ions
(b) in the form of dissolved gas molecules
(c) by binding to R.B.C
(d) as carbamino - haemoglobin. *(2014)*

10. The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option which gives correct identification and main function and / or characteristic.



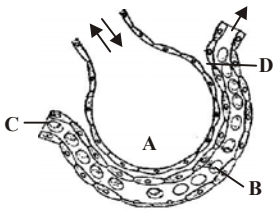
(a) C - Alveoli - Thin walled vascular bag like structures for exchange of gases.

(b) D - Lower end of lungs - Diaphragm pulls it down during inspiration.
(c) A - Trachea - Long tube supported by complete cartilaginous rings for conducting inspired air.
(d) B - Pleural membrane - Surround ribs on both sides to provide cushion against rubbing. *(NEET 2013)*

11. Which one of the following is the correct statement for respiration in humans?
(a) Cigarette smoking may lead to inflammation of bronchi.
(b) Neural signals from pneumotoxic centre in pons region of brain can increase the duration of inspiration.
(c) Workers in grinding and stone-breaking industries may suffer, from lung fibrosis.
(d) About 90% of carbon dioxide (CO_2) is carried by haemoglobin as carbamino-haemoglobin. *(2012)*

12. People who have migrated from the planes to an area adjoining Rohtang Pass about six months back
(a) have more RBCs and their haemoglobin has a lower binding affinity to O_2
(b) are not physically fit to play games like football
(c) suffer from altitude sickness with symptoms like nausea, fatigue, etc.
(d) have the usual RBC count but their haemoglobin has very high binding affinity to O_2. *(2012)*

13. The figure given below shows a small part of human lung where exchange of gases takes place. Select the option which represents labelled part (A, B, C or D) correctly identified along with its function.



(a) C : arterial capillary - passes oxygen to tissues
(b) A : alveolar cavity - main site of exchange of respiratory gases
(c) D : capillary wall - exchange of O_2 and CO_2 takes place here
(d) B : red blood cells - transport of CO_2 mainly. *(2011)*

14. A large proportion of oxygen remains unused in the human blood even after its uptake by the body tissues. This O_2
(a) acts as a reserve during muscular exercise
(b) raises the pCO_2 of blood to 75 mm of Hg.
(c) is enough to keep oxyhaemoglobin saturation at 96%
(d) helps in releasing more O_2 to the epithelial tissues. *(2011)*

15. Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort?
(a) One can breathe out air totally without oxygen.
(b) One can breathe out air through Eustachian tube by closing both nose and mouth.
(c) One can consciously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.
(d) The lungs can be made fully empty by forcefully breathing out all air from them. *(Mains 2011)*

16. Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as
(a) bicarbonate in blood plasma and RBCs
(b) free CO_2 in blood plasma
(c) 70% carbamino-haemoglobin and 30% as bicarbonate
(d) carbamino-haemoglobin in RBCs. *(Mains 2011)*

17. Listed below are four respiratory capacities (i–iv) and four jumbled respiratory volumes of a normal human adult.

Respiratory capacities	**Respiratory volumes**
(i) Residual volume	2500 mL
(ii) Vital capacity	3500 mL
(iii) Inspiratory reserve volume	1200 mL
(iv) Inspiratoy capacity	4500 mL

Which one of the following is the correct matching of two capacities and volumes?
(a) (ii) 2500 mL, (iii) 4500 mL
(b) (iii) 1200 mL, (iv) 2500 mL
(c) (iv) 3500 mL, (i) 1200 mL
(d) (i) 4500 mL, (ii) 3500 mL *(2010)*

18. What is true about RBCs in humans?
(a) They carry about 20-25 percent of CO_2.
(b) They transport 99.5 percent of O_2.

(c) They transport about 80 percent oxygen only and the rest 20 percent of it is transported in dissolved state in blood plasma.
(d) They do not carry CO_2 at all. *(2010)*

19. What is vital capacity of our lungs?
(a) Inspiratory reserve volume *plus* expiratory reserve volume
(b) Total lung capacity *minus* residual volume
(c) Inspiratory reserve volume *plus* tidal volume
(d) Total lung capacity *minus* expiratory reserve volume *(2009)*

20. The haemoglobin of a human foetus
(a) has only 2 protein subunits instead of 4
(b) has a higher affinity for oxygen that that of an adult
(c) has a lower affinity for oxygen than that of the adult
(d) its affinity for oxygen is the same as that of an adult. *(2009)*

21. The majority of carbon dioxide produced by our body cells is transported to the lungs as
(a) attached to haemoglobin
(b) dissolved in the blood
(c) as bicarbonates
(d) as carbonates. *(2006)*

22. Which one of the following statements is incorrect?
(a) The principle of countercurrent flow facilitates efficient respiration in gills of fishes.
(b) The residual air in lungs slightly decreases the efficiency of respiration in mammals.
(c) The presence of non-respiratory air sacs, increases the efficiency of respiration in birds.
(d) In insects, circulating body fluids serve to distribute oxygen to tissues. *(2006)*

23. People living at sea level have around 5 million RBC per cubic millimeter of their blood whereas those living at an altitude to 5400 metres have around 8 million. This is because at high altitude
(a) people eat more nutritive food, therefore more RBCs are formed
(b) people get pollution-free air to breath and more oxygen is available
(c) atmospheric O_2 level is less and hence more RBCs are needed to absorb the required amount of O_2 to survive
(d) there is more UV radiation which enhances RBC production. *(2006)*

24. Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct?
The patient has been inhaling polluted air containing unusually high content of
(a) carbon disulphide (b) chloroform
(c) carbon dioxide (d) carbon monoxide. *(2004)*

25. When CO_2 concentration in blood increases breathing becomes
(a) shallower and slow
(b) there is no effect on breathing
(c) slow and deep
(d) faster and deeper. *(2004)*

26. An average person not doing hard work requires energy per day about
(a) 2000 kcal (b) 1000 kcal
(c) 750 kcal (d) 2800 kcal. *(1999)*

27. Haemoglobin is a type of
(a) carbohydrate
(b) respiratory pigment
(c) vitamin
(d) skin pigment. *(1999)*

28. The respiratory centres, which control inspiration and expiration, are located in
(a) diencephalon (b) medulla oblongata
(c) cerebellum (d) spinal cord. *(1999)*

29. The exchange of gases in the alveoli of the lungs takes place by
(a) passive transport (b) active transport
(c) osmosis (d) simple diffusion. *(1998)*

30. The CO_2 content by volume, in the atmospheric air is about
(a) 3.34% (b) 4%
(c) 0.0314% (d) 0.34%. *(1997)*

31. In lungs, the air is separated from the venous blood through
(a) transitional epithelium + tunica externa of blood vessel
(b) squamous epithelium + endothelium of blood vessel
(c) squamous epithelium + tunica media of blood vessel
(d) none of the above. *(1997)*

32. Which vertebrate organ receives only oxygenated blood?
(a) Spleen (b) Liver
(c) Gill (d) Lung *(1996)*

33. How the transport of O_2 and CO_2 by blood happens?
(a) With the help of WBCs and blood serum
(b) With the help of platelets and corpuscles
(c) With the help of RBCs and blood plasma
(d) With the help of RBCs and WBCs *(1996)*

34. When 1500 ml air is in the lungs, it is called
(a) residual volume
(b) inspiratory reserve volume
(c) vital capacity
(d) tidal volume. *(1996)*

35. Lungs are enclosed in
(a) periosteum (b) perichondrium
(c) pericardium (d) pleural membrane. *(1996)*

36. At high altitude, the RBCs in the human blood will
(a) increase in number
(b) decrease in number
(c) increase in size
(d) decrease in size. *(1995)*

37. Although much CO_2 is carried in blood, yet blood does not become acidic, because
(a) CO_2 is continuously diffused through the tissues and is not allowed to accumulate
(b) in CO_2 transport, blood buffers play an important role
(c) CO_2 is absorbed by the leucocytes
(d) CO_2 combines with water to form H_2CO_3 which is neutralized by $NaCO_3$. *(1995)*

38. The carbon dioxide is transported *via* blood to lungs mostly
(a) in combination with haemoglobin only
(b) dissolved in blood plasma
(c) in the form of bicarbonate ions
(d) as carbaminohaemoglobin and as carbonic acid. *(1995)*

39. The ventilation movements of the lungs in mammals are governed by
(a) muscular walls of lung
(b) diaphragm
(c) costal muscles
(d) both (b) and (c). *(1995)*

40. The respiratory centre which regulates respiration is located in
(a) cerebellum
(b) medulla oblongata
(c) cerebral peduncle
(d) the vagus nerve. *(1994)*

41. Carbon dioxide is transported from tissues to respiratory surface by only
(a) plasma and erythrocytes
(b) plasma
(c) erythrocytes
(d) erythrocytes and leucocytes. *(1993)*

42. The alveolar epithelium in the lung is
(a) nonciliated columnar
(b) nonciliated squamous
(c) ciliated columnar
(d) ciliated squamous. *(1990)*

43. Skin is an accessory organ of respiration in
(a) humans (b) frog
(c) rabbit (d) lizard. *(1990)*

Answer Key

1.	(d)	**2.**	(b)	**3.**	(b)	**4.**	(a)	**5.**	(c)	**6.**	(d)	**7.**	(d)	**8.**	(d)	**9.**	(a)	**10.**	(a)
11.	(c)	**12.**	(a)	**13.**	(b)	**14.**	(a)	**15.**	(c)	**16.**	(a)	**17.**	(c)	**18.**	(a)	**19.**	(b)	**20.**	(b)
21.	(c)	**22.**	(d)	**23.**	(c)	**24.**	(d)	**25.**	(d)	**26.**	(d)	**27.**	(b)	**28.**	(b)	**29.**	(d)	**30.**	(c)
31.	(b)	**32.**	(a)	**33.**	(c)	**34.**	(a)	**35.**	(d)	**36**	(a)	**37.**	(b)	**38.**	(c)	**39.**	(d)	**40.**	(b)
41.	(a)	**42.**	(b)	**43.**	(b)														

EXPLANATIONS

1. (d) : Residual volume is the volume of air which remains in the lungs after the most forceful expiration. This residual air enables the lungs to continue exchange of gases even after maximum exhalation. Due to this, lungs do not collapse even after forceful expiration.

2. (b) : The partial pressure of oxygen in alveolar air is 104mmHg whereas it is 40mmHg in deoxygenated blood and 95mmHg in oxygenated blood.

3. (b) : Intrapleural pressure is the pressure of air within the pleural cavity. Intrapleural pressure is always negative, which acts like a suction to keep the lungs inflated and prevent them from collapsing. The negative intrapleural pressure is due to three main factors: surface tension of the alveolar fluid; elasticity of lungs; elasticity of thoracic wall. Normally, there is a difference between intrapleural and intrapulmonary pressure, which is called transpulmonary pressure. This transpulmonary pressure creates the suction to keep the lungs inflated. If there is no pressure difference, there is no suction and lungs will collapse.

4. (a) : Reduction in pH of blood causes oxygen-haemoglobin dissociation curve to shift to right which indicates dissociation of oxygen from haemoglobin. This decreases affinity of haemoglobin for oxygen.

5. (c) : Emphysema is a chronic obstructive pulmonary disease (COPD) caused due to cigarette smoking. It is an inflation or abnormal distention of the bronchioles or alveolar sacs of the lungs which causes irreversible distension and loss of elasticity of alveoli of the lungs.

6. (d) : Asthma is an allergic condition in which the tissue surrounding the bronchioles of the lungs swell up and compress the bronchioles thus causing difficulty in breathing. This allergy mainly involves IgE antibodies and chemicals like histamine and serotonin from the mast cells.

7. (d) : Emphysema is an inflation or abnormal distension of the bronchioles or alveolar sacs of the lungs. Many of the septa between the alveoli are destroyed and much of the elastic tissue of the lungs is replaced by connective tissue. As the alveolar septa collapse, the surface area for gas exchange is greatly reduced. There is loss of elasticity in the walls of bronchioles or alveolar sacs. As a result the alveolar sacs remain filled with air even after expiration. The exhalation becomes more difficult. The lungs remain inflated. Major causes of emphysema are cigarette smoking and the inhalation of smoke or other toxic substances over a period of time.

8. (d) : Excess CO_2 mainly stimulates the respiratory centre of the brain and increases the inspiratory and expiratory signals to the respiratory muscles. O_2 does not have a significant direct effect on the respiratory centre of the brain in controlling respiration.

9. (a) : About 70% of CO_2 (about 2.5ml per 100 ml. of blood), received by blood from the tissues, enters the RBCs where it reacts with water to form carbonic acid (H_2CO_3).
Carbonic anhydrase, exclusively found in RBCs, speeds up the formation of H_2CO_3 and rapidly converts it back to carbon dioxide and water when blood reaches th lungs. Almost as rapidly as formed, all carbonic acid of RBCs dissociates into hydrogen (H^+) and bicarbonate ions (HCO^-_3).

10. (a) : In the given figure A is trachea. It is supported by incomplete cartilaginous rings which prevent its collapse during inspiration. B is pleural membrane. It encloses lungs. C are alveoli. They are thin walled sacs having extensive network of capillaries for gaseous exchange. D is diaphragm.

11. (c) : In certain industries, especially those involving grinding or stone breaking so much dust is produced that the defense mechanism of the body cannot fully cope with the situation. Long exposure can give rise to inflammation leading to fibrosis (proliferation of fibrous tissues) and thus causing serious lung damage. Workers in such industries should wear protective masks.

12. (a) : Tourists visiting high altitude areas such as Rohtang Pass or Mansarovar, experience altitude sickness. Its symptoms include nausea, fatigue and heart palpitations. This is because in the low atmospheric pressure of high altitudes, the body does not get enough oxygen. But, gradually we get acclimatized and stop experiencing altitude sickness. The body compensates low oxygen availability by increasing red blood cell production, decreasing the binding affinity of haemoglobin and by increasing breathing rate.

13. (b) **14. (a)** **15. (c)**

16. (a) : At the tissue site where partial pressure of CO_2 is high due to catabolism, CO_2 diffuses into blood

(RBCs and plasma) and forms HCO_2^- and H^+. At the alveolar site where pCO_2 is low, the reaction proceeds in the opposite direction leading to the formation of CO_2 and H_2O. Thus, CO_2 trapped as bicarbonate at the tissue level and transported to the alveoli is released out as CO_2.

17. (c) :

Respiratory capacities	Respiratory volumes
Residual volume	1200 mL
Vital capacity	4500 mL
Inspiratory reserve volume	2500 mL
Inspiratory capacity	3500 mL

18. (a) : Blood is the medium of transport for O_2 and CO_2. About 97 percent of O_2 is transported by RBCs in the blood. The remaining 3 percent of O_2 is carried in a dissolved state through the plasma. Nearly 20-25 percent of CO_2 is transported by RBCs whereas 70 percent of it is carried as bicarbonate. About 7 percent of CO_2 is carried in a dissolved state through plasma.

19. (b) : Vital capacity is the amount of air which one can inhale or exhale with maximum effort. It is the sum of tidal volume, inspiratory reserve volume and expiratory reserve volume, while total lung capacity is the total amount of air present in the lungs and the respiratory passage after a maximum inspiration. It is the sum of the vital capacity and the residual volume. TLC = VC + RV. So, vital capacity is also total lung capacity (TLC) – residual volume (RV).

20. (b) : Oxygen is needed for aerobic respiration and diffuses from a region of high to low concentration from the mother's blood to the blood of the foetus. The haemoglobin of the foetus has a higher affinity for oxygen than that of adult haemoglobin and so the efficiency of exchange is increased. Carbon dioxide, a waste product of aerobic respiration diffuses in the opposite direction.

21. (c) : When systemic arterial blood flows through capillaries, carbon dioxide diffuses from the tissues into the blood. Some carbon dioxide is dissolved in the blood. Some carbon dioxide reacts with haemoglobin to form carbaminohaemoglobin. The remaining carbon dioxide is converted to bicarbonate and hydrogen ions. Most carbon dioxide is transported through the blood in the form of bicarbonate ions.

22. (d) : The circulatory system of insects is open, whereby blood (haemolymph), flows freely through the body cavity (haemocoel). There is a dorsal vessel which is closed at the posterior end of the abdomen, and runs forward along the dorsal midline and opens in the head at the anterior portion (aorta). There are several chambers and openings (ostia), along the dorsal vessel where blood enters it through valves. The blood is then pumped forward to the aorta and into the body cavity.Blood contains: water - about 90%; inorganic ions - dissolved salts of Na, K, Ca, Mg; organic molecules - amino acids, sugars for muscle use; blood cells. Haemolymph does not contain an oxygen carrying pigment like Hb, hence, does not assist in respiration.

23. (c) : At high altitudes composition of air remains almost same as at sea level, but density (barometric pressure) of air gradually decreases due to which arterial pO_2 is also decreased (hypoxemia). High altitudes presents with complex conditions to which human body has to acclimatize. Number of red blood cells per unit volume of blood is likely to be higher in a person living at high altitudes. This is in response to the air being less dense at high altitude. More number of red blood cells are needed to trap O_2 from rarefied air having low pO_2 (partial pressure of oxygen).

24. (d) : Carboxyhaemoglobin, a stable compound, is formed when haemoglobin readily combines with carbon monoxide. Carbon monoxide converts iron (II) to iron (III) in its reaction with haemoglobin. In this form haemoglobin does not carry oxygen resulting in its (oxygen) starvation and leads to asphyxiation and in extreme cases to death. The affinity of haemoglobin for CO is 250 times its affinity for O_2 and COHb liberates CO very slowly and also due to that compound the dissociation curve of the remaining HbO_2 shifts to the left, decreasing the amount of O_2 released.

25. (d) : The effect of rising CO_2 tension is to decrease the affinity of Hb for O_2. Thus, when CO_2 concentration in blood increases, breathing becomes faster and deeper.

26. (d) : An average person, not doing hard labour *i.e.*, leading a rather sedentary life, needs about 2800 kcal of energy per day. This is called routine metabolic rate (RMR).

27. (b) : Haemoglobin (Hb) is a conjugated protein. It consists of a basic protein globin joined to a nonprotein group heme. Heme is an iron-porphyrin ring. A mammalian Hb molecule is a complex of 4 heme molecules joined with 4 globin molecules. It is present in RBC, and carries O_2 from the lungs to the tissues and transports CO_2 from the tissues to the lungs.

28. (b) : The respiratory centre is the medulla oblongata, that regulates the rate and depth of breathing. The dorsal group of neurons located in the

dorsal portion of medulla oblongata regulates inspiration and ventral group of neurons located in the ventrolateral part of medulla oblongata regulates both inspiration and expiration.

29. (d) : Diffusion is the net flow of a substance from a region of higher concentration to a region of lower concentration. The exchange of gases between the alveoli and blood in the lung is the result of difference in partial pressure of respiratory gases. The partial pressure of oxygen (pO_2) of the alveolar air is higher than the pO_2 of blood in alveolar capillaries, thus O_2 diffuses rapidly from the alveolar air into the blood of alveolar capillaries. The pCO_2 of blood reaching the alveolar capillaries is higher than the pCO_2 of alveolar air. Therefore, CO_2 into the alveolar air.

30. (c) : The atmosphere (air) is a mixture of several gases. Near the earth's surface it consists of 78% nitrogen, 21% oxygen, 0.93% argon, 0.03% carbon dioxide and small quantities of hydrogen, helium, neon, krypton and traces of many other gases.

31. (b) : In lungs, the air is separated from the venous blood through squamous epithelium and endothelium of blood vessel. As a result, the barriers between the air in an alveolus and the blood in its capillaries is only about 0.5 mm.

32. (a) : Spleen receives only oxygenated blood from the heart through splenic artery. The liver receives a blood supply from two sources. The first is the hepatic artery which delivers oxygenated blood from the general circulation. The second is the hepatic portal vein delivering deoxygenated blood from the small intestine containing nutrients. The blood flows through the liver tissue to the hepatic cells where many metabolic functions take place. The blood drains out of the liver via the hepatic vein. Gill and Lung receive deoxygenated blood as these are the organs where oxygenation of blood takes place.

33. (c) : The transport of O_2 and CO_2 occurs with the help of RBCs and blood plasma. 97% of O_2 is transported by RBCs and 3% of O_2 is carried by plasma. About 7% of CO_2 is transported in plasma and rest by RBCs (23%) by binding with Hb and 70% reacts with water to form carbonic acid in RBCs.

34. (a) : Residual volume is the amount of air that remains in the lungs after forcible expiration. It is about 1500 ml. It enables the lungs to continue exchange of gases even after maximum exhalation or holding the breath. Inspiratory reserve volume is the extra amount of air which can be inhaled forcibly after a normal inspiration. It is about 2000 to 2500 ml. Vital capacity is the amount of air which one can inhale and also exhale with maximum effort. It is about 3.5 - 4.5 litres. Tidal volume (500 ml) is the volume of air normally inspired or expired in one breath without any effort.

35. (d) : Each lung is enclosed in two membranes, the pleura. The inner membrane is called the visceral pleuron and the outer membrane is called parietal pleuron. A very narrow space exists between the two pleura. It is called the pleural cavity and contains a watery fluid called the pleural fluid that lubricates the pleura. Periosteum is the outer membrane of the bone.

Perichondrium is a layer that surrounds the cartilage and pericardium is the membrane that encloses the pericardial cavity, containing the vertebrate heart.

36 (a) : At high altitudes, arterial pO_2 decreases as density of air decreases. Number of RBCs per unit volume of blood is likely to be higher in a person living at high altitudes. More number of RBCs are needed to trap O_2 from air having less O_2.

37. (b) : Buffer is a solution that resists change in pH when an acid or alkali is added or when the solution is diluted. Acidic buffers consists of a weak acid with a salt of the acid. The salt provides the negative ion A, which is the conjugate base of the acid HA. An example is carbonic acid and sodium hydrogen carbonate in which molecules H_2CO_3 and ions HCO_3^- are present. About 70% of CO_2 released combines with water in the RBCs to form carbonic acid. Carbonic acid dissociates into bicarbonate and hydrogen ions. Addition of H^+ ions would make the blood acidic. However, most of the hydrogen ions are neutralized by combination with Hb, forming acid haemoglobin. This reduces the acidity of the blood and also releases additional O_2.

$$HbO_2^- + H^+ \rightleftharpoons HHb + O_2$$

38. (c) : About 70% of CO_2 released diffuses into the plasma and then into the RBCs. Here, it combines with water to form carbonic acid. Carbonic acid dissociates into bicarbonate and hydrogen ions. Hydrogen ions are picked up by proteins and a small amount of bicarbonate ions is transported in the RBCs, whereas most of them diffuse into the plasma to be carried by it. About 7% of CO_2 is transported as dissolved in plasma and 23% of CO_2 combines with Hb to form carbaminohaemoglobin.

$$CO_2 + H_2O \underset{\text{anhydrase}}{\overset{\text{carbonic}}{\rightleftharpoons}} \underset{\text{carbonic acid}}{H_2CO_3}$$

$$H_2CO_3 \rightleftharpoons H^+ + \underset{\text{bicarbonate ion}}{HCO_3^-}$$

39. (d) : The ventilation movements of the lungs in mammals are governed by diaphragm and intercostal muscles (between the ribs). The method is as follows:

During inspiration

Flattening of diaphragm and contraction of intercostal muscles

↓

Volume of thorax increases

↓

Fall of pressure in the thoracic cavity

↓

Air from outside rushes into the lungs *via* nostrils, trachea and bronchi

During expiration

Diaphragm becomes convex and relaxation of external intercostal muscles

↓

Volume of thorax decreases

↓

Rise of pressure in the thoracic cavity

↓

Air from inside rushes through bronchi and trachea and then into lungs and out through nostrils

40. (b) : *Refer to answer 28.*

41. (a) : Carbon dioxide is carried by the blood in three forms : physical solution, bicarbonate ions and carbamino-haemoglobin. A very small amount of carbon dioxide dissolves in the plasma and is carried as a physical solution. About 70% of carbon dioxide released by respiring tissue cells diffuses into the plasma and then into the red blood corpuscles. Here, CO_2 combines with water to form carbonic acid. Carbonic acid dissociates into bicarbonate and hydrogen ions.

42. (b) : In the lung, each alveolar duct opens into a blind chamber, the alveolar sac, or infundibulum. The latter consists of a central passage giving off several small pouches, the alveoli, or air sacs on all sides.The air sacs give the infundibulum the appearance of a small bunch of grapes. The alveoli have a very thin (0.0001 mm thick) wall composed of simple moist, nonciliated, squamous epithelium. The number of alveoli is countless and their surface area enormous. This further accelerates the gaseous exchange in the alveoli.

43. (b) : In addition to lungs, skin is also an organ of respiration in frog. It is practically the only mode of respiration when the frog is under water or hibernating. Skin is richly supplied with blood and is permeable to gases. That is why frogs always stay near water to keep their skin moist. It is further kept moist by secretion of mucus from its glands, and does not become dry out of water.

Chapter
18

Body Fluids and Circulation

1. Adult human RBCs are enucleate. Which of the following statement(s) is/are most appropriate explanation for this feature?
(1) They do not need to reproduce.
(2) They are somatic cells.
(3) They do not metabolise.
(4) All their internal space is available for oxygen transport.
(a) Only (1) (b) (1), (3) and (4)
(c) (2) and (3) (d) Only (4)
(NEET 2017)

2. The hepatic portal vein drains blood to liver from
(a) stomach (b) kidneys
(c) intestine (d) heart.
(NEET 2017)

3. Name the blood cells, whose reduction in number can cause clotting disorder, leading to excessive loss of blood from the body.
(a) Erythrocytes (b) Leucocytes
(c) Neutrophils (d) Thrombocytes
(NEET-II 2016)

4. Serum differs from blood in
(a) lacking globulins
(b) lacking albumins
(c) lacking clotting factors
(d) lacking antibodies. *(NEET-II 2016)*

5. Blood pressure in the pulmonary artery is
(a) more than that in the pulmonary vein
(b) less than that in the venae cavae
(c) same as that in the aorta
(d) more than that in the carotid.
(NEET-I 2016)

6. In mammals, which blood vessel would normally carry largest amount of urea?
(a) Hepatic Vein
(b) Hepatic Portal Vein
(c) Renal Vein
(d) Dorsal Aorta *(NEET-I 2016)*

7. Which one of the following animals has two separate circulatory pathways?
(a) Whale (b) Shark
(c) Frog (d) Lizard *(2015)*

8. Doctors use stethoscope to hear the sounds produced during each cardiac cycle. The second sound is heard when
(a) AV node receives signal from SA node
(b) AV valves open up
(c) Ventricular walls vibrate due to gushing in of blood from atria
(d) Semilunar valves close down after the blood flows into vessels from ventricles. *(2015)*

9. Erythropoiesis starts in
(a) spleen (b) red bone marrow
(c) kidney (d) liver.
(2015 Cancelled)

10. Which one of the following is correct?
(a) Lymph = Plasma + RBC + WBC
(b) Blood = Plasma + RBC + WBC + Platelets
(c) Plasma = Blood – Lymphocytes
(d) Serum = Blood + Fibrinogen
(2015 Cancelled)

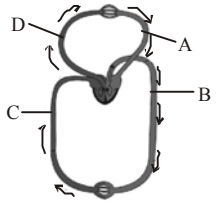
11. Blood pressure in the mammalian aorta is maximum during
(a) systole of the left ventricle
(b) diastole of the right atrium
(c) systole of the left atrium
(d) diastole of the right ventricle.
(2015 Cancelled)

12. Person with blood group AB is considered as universal recipient because he has
(a) both A and B antigens on RBC but no antibodies in the plasma
(b) both A and B antibodies in the plasma
(c) no antigen on RBC and no antibody in the plasma
(d) both A and B antigens in the plasma but no antibodies. *(2014)*

13. How do parasympathetic neural signals affect the working of the heart?
(a) Reduce both heart rate and cardiac output.
(b) Heart rate is increased without affecting the cardiac output.

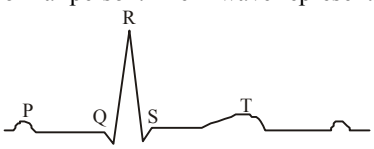
(c) Both heart rate and cardiac output increase.
(d) Heart rate decreases but cardiac output increases. *(2014)*

14. The given figure shows schematic plan of blood circulation in humans with labels A to D. Identify the label and give its functions?



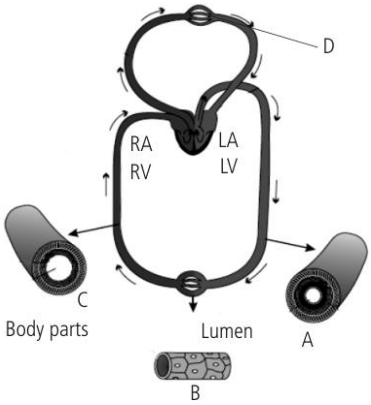
(a) C - Vena cava - takes blood from body parts to right auricle, pCO_2 = 45 mm Hg
(b) D - Dorsal aorta - takes blood from heart to body parts, pO_2 = 95 mm Hg
(c) A - Pulmonary vein - takes impure blood from body parts, pO_2 = 60 mm Hg
(d) B - Pulmonary artery - takes blood from heart to lungs, pO_2 = 90 mm Hg
(*NEET 2013*)

15. The diagram given here is the standard ECG of a normal person. The P-wave represents the



(a) beginning of the systole
(b) end of systole
(c) contraction of both the atria
(d) initiation of the ventricular contraction.
(*NEET 2013*)

16. The figure shows blood circulation in humans with labels A to D. Select the option which gives correct identification of label and functions of the part.



(a) B - Capillary-Thin without muscle layer and wall two cell layers thick
(b) C - Vein-Thin walled and blood flows in jerks/spurts
(c) D - Pulmonary vein-Takes oxygenated blood to heart, pO_2 = 95 mmHg
(d) A - Artery-Thick walled and blood flows evenly (*Karnataka NEET 2013*)

17. The figure shows a human blood cell. Identify it and give its characteristics.

	Blood cell	**Characteristics**
(a)	Basophil	Secretes serotonin, inflammatory response
(b)	B-lymphocyte	Forms about 20% of blood cells involved in immune response
(c)	Neutrophil	Most abundant blood cells, phagocytic
(d)	Monocyte	Life span of 3 days, produces antibodies

(*Karnataka NEET 2013*)

18. A certain road accident patient with unknown blood group needs immediate blood transfusion. His one doctor friend at once offers his blood. What was the blood group of the donor?
(a) Blood group B (b) Blood group AB
(c) Blood group O (d) Blood group A
(2012)

19. Which one of the following human organs is often called the "graveyard" of RBCs?
(a) Gall bladder (b) Kidney
(c) Spleen (d) Liver
(Mains 2012)

20. 'Bundle of His' is a part of which one of the following organs in humans?
(a) Brain (b) Heart
(c) Kidney (d) Pancreas *(2011)*

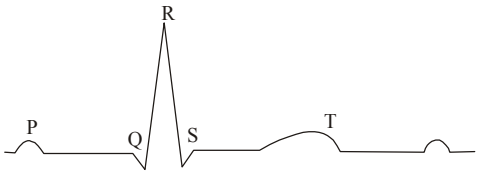
21. Which one of the following plasma proteins is involved in the coagulation of blood?
(a) Albumin (b) Serum amylase
(c) Globulin (d) Fibrinogen
(2011)

22. Arteries are best defined as the vessels which
(a) supply oxygenated blood to the different organs
(b) carry blood away from the heart to different organs
(c) break up into capillaries which reunite to form a vein
(d) carry blood from one visceral organ to another visceral organ. *(2011)*

23. Which one of the following statements is correct regarding blood pressure?
(a) 130/90 mm Hg is considered high and requires treatment.
(b) 100/55 mm Hg is considered an ideal blood pressure.
(c) 105/50 mm Hg makes one very active.
(d) 190/110 mm Hg may harm vital organs like brain and kidney. *(2011)*

24. A person with unknown blood group under ABO system, has suffered much blood loss in an accident and needs immediate blood transfusion. His friend who has valid certificate of his own blood type, offers for blood donation without delay. What would have been the type of blood group of the donor friend?
(a) Type B (b) Type AB
(c) Type O (d) Type A *(2011)*

25. Given below is the ECG of a normal human. Which one of its components is correctly interpreted below?



(a) Complex QRS - one complete pulse
(b) Peak T - initiation of total cardiac contraction
(c) Peak P and peak R together - systolic and diastolic blood pressures
(d) Peak P- initiation of left atrial contraction only *(Mains 2011)*

26. If due to some injury the chordae tendinae of the tricuspid valve of the human heart is partially non-functional, what will be the immediate effect?
(a) The flow of blood into the aorta will be slowed down
(b) The 'pacemaker' will stop working
(c) The blood will tend to flow back into the left atrium
(d) The flow of blood into the pulmonary artery will be reduced *(2010)*

27. Which two of the following changes (i –iv) usually tend to occur in the plain dwellers when they move to high altitudes (3,500 m or more)?
(i) Increase in red blood cell size
(ii) Increase in red blood cell production
(iii) Increased breathing rate
(iv) Increase in thrombocyte count
Changes occurring are
(a) (ii) and (iii) (b) (iii) and (iv)
(c) (i) and (iv) (d) (i) and (ii).
(2010)

28. Fastest distribution of some injectible material/ medicine and with no risk of any kind can be achieved by injecting it into the
(a) muscles (b) arteries
(c) veins (d) lymph vessels.
(Mains 2010)

29. Given below are four statements (i-iv) regarding human blood circulatory system.
(i) Arteries are thick-walled and have narrow lumen as compared to veins.
(ii) Angina is acute chest pain when the blood circulation to the brain is reduced.
(iii) Persons with blood group AB can donate blood to any person with any blood group under ABO system.
(iv) Calcium ions play a very important role in blood clotting.
Which two of the above statements are correct?
(a) (i) and (iv) (b) (i) and (ii)
(c) (ii) and (iii) (d) (iii) and (iv)
(Mains 2010)

30. The haemoglobin content per 100 ml of blood of a normal healthy human adult is
(a) 5 - 11 mg (b) 25 - 30 mg
(c) 17 - 20 mg (d) 12 - 16 mg.
(Mains 2010)

31. There is no DNA in
(a) mature RBCs
(b) a mature spermatozoan
(c) hair root
(d) an enucleated ovum. *(2009)*

32. In a standard ECG which one of the following alphabets is the correct representation of the respective activity of the human heart?

(a) S - start of systole
(b) T - end of diastole
(c) P - depolarisation of the atria
(d) R - repolarisation of ventricles *(2009)*

33. Globulins contained in human blood plasma are primarily involved in
(a) osmotic balance of body fluids
(b) oxygen transport in the blood
(c) clotting of blood
(d) defence mechanisms of body. *(2009)*

34. Compared to blood our lymph has
(a) plasma without proteins
(b) more WBCs and no RBCs
(c) more RBCs and less WBCs
(d) no plasma . *(2009)*

35. In humans, blood passes from the post caval to the diastolic right atrium of heart due to
(a) stimulation of the sino auricular node
(b) pressure difference between the post caval and atrium
(c) pushing open of the venous valves
(d) suction pull. *(2008)*

36. The most active phagocytic white blood cells are
(a) eosinophils and lymphocytes
(b) neutrophils and monocytes
(c) neutrophils and eosinophils
(d) lymphocytes and macrophages. *(2008)*

37. Which type of white blood cells are concerned with the release of histamine and the natural anticoagulant heparin?
(a) Eosinophils (b) Monocytes
(c) Neutrophils (d) Basophils *(2008)*

38. A drop of each of the following, is placed separately on four slides. Which of them will not coagulate?
(a) Blood serum
(b) Sample from the thoracic duct of lymphatic system
(c) Whole blood from pulmonary vein
(d) Blood plasma *(2007)*

39. Which one of the following has an open circulatory system?
(a) *Octopus* (b) *Pheretima*
(c) *Periplaneta* (d) *Hirudinaria* *(2006)*

40. You are required to draw blood from a patient and to keep it in a test tube for analysis of blood corpuscles and plasma. You are also provided with the following four types of test tubes. Which of these you will not use for the purpose?
(a) Test tube containing calcium bicarbonate
(b) Chilled test tube
(c) Test tube containing heparin
(d) Test tube containing sodium oxalate *(2004)*

41. The cardiac pacemaker in a patient fails to function normally. The doctors find that an artificial pacemaker is to be grafted in him. It is likely that it will be grafted at the site of
(a) atrioventricular bundle
(b) Purkinje system
(c) sinuatrial node
(d) atrioventricular node. *(2003)*

42. Bundle of His is a network of
(a) muscle fibres distributed throughout the heart walls
(b) muscle fibres found only in the ventricle wall
(c) nerve fibres distributed in ventricles
(d) nerve fibres found throughout the heart. *(2003)*

43. In the ABO system of blood groups, if both antigens are present but no antibody, the blood group of the individual would be
(a) B (b) O
(c) AB (d) A. *(2003)*

44. Impulse of heart beat originates from
(a) SA node (b) AV node
(c) vagus nerve (d) cardiac nerve. *(2002)*

45. Which of the following statements is true for lymph?
(a) WBC + serum
(b) Blood – RBCs and some proteins
(c) RBCs + WBCs + plasma
(d) RBCs + proteins + platelets *(2002)*

46. What is correct for blood group O?
(a) No antigens but both a and b antibodies are present
(b) A antigen and b antibody present
(c) Antigen and antibody both absent
(d) A and B antigens and a, b antibodies present *(2001)*

47. Difference between pulmonary artery and pulmonary vein is that, the pulmonary artery has
(a) no endothelium (b) valves
(c) thicker walls (d) oxygenated blood. *(2000)*

48. In which point, pulmonary artery is different from pulmonary vein?
(a) Its lumen is broad.
(b) Its wall is thick.
(c) It has valves.
(d) It does not possess endothelium. *(2000)*

49. Which statement is true for WBC?
(a) Non-nucleated
(b) In deficiency, cancer is caused
(c) Manufactured in thymus
(d) Can squeeze through blood capillaries *(2000)*

50. Rate of heart beat is determined by
(a) Purkinje fibres (b) papillary muscles
(c) AV node (d) SA node. *(1999)*

51. Which is the principal cation in the plasma of the blood?
(a) Potassium (b) Magnesium
(c) Calcium (d) Sodium *(1999)*

52. The blood group, with antibody-A and antibody-B is
(a) O (b) B
(c) A (d) AB. *(1999)*

53. The thickening of walls of arteries is called
(a) arteriosclerosis (b) arthritis
(c) aneurysm (d) both (b) and (c). *(1999)*

54. An adult human with average health has systolic and diastolic pressures as
(a) 120 mm Hg and 80 mm Hg
(b) 50 mm Hg and 80 mm Hg
(c) 80 mm Hg and 80 mm Hg
(d) 70 mm Hg and 120 mm Hg. *(1998)*

55. Which of the following is not the main function of lymph glands?
(a) Forming RBCs
(b) Destroying bacteria
(c) Forming WBCs
(d) Forming antibodies *(1998)*

56. Which of the following is agranulocyte?
(a) Basophil (b) Neutrophil
(c) Lymphocyte (d) Eosinophil *(1997)*

57. The life span of human WBC is approximately
(a) between 2 to 3 months
(b) more than 4 months
(c) less than 10 days
(d) between 20 to 30 days. *(1997)*

58. The correct route through which pulse-making impulse travels in the heart is
(a) SA node → Purkinje fibres → bundle of His → AV node → heart muscles
(b) SA node → AV node → bundle of His → Purkinje fibres → heart muscles
(c) AV node → bundle of His → SA node → Purkinje fibres → heart muscles
(d) AV node → SA node → Purkinje fibres → bundle of His → heart muscles *(1995)*

59. The lymph serves to
(a) return the interstitial fluid to the blood
(b) return the WBCs and RBCs to the lymph nodes
(c) transport CO_2 to the lungs
(d) transport O_2 to the brain. *(1995)*

60. In veins, valves are present to check backward flow of blood flowing at
(a) atmospheric pressure
(b) high pressure
(c) low pressure
(d) all of these. *(1995)*

61. The neurogenic heart is the characteristic feature of
(a) humans (b) arthropods
(c) rabbits (d) rats. *(1995)*

62. The heart sound 'dup' is produced when
(a) mitral valve is closed
(b) semi-lunar valves at the base of aorta get closed
(c) tricuspid valve is opened
(d) mitral valve is opened. *(1994)*

63. The pacesetter in the heart is called
(a) sino-atrial node (SAN)
(b) atrio-ventricular node (AVN)
(c) Purkinje fibres
(d) papillary muscle. *(1994)*

64. Blood capillaries are made of
(a) endothelium, connective tissue and muscle fibres
(b) endothelium and muscle fibres
(c) endothelium and connective tissue
(d) endothelium only. *(1993)*

65. Cells formed in bone marrow include
(a) RBC
(b) RBC and leucocytes
(c) leucocytes
(d) lymphocytes. *(1992)*

66. The genotype of B blood group father of an O blood group child is
(a) I^OI^O (b) I^BI^B
(c) I^AI^B (d) I^OI^B. *(1992)*

67. Component of blood responsible for producing antibodies is
(a) thrombocytes (b) monocytes
(c) erythrocytes (d) lymphocytes. *(1992)*

68. Blood group AB has
(a) no antigen
(b) no antibody
(c) neither antigen nor antibody
(d) both antigen and antibody. *(1991)*

69. Carbonic anhydrase occurs in
(a) lymphocytes (b) blood plasma
(c) RBC (d) leucocytes. *(1991)*

70. Wall of blood capillary is formed of
(a) haemocytes (b) parietal cells
(c) endothelial cells (d) oxyntic cells. *(1991)*

71. Splenic artery arises from
(a) anterior mesenteric artery
(b) coeliac artery
(c) posterior mesenteric artery
(d) intestinal artery. *(1991)*

72. A vein possesses a large lumen because
(a) tunica media and tunica externa form a single coat
(b) tunica interna and tunica media form a single coat
(c) tunica interna, tunica media and tunica externa are thin
(d) tunica media is a thin coat. *(1990)*

73. Arteries carry oxygenated blood except
(a) pulmonary (b) cardiac
(c) hepatic (d) systemic. *(1989)*

74. Removal of calcium from freshly collected blood would
(a) cause delayed clotting
(b) prevent clotting
(c) cause immediate clotting
(d) prevent destruction of haemoglobin. *(1989)*

75. A person with blood group A requires blood. The blood group which can be given is
(a) A and B (b) A and AB
(c) A and O (d) A, B, AB and O. *(1989)*

76. Tricuspid valve is found in between
(a) sinus venosus and right auricle
(b) right auricle and right ventricle
(c) left ventricle and left auricle
(d) ventricle and aorta. *(1989)*

77. Lymph differs from blood in possessing
(a) only WBC
(b) more RBC and WBC
(c) more RBC and few WBC
(d) more WBC and few RBC. *(1989)*

78. Presence of RBC in urine is
(a) alkaptonuria (b) urothiasis
(c) hematuria (d) proteinuria. *(1988)*

79. Child death may occur in the marriage of
(a) Rh^+ man and Rh^+ woman
(b) Rh^+ man and Rh^- woman
(c) Rh^- man and Rh^- woman
(d) Rh^- man and Rh^+ woman. *(1988)*

80. Breakdown product of haemoglobin is
(a) bilirubin (b) iron
(c) biliverdin (d) calcium. *(1988)*

81. RBCs do not occur in
(a) frog (b) cow
(c) camel (d) cockroach. *(1988)*

Answer Key

1.	(d)	**2.**	(a,c)	**3.**	(d)	**4.**	(c)	**5.**	(a)	**6.**	(a)	**7.**	(a)	**8.**	(d)	**9.**	(b)	**10.**	(b)
11.	(a)	**12.**	(a)	**13.**	(a)	**14.**	(a)	**15.**	(c)	**16.**	(c)	**17.**	(a)	**18.**	(c)	**19.**	(c)	**20.**	(b)
21.	(d)	**22.**	(b)	**23.**	(d)	**24.**	(c)	**25.**	(a)	**26.**	(d)	**27.**	(a)	**28.**	(c)	**29.**	(a)	**30.**	(d)
31.	(a)	**32.**	(c)	**33.**	(d)	**34.**	(b)	**35.**	(b)	**36.**	(b)	**37.**	(d)	**38.**	(a)	**39.**	(c)	**40.**	(c)
41.	(c)	**42.**	(b)	**43.**	(c)	**44.**	(a)	**45.**	(b)	**46.**	(a)	**47.**	(c)	**48.**	(b)	**49.**	(d)	**50.**	(d)
51.	(d)	**52.**	(a)	**53.**	(a)	**54.**	(a)	**55.**	(a)	**56.**	(c)	**57.**	(c)	**58.**	(b)	**59.**	(a)	**60.**	(c)
61.	(b)	**62.**	(b)	**63.**	(b)	**64.**	(d)	**65.**	(b)	**66.**	(d)	**67.**	(d)	**68.**	(b)	**69.**	(c)	**70.**	(c)
71.	(b)	**72.**	(d)	**73.**	(a)	**74.**	(b)	**75.**	(c)	**76.**	(b)	**77.**	(a)	**78.**	(c)	**79.**	(b)	**80.**	(a,b)
81.	(d)																		

EXPLANATIONS

1. (d) : Red blood cells of adult humans do not have cell organelles including nucleus, Golgi bodies, mitochondria, ribosomes, etc. It increases the surface area of RBCs and enables them to contain more haemoglobin (the oxygen carrying pigment).

2. (a,c) : Blood enters the liver from two sources. From the hepatic artery, it gets oxygenated blood and from the hepatic portal vein, it receives deoxygenated blood. Blood in the hepatic artery comes from the aorta. Blood in the hepatic portal vein comes directly from the intestine containing newly absorbed nutrients, stomach, etc.

3. (d) : Thrombocytes are called blood platelets. They are minute disc-shaped cell fragments in mammalian blood. They are formed as fragments of larger cells found in red bone marrow; they have no nucleus. They play an important role in blood clotting and release thromboxane A_2, serotonin and other chemicals, which cause a chain of events leading to the formation of a plug at the site of the damage, thus preventing further blood loss. A reduction in their number can lead to clotting factors which will lead to excessive loss of blood from the body.

4. (c) : Serum is the fluid that separates from blood plasma on centrifugation. Serum is essentially similar in composition to plasma but lacks fibrinogen and other substances that are used in the coagulation process.

5. (a)

6. (a) : Hepatic vein carries largest amount of urea. Urea is produced in liver. Hepatic vein transports liver's deoxygenated blood to heart for oxygenation.

7. (a) : Whale is a mammal and in mammals, two separate circulatory pathways are found — systemic circulation and pulmonary circulation. Oxygenated and deoxygenated bloods received by the left and right atria respectively pass on to the left and right ventricles. Thus, oxygenated and deoxygenated bloods are not mixed. This is referred to as double circulation.

8. (d) : Second heart sound *i.e.*, *dup* is caused by the closure of the semilunar values and marks the end of ventricular systole.

9. (b) : Erythropoiesis is the formation of red blood cells (erythrocytes) which occurs in the red bone marrow. Proerythroblast is the earliest precursor which gives rise successively to the early erythroblast, intermediate erythroblast and late erythroblast. Then, the nucleus is forced out and a biconcave, enucleated cell called reticulocyte is formed, which is released into blood. In blood, it develops into mature erythrocytes.

10. (b) : Lymph = Plasma + WBC
Plasma = Blood – Cellular components
Serum = Plasma – Clotting factors

11. (a) : The temporary rise in blood pressure during the contraction of the heart is called systolic pressure and the temporary fall in blood pressure during relaxation of the heart is called diastolic pressure. Blood pressure is expressed as the ratio of the systolic pressure over the diastolic pressure. For a healthy resting adult person, the average systolic/diastolic pressures are 120/80 mmHg. Aorta is directly supplied by left ventricle thus, the blood pressure in aorta is highest during systole of left ventricle. During it, left ventricle contracts and pushes blood into aorta.

12. (a) : Individuals with AB blood group have both antigen A and B on their RBCs, and no antibodies for either of the antigen in their plasma. Type O individuals are without A and B antigens on their RBCs, but have antibodies for both these antigens in their plasma. Individuals with blood group AB can receive blood of A, B or O group, while those with blood group O can donate blood to anyone.

13. (a) : A special neural centre in medulla oblongata can moderate the cardiac function through autonomic nervous system (ANS). Neural signals through the sympathetic nerves (part of ANS) can increase the rate of heart beat, the strength of ventricular contraction and thereby the cardiac output. Parasympathetic neural signals (component of ANS) decrease the rate of heart beat, speed of conduction of action potential and thereby the cardiac output.

14. (a) : In the given figure: A is pulmonary vein which brings pure blood from lungs to left atrium, B is dorsal aorta which carries blood from heart to body parts, C is vena cava which carries impure blood from body parts to right auricle, and D is pulmonary artery which takes impure blood from heart to lungs.

15. (c) : In the given diagram the P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole. The T-wave represents the

return of the ventricles from excited to normal state (repolarisation). The end of the T-wave marks the end of systole.

16. (c) : A- Artery : Carries blood from heart to different body parts. It is thick-walled and elastic. The flow of blood in it is intermittent.

B - Capillary : Nutrients, hormones, gases etc. can diffuse into tissue cells through capillaries and *vice versa*. It is thin-walled, and only one layer thick resting on basement membrane.

C - Vein : Brings blood from different body parts to the heart. It is thin-walled and acts as low-resistance conduct for blood flow.

D - Pulmonary vein : Two pulmonary veins from each lung transport the oxygenated blood to the left atrium.

17. (a) : Basophils have nucleus which is three-lobed and have less number of coarse granules. Their granules take basic stain and release heparin, histamine and serotonin.

18. (c) : The blood group was O. The person having O blood group is universal donor. It lacks both antigens 'A' and 'B' thus does not cause agglutination or clumping of blood cells when transfused into person with any of the four blood groups.

19. (c) : Spleen is a vertebrate organ, lying behind the stomach, that is basically a collection of lymphoid tissue. Its functions include producing lymphocytes and destroying foreign particles. It acts as a reservoir for RBCs and can regulate the number in circulation. It is also the site for the breakdown of worn out RBCs and thus is known as graveyard of RBCs.

20. (b) : 'Bundle of His' is a part of heart. A bundle of nodal fibres, atrioventricular bundle (AV bundle), continues from the atrioventricular node (AVN) and passes through the atrioventricular septa. It emerges on the top of the interventricular septum and immediately divides into a right and left bundle, which give rise to minute fibres throughout the ventricular musculature of the respective sides called Purkinje fibres. These fibres along with right and left bundles are known as Bundle of His.

21. (d) : Blood plasma is a faint yellow, slightly alkaline and somewhat viscous fluid. The plasma contains a number of proteins: serum albumin, serum globulins, properdin, prothrombin and fibrinogen. Prothrombin and fibrinogen play a role in blood clotting.

22. (b) : Arteries and veins are main blood vessels. Arteries carry blood from the heart to different body parts. Veins bring blood from different body parts to the heart.

23. (d) : If repeated checks of blood pressure of an individual is 140/90 or higher, it shows hypertension or high blood pressure. It leads to heart diseases and also affects vital organs like brain and kidney.

24. (c) : *Refer to answer 18.*

25. (a) : By counting the number of QRS complexes that occur in a given time period, one can determine the heart beat rate (pulse) of an individual. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction.

26. (d) : Tricuspid valve is the valve in the heart between the right atrium and right ventricle. It consists of three cusps that channel the flow of blood from the atrium to the ventricle. When the right ventricle contracts, forcing blood into the pulmonary artery, the tricuspid valve closes the aperture to the atrium, thereby preventing any backflow of blood. The valve reopens to allow blood to flow from the atrium into the ventricle. Thus, if tricuspid valve is partially non-functional the flow of blood into the pulmonary artery will be reduced.

27. (a) : The body undergoes numerous changes at higher elevation in order to increase oxygen delivery to cells and improve efficiency of oxygen use. The early changes includes increased breathing rate, increased heart rate and fluid shifts. The later changes includes increased red blood cell production, increased 2, 3 DPG production and increased number of capillaries.

28. (c) : Intravenous injection is given for rapid distribution of drugs/substance. Intra-muscular injection is given for producing local effect.

29. (a) : The term angina means chest pain. In this disease enough oxygen does not reach the heart muscles. The patient experiences heart pain usually in front of the chest.

AB blood group person have both antigens A and B, but do not have antibodies in the plasma. Due to the presence of both the antigens, AB blood group person cannot donate blood to anyone. However, the person can receive blood from any blood group as it has no antibodies. Thus, AB blood group is a universal recepient.

30. (d)

31. (a)

32. (c) : *Refer to answer 15.*

33. (d) : Globulins in human blood plasma are primarily involved in defence mechanisms of body. Globulins like immunoglobulins act as antibodies that destroy bacteria, viruses and toxic substances that may enter into the blood from outside.

34. (b) : *Refer to answer 10.*

35. (b) : Due to the pressure difference between the post caval and atrium, the blood passes from the post caval to the diastolic right atrium. Diastolic right atrium has less pressure and post caval has high pressure, thus blood moves from post caval to right atrium.

36. (b) : Phagocytes are cells that are able to engulf and breakdown foreign particles, cell debris and disease producing microorganisms. Neutrophils and monocytes (type of white blood cells) are the most active phagocytic cells.

37. (d) : *Refer to answer 17.*

38. (a) : Blood serum is blood plasma from which the fibrin and clotting factors have been removed by centrifugation or vigorous stirring, so that it cannot clot. Serum containing a specific antibody or antitoxin may be used in the treatment or prevention of certain infections. Such serum is generally derived from a nonhuman mammal (*e.g.,* a horse).

39. (c) : *Periplaneta* has open circulatory system *i.e.,* the blood does not flow in blood vessels but flows in a haemocoel (body cavity). The circulatory systems of all vertebrates, as well as of annelids (for example, earthworms) and cephalopods (squid and *Octopus*) are closed, in which the blood never leaves the system of blood vessels consisting of arteries, capillaries and veins.

40. (c) : Clotting of collected blood can be prevented by -

(i) coating test tubes with silicon (which produce non wettable surface similar in its smoothness to endothelial lining of blood vessels).

(ii) adding chelating agents (includes trisodium citrate, sodium oxalate and sodium EDTA) which remove calcium which is important for blood coagulation, and prevent blood clotting.

(iii) adding heparin, most powerful anticoagulant which acts indirectly by activating plasma antithrombin III. Heparin is effective both *in vivo* and *in vitro* whereas the option a, b and d are effective *in vitro*.

Heparinized blood is not suitable for blood counts (as it alters the shape of RBCs and WBCs which affects blood testing), Fragility testing and complement fixation tests. Hence (c) is the correct answer.

41. (c) : SA (sinoatrial) node is a specialised bundle of neurons located in the upper part of the right atrium of the heart. SA node is the natural cardiac pacemaker from which the heart beat originates. If this system is damaged, it may send non-coordinated impulses to the heart chambers resulting in symptoms like irregular heart rate, tiredness, dizziness and loss of consciousness. As the pacemaker cells create these rhythmical impulse therefore an artificial pacemaker is implanted at the site of SA node to mimic the actions of the node and conducting system and helps to regulate heart beat.

42. (b) : *Refer to answer 20.*

43. (c) : *Refer to answer 12.*

44. (a) : *Refer to answer 41.*

45. (b) : *Refer to answer 10.*

46. (a) : *Refer to answer 12.*

47. (c) : An artery has thick and more elastic wall but its lumen is narrow as compared to vein. Pulmonary artery carries deoxygenated blood from the right ventricle to the lungs for oxygenation. Pulmonary vein carries oxygenated blood from the lungs to the left auricle.

48. (b)

49. (d) : WBCs are the colourless nucleated amoeboid cells that can squeeze through blood capillaries by a process known as diapedsis. The increase in their number causes leukaemia, a cancer. WBCs are of two types, granulocytes (formed in bone marrow) and agranulocytes (formed in bone marrow and thymus).

50. (d) : *Refer to answer 41.*

51. (d) : Blood consists of a watery fluid called plasma. Plasma is a faint yellow, slightly alkaline, viscous fluid. It consists of 90% water, 1% inorganic salts, 7% or 8% proteins and 1% of other substances. The inorganic salts in plasma occur as ions. Sodium is the main cation of plasma and chloride, the main anion. Potassium, calcium and magnesium occur in small amount.

52. (a) : *Refer to answer 12.*

53. (a) : Arteriosclerosis is the hardening of arteries and arterioles due to thickening of the fibrous tissue, and the consequent loss of elasticity. In this disease, calcium salts precipitate with the cholesterol. This calcification ultimately makes the wall of arteries stiff and rigid.

54. (a) : *Refer to answer 11.*

55. (a) : Formation of WBCs, antibodies and destruction of bacteria occur in lymph glands while formation of RBCs occur in bone marrow. Lymph gland is a rounded mass of lymphatic tissue that is surrounded by a capsule of connective tissue. Lymph glands filter lymph (lymphatic fluid), and they store lymphocytes

(white blood cells). They are located along lymphatic vessels. They are also called a lymph node.

56. (c) : Agranulocytes are leucocytes that lack granules in the cytoplasm. They are formed in spleen and lymph nodes and bone marrow. Since lymphocyte does not have granules in their cytoplasm so it is called agranulocyte. Lymphocytes are important in the body's defence and are responsible for immune reactions as the presence of antigens stimulates them to produce antibodies. Another type of agranulocyte is monocyte. The other three are granulocytes which are produced in red bone marrow.

57. (c) : WBCs (also called leucocytes) are rounded or irregular colourless cells with a nucleus. They can change their shape and are capable of amoeboid movement. Leucocytes, formed in lymph nodes and red bone marrow, can produce antibodies and move through the walls of vessels to migrate to the sites of injuries, where they surround and isolate dead tissue, foreign bodies and bacteria. They survive for a few days generally 3-4 days after which they die and get phagocytized in blood, liver and lymph nodes.

58. (b)

59. (a) : Lymph (also called tissue fluid in the intercellular spaces) is the colourless liquid found within the lymphatic system. An important function of lymph is to return interstitial fluid back to the blood. The interstitial fluid is the filtered form of the blood without the cellular components and plasma proteins. It consists of water containing dissolved materials. It receives CO_2, nitrogenous waste products, hormones and other synthetic substances from the tissue cells and enters the lymph capillaries to discharge them into blood.

60. (c) : Veins carry blood at low pressure as compared to blood carried by arteries. Arteries carry blood from the heart whose function is to pump blood at high pressure so that blood can reach each and every part of the body. Veins carry blood from tissues to the heart, so they carry blood at low pressure. Valves are present in the veins to prevent backflow of blood due to force of gravity.

61. (b) : The neurogenic heart is a characteristic feature of most arthropods and some annelids. In this, the heart beat is initiated by a nerve impulse coming from a nerve ganglion situated near the heart. The myogenic heart is a characteristic feature of molluscs and vertebrates. In this, heart beat is initiated by a patch of modified heart muscle itself. So, humans, rabbits and rats have myogenic heart.

62. (b) : *Refer to answer 8.*

63. (b) : AV (atrioventricular) node is a mass of modified heart muscle situated in the lower middle part of the right atrium. It receives the impulse to contract from the SA node *via* the atria and transmits it through the atrioventricular bundles to the ventricles. AV node is called the pacesetter. Here, the impulses are delayed for 0.1 second to ensure that the auricles will contract first and empty fully before the ventricles contract.

64. (d) : The wall of capillaries is very thin (usually less than one micron) and have numerous minute pores and made up of only endothelium. Exchange of material takes place between blood and tissue fluid across the endothelial membrane of capillaries through active diffusion.

65. (b) : In the embryo and foetal stage of vertebrates, RBCs and leucocytes are formed in the bone marrow, lymph nodes, yolk sac, liver, spleen and thymus but after birth they are formed in red bone marrow only.

66. (d)

67. (d) : Lymphocytes have a very large, rounded nucleus and scanty cytoplasm. They are nonmotile and nonphagocytic. They secrete antibodies to destory microbes and their toxins, reject grafts and kill tumour cells. They also help in healing of injuries. Thrombocytes aid in clotting of blood. Monocytes are phagocytic in nature. RBCs transport gases in the body.

68. (b) : *Refer to answer 12.*

69. (c) : During transport of CO_2 in the blood, about 70% of CO_2 released by respiring tissue cells is transported as bicarbonate ions. It diffuses into the plasma and then into the RBCs. Here, CO_2 combines with water to form carbonic acid. This reaction is catalyzed by a zinc containing enzyme carbonic anhydrase. Carbonic acid dissociates into bicarbonate and hydrogen ions. A small amount of bicarbonate ions is transported in the RBCs, whereas most of them diffuse into the plasma to be carried by it.

70. (c) : *Refer to answer 64.*

71. (b) : The splenic artery is the blood vessel that supplies oxygenated blood to the spleen. It branches from the coeliac artery, and follows a course superior to the pancreas. The coeliac artery is the first major branch of the abdominal aorta and branches from the aorta around the level of the T12 vertebra in humans. It is one of three anterior/ midline branches of the abdominal aorta.

72. (d) : Wall of a vein consists of tunic externa, tunica media and tunica interna. All these layers are also present in the wall of artery. However, in the wall of a vein, the elastic membrane of tunica interna is relatively thin, and muscle fibres and elastic fibres in tunica media are fewer. Therefore, a vein has a thinner and less elastic wall but a wider cavity than an artery of the same diameter.

73. (a) : Pulmonary artery carries the blood from the right ventricle of the heart to the lungs for oxygenation so it carries deoxygenated blood.

74. (b) : Thromboplastin, a lipoprotein, helps in clot formation. Thromboplastin helps in the formation of an enzyme prothrombinase. This enzyme inactivates heparin and it also converts the inactive plasma protein prothrombin into its active form, thrombin. Both the changes require calcium ions. Thrombin converts fibrinogen molecule to insoluble fibrin. The fibrin monomers polymerize to form long, sticky fibres. The fibrin threads form a fine network over the wound and trap blood corpuscles (RBCs, WBCs, platelets) to form a crust, the clot. Thus, if calcium is removed from the blood, clotting process will not occur.

75. (c)

76. (b) : *Refer to answer 26.*

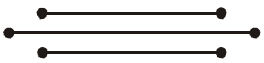
77. (a) : *Refer to answer 10.*

78. (c) : Presence of RBCs in the blood is known as hematuria. Alkaptonuria is the excretion of large amount of alkapton in urine which when comes in contact with light turns black. Proteinuria is the presence of proteins in the blood.

79. (b) : Rh factor plays a crucial role in child's birth born out of a marriage between Rh^- woman and a Rh^+ man. In such a case, the mother becomes sensitive while carrying a first Rh^+ child within her womb. The reason for such sensitivity is that some of the RBCs from the developing embryo get into the blood stream of the mother during development, causing her to produce anti-Rh antibodies. In fact, the first child of such parents is nearly normal and is delivered safely. However, if such a mother gets pregnant again, the subsequent Rh^+ foetuses will be exposed to the anti-Rh antibodies produced by the mother. As a result serious damage to the red blood cells of the developing embryo will occur causing haemolytic disease of the newborn (HDN) or erythroblastosis foetalis. This disease leads to the death of the developing embryo before birth or after parturition.

80. (a, b) : The haemoglobin is broken down into haem *i.e.,* iron and globin protein which is then converted into yellowish substance bilirubin which is extracted by the liver cells from the blood and stored in the form of bile in gall bladder.

81. (d) : RBCs do not occur in the blood of cockroach. The circulatory system of cockroach is of open type. Viscera lie in the haemocoel immersed in blood called haemolymph. The latter consists of colourless plasma and irregular white corpuscles, the leucocytes. There are no blood vessels except aorta that carries blood from the heart to the haemocoel.



Chapter
19

Excretory Products and Their Elimination

1. A decrease in blood pressure/volume will not cause the release of
(a) atrial natriuretic factor
(b) aldosterone
(c) ADH
(d) renin. *(NEET 2017)*

2. Which of the following statements is correct?
(a) The descending limb of loop of Henle is impermeable to water.
(b) The ascending limb of loop of Henle is permeable to water.
(c) The descending limb of loop of Henle is permeable to electrolytes.
(d) The ascending limb of loop of Henle is impermeable to water.
(NEET 2017)

3. The part of nephron involved in active reabsorption of sodium is
(a) distal convoluted tubule
(b) proximal convoluted tubule
(c) Bowman's capsule
(d) descending limb of Henle's loop.
(NEET-II 2016)

4. Human urine is usually acidic because
(a) potassium and sodium exchange generates acidity
(b) hydrogen ions are actively secreted into the filtrate
(c) the sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries.
(d) excreted plasma proteins are acidic.
(2015)

5. Which of the following does not favour the formation of large quantities of dilute urine?
(a) Renin
(b) Atrial-natriuretic factor
(c) Alcohol
(d) Caffeine *(2015 Cancelled)*

6. Removal of proximal convoluted tubule from the nephron will result in
(a) no change in quality and quantity of urine
(b) no urine formation
(c) more diluted urine
(d) more concentrated urine.
(2015 Cancelled)

7. Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule?
(a) Increase in aldosterone levels
(b) Increase in antidiuretic hormone levels
(c) Decrease in aldosterone levels
(d) Decrease in antidiuretic hormone levels
(2014)

8. Select the option which shows correct matching of animal with its excretory organ and excretory product.

	Animal	**Excretory organ**	**Excretory product**
(a)	*Labeo* (Rohu)	Nephridial tubes	Ammonia
(b)	Salamander	Kidneys	Urea
(c)	Peacock	Kidneys	Urea
(d)	Housefly	Renal tubules	Uric acid

(*Karnataka NEET 2013*)

9. The maximum amount of electrolytes and water (70 – 80 percent) from the glomerular filtrate is reabsorbed in which part of the nephron?
(a) Ascending limb of loop of Henle
(b) Distal convoluted tubule
(c) Proximal convoluted tubule
(d) Descending limb of loop of Henle
(2012)

10. Which one of the following options gives the correct categorization of six animals according to the type of nitrogenous waste they give out?

	Ammonotelic	Ureotelic	Uricotelic
(a)	Pigeon, humans	Aquatic amphibia, lizards	Cockroach, frog
(b)	Frog, lizards	Aquatic amphibia, humans	Cockroach, pigeon
(c)	Aquatic amphibia	Frog, humans	Pigeon, lizards, cockroach
(d)	Aquatic amphibia	Cockroach, humans	Frog, pigeon, lizards

(Mains 2012)

11. A fall in glomerular filtration rate (GFR) activates
(a) juxtaglomerular cells to release renin
(b) adrenal cortex to release aldosterone
(c) adrenal medulla to release adrenaline
(d) posterior pituitary to release vasopressin.
(Mains 2012)

12. Which one of the following characteristics is common both in humans and adult frogs?
(a) Four chambered heart
(b) Internal fertilization
(c) Nucleated RBCs
(d) Ureotelic mode of excretion
(Mains 2012)

13. Which one of the following is not a part of a renal pyramid?
(a) Peritubular capillaries
(b) Convoluted tubules
(c) Collecting ducts
(d) Loop of Henle *(Mains 2011)*

14. Which one of the following correctly explains the function of a specific part of the human nephron?
(a) Podocytes : create minute spaces (slit pores) for the filtration of blood into the Bowman's capsule
(b) Henle's loop : most reabsorption of the major substances from the glomerular filtrate
(c) Distal convoluted tubule : reabsorption of K^+ ions into the surrounding blood capillaries
(d) Afferent arteriole : carries the blood away from the glomerulus towards renal vein.
(Mains 2011)

15. Which one of the following statements is correct with respect to kidney function regulation?
(a) When someone drinks lot of water, ADH release is suppressed.
(b) Exposure to cold temperature stimulates ADH release.
(c) An increase in glomerular blood flow stimulates formation of angiotensin II.
(d) During summer when body loses lot of water by evaporation, the release of ADH is suppressed.
(Mains 2011)

16. Uricotelic mode of excreting nitrogenous wastes is found in
(a) reptiles and birds
(b) birds and annelids
(c) amphibians and reptiles
(d) insects and amphibians. *(Mains 2011)*

17. Which one of the following statements in regard to the excretion by the human kidneys is correct?
(a) Descending limb of loop of Henle is impermeable to water.
(b) Distal convoluted tubule is incapable of reabsorbing HCO_3^-.
(c) Nearly 99 per cent of the glomerular filtrate is reabsorbed by the renal tubules.
(d) Ascending limb of loop of Henle is impermeable to electrolytes.
(2010)

18. The principal nitrogenous excretory compound in humans is synthesised
(a) in kidneys but eliminated mostly through liver
(b) in kidneys as well as eliminated by kidneys
(c) in liver and also eliminated by the same through bile
(d) in the liver, but eliminated mostly through kidneys.
(2010)

19. What will happen if the stretch receptors of the urinary bladder wall are totally removed?
(a) Micturition will continue
(b) Urine will continue to collect normally in the bladder
(c) There will be no micturition
(d) Urine will not collect in the bladder
(2009)

20. Uric acid is the chief nitrogenous component of the excretory products of
(a) earthworm (b) cockroach
(c) frog (d) man. *(2009)*

21. A person who is on a long hunger strike and is surviving only on water, will have
(a) less amino acids in his urine
(b) more glucose in his blood
(c) less urea in his urine
(d) more sodium in his urine. *(2007)*

22. Angiotensinogen is a protein produced and secreted by
(a) juxtaglomerular (JG) cells
(b) macula densa cells
(c) endothelial cells (cells lining the blood vessels)
(d) liver cells. *(2006)*

23. In ornithine cycle, which of the following wastes are removed from the blood?
(a) CO_2 and urea
(b) Ammonia and urea
(c) CO_2 and ammonia
(d) Urea and urine *(2005)*

24. The net pressure gradient that causes the fluid to filter out of the glomeruli into the capsule is
(a) 50 mm Hg (b) 75 mm Hg
(c) 20 mm Hg (d) 30 mm Hg.
(2005)

25. A person is undergoing prolonged fasting. His urine will be found to contain abnormal quantities of
(a) fats (b) amino acids
(c) glucose (d) ketones. *(2005)*

26. If Henle's loop were absent from mammalian nephron, which one of the following is to be expected ?
(a) There will be no urine formation.
(b) There will be hardly any change in the quality and quantity of urine formed .
(c) The urine will be more concentrated.
(d) The urine will be more dilute. *(2003)*

27. Conversion of ammonia to urea is done by
(a) ornithine cycle (b) arginine cycle
(c) fumaric cycle (d) citrulline cycle.
(2000)

28. Concentration of urine depends upon which organ?
(a) Bowman's capsule
(b) Length of Henle's loop
(c) PCT
(d) Network of capillaries arising from glomerulus
(2000)

29. A condition of failure of kidney to form urine is called
(a) anuria (b) deamination
(c) uremia (d) none of these.
(1998)

30. The basic functional unit of human kidney is
(a) nephridia (b) Henle's loop
(c) nephron (d) pyramid.
(1997)

31. In ureotelic animals, urea is formed by
(a) Krebs' cycle (b) EM pathway
(c) Ornithine cycle (d) Cori cycle.
(1997)

32. The ornithine cycle removes two waste products from the blood in liver. These products are
(a) CO_2 and ammonia
(b) ammonia and uric acid
(c) CO_2 and urea
(d) ammonia and urea. *(1996)*

33. Which one of the four parts mentioned below does not constitute a part of single uriniferous tubule?
(a) Distal convoluted tubule
(b) Collecting duct
(c) Bowman's capsule
(d) Loop of Henle *(1994)*

34. If excess water passes out from the tissue without being restored by the kidneys, the cells would
(a) burst open and die
(b) take water from the plasma
(c) not be affected at all
(d) shrivel and die. *(1994)*

35. Glucose is taken back from glomerular filtrate through
(a) active transport (b) passive transport
(c) osmosis (d) diffusion.
(1993)

36. Nitrogenous waste products are eliminated mainly as
(a) urea in tadpole and ammonia in adult frog
(b) ammonia in tadpole and urea in adult frog
(c) urea in both tadpole and adult frog
(d) urea in tadpole and uric acid in adult frog. *(1991)*

37. Under normal conditions which one is completely reabsorbed in the renal tubule?
(a) Urea (b) Uric acid
(c) Salts (d) Glucose *(1991)*

38. Proximal and distal convoluted tubules are parts of
(a) seminiferous tubules
(b) nephron
(c) oviduct
(d) vas deferens. *(1990)*

39. Brush border is characteristic of
(a) neck of nephron
(b) collecting tube
(c) proximal convoluted tubule
(d) all of the above. *(1990)*

40. Reabsorption of useful substances from glomerular filtrate occurs in
(a) collecting tube
(b) loop of Henle
(c) proximal convoluted tubule
(d) distal convoluted tubule. *(1989)*

Answer Key

1.	(a)	**2.**	(d)	**3.**	(b)	**4.**	(b)	**5.**	(a)	**6.**	(d)	**7.**	(a)	**8.**	(b)	**9.**	(c)	**10.**	(c)
11.	(a)	**12.**	(d)	**13.**	(b)	**14.**	(a)	**15.**	(a)	**16.**	(a)	**17.**	(c)	**18.**	(d)	**19.**	(a)	**20.**	(b)
21.	(c)	**22.**	(d)	**23.**	(c)	**24.**	(c)	**25.**	(d)	**26.**	(d)	**27.**	(a)	**28.**	(b)	**29.**	(a)	**30.**	(c)
31.	(c)	**32.**	(a)	**33.**	(b)	**34.**	(c)	**35.**	(a)	**36.**	(b)	**37.**	(d)	**38.**	(b)	**39.**	(c)	**40.**	(c)

EXPLANATIONS

1. (a) : Atrial natriuretic factor (ANF) is responsible for lowering of blood pressure and volume. The walls of the atria of the heart release ANF in response to an increase in blood volume and pressure. It opposes regulation by RAAS. It inhibits release of renin from JGA thereby inhibiting NaCl reabsorption by the collecting duct and reduces aldosterone release from adrenal gland.

2. (d) : Descending limb of loop of Henle is permeable to water but impermeable to electrolytes. Ascending limb of loop of Henle is impermeable to water but permeable to electrolytes.

3. (b) : From the Bowman's capsule, a glomerular filtrate enters the proximal convoluted tubule. Absorption of selected materials takes place from the filtrate into the blood of the peritubular capillaries or vasa recta. It is termed the tubular reabsorption. Reabsorption involves both passive and active transport across the tubular epithelium. About 65 per cent of the glomerular filtrate is normally reabsorbed in the proximal convoluted tubule before reaching the loop of Henle. Glucose, amino acids, vitamins, hormones, sodium, potassium, chlorides, phosphates, bicarbonates, much of water and some urea from the filtrate are absorbed. Sodium and potassium are reabsorbed by primary active transport.

4. (b)

5. (a) : Angiotensinogen is an α-globulin protein produced by liver. Renin serves as an enzyme in the conversion of the plasma protein angiotensinogen into angiotensin. This protein stimulates the adrenal cortex to produce aldosterone which acts on the cells of the ascending limb of the loop of Henle, and increases the rate of reabsorption of Na^+. Reabsorption of Na^+ brings about the uptake of an osmotically equivalent amount of water. Absorption of sodium and water increases blood volume and pressure.

6. (d) : About 65% of the glomerular filtrate is normally reabsorbed in proximal convoluted tubule before reaching the loop of Henle. It absorbs glucose, amino acids, vitamins, hormones, Na, K, Cl, phosphates, bicarbonates, water and urea etc. If it is removed, then more concentrated urine with high osmolarity will be produced.

7. (a) : Aldosterone is a hormone secreted by the outer layer of the adrenal gland (cortex part). Decreased blood volume and interstitial fluid level, resulting in decreased blood pressure, trigger aldosterone secretion. When aldosterone is present in the blood, reabsorption of Na^+ in the filtrate is increased by the epithelial cells of the collecting duct. Retaining Na^+, raises the osmotic pressure of the blood and reduces water loss from the body. When aldosterone is absent, some Na^+ remains in the filtrate and is excreted with the urine.

8. (b) : In salamander, kidneys (mesonepheric) are the excretory organs and the excretory matter is urea. In *Labeo*, mesonephric kidney is the excretory organ and excretion is ammonotelic.

Peacock has metanephric kidneys with excretory matter being uric acid. In housefly, excretion takes place by Malpighian tubules. Excretory waste is uric acid chiefly.

9. (c) : During glomerular filtration in kidneys, ultrafiltration of blood occurs *i.e.*, almost all the constituents of plasma except proteins pass onto the Bowman's capsule. Then nearly 99% of the filtrate is reabsorbed by renal tubules. Proximal convoluted tubules shows maximum reabsorption and nearly all the essential nutrients and 70-80% of electrolytes and water are reabsorbed by this segment.

10. (c)

11. (a) : The amount of the filtrate formed by the kidneys per minute is called glomerular filtration rate (GFR). GFR in a healthy individual is approximately 125 ml/minute, *i.e.*, 180 litres per day.

The kidneys have built-in mechanisms for the regulation of glomerular filtration rate. One such efficient mechanism is carried out by juxtaglomerular apparatus (JGA). JGA is a special sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole at the location of their contact. A fall in GFR can activate the JG cells to release renin which can stimulate the glomerular blood flow and thereby the GFR come back to normal.

12. (d) : Excretion of urea is known as ureotelism and the animals which excrete urea are called ureotelic. Ureotelic animals include *Ascaris*, earthworm (both are ammonotelic and ureotelic), cartilaginous fishes like sharks and sting rays, semi-aquatic amphibians such as frogs and toads, aquatic

or semi- aquatic reptiles like turtles, terrapins and alligators, and man and all other mammals. Urea is less toxic and less soluble in water than ammonia. Hence, it can stay for some time in the body. Amphibian tadpole (*e.g.*, tadpole of frog) excrete ammonia but after metamorphosis frog excretes urea.

13. (b) : The medulla of kidney is divided into a number of conical areas, the medulla pyramids or renal pyramids. Peritubular capillaries, loop of Henle and collecting ducts lie in the medulla (renal pyramids) while convoluted tubules lie in the cortex of kidney.

14. (a) : The visceral layer of Bowman's capsule surrounds the glomerulus and is composed of special type of cells, the podocytes. The podocytes are so called because they possess foot like processes (projection), the pedicels. The space between pedicels are called slit pores (= filtration slits) through which the glomerular filtrate filters.

15. (a) : Antidiuretic hormone (ADH) or vasopressin increases the reabsorption of water in the distal convoluted tubule, collecting tubules and collecting ducts of the nephrons of the kidneys. As a result, the reabsorption of water from the glomerular filtrate is increased. When someone drinks lot of water, requirement of absorption of water decreases, so ADH release is suppressed.

16. (a) : Reptiles, birds, land snails and insects excrete nitrogenous wastes as uric acid in the form of pellet or paste with a minimum loss of water and are called uricotelic animals.

17. (c) : Urine formation involves three main processes namely, glomerular filtration, reabsorption and secretion, that takes place in different parts of the nephron. A comparison of the volume of the filtrate formed per day (180 litres per day) with that of the urine released (1.5 litres), suggest that nearly 99 percent of the filtrate is reabsorbed by the renal tubules. The descending limb of loop of Henle is permeable to water but almost impermeable to electrolytes. The ascending limb is impermeable to water but allows transport of electrolytes actively or passively. Conditional reabsorption of Na^+ and water takes place in distal convoluted tubule. It is also capable of reabsorption of HCO_3^-.

18. (d) : The principle nitrogenous excretory compound in humans is urea. Urea is produced in a series of reactions (urea cycle) which take place in the mitochondrial matrix and cytosol of liver cells. Urea cycle (ornithine cycle) is the series of biochemical reactions that converts ammonia, which is highly toxic, and carbon dioxide to the much less toxic urea during the excretion of metabolic nitrogen derived from the deamination of excess amino acids. The urea is ultimately excreted in solution in urine.

19. (a) : Sensory stretch receptors are responsible for the stretch reflex. If these are removed then autonomic nervous system control will not be there and micturition will continue. Micturition is the expulsion of urine from the urinary bladder.

20. (b) : Cockroach shows uricotelism. Excretion of uric acid is known as uricotelism and the animals which excrete uric acid are called uricotelic. Animals which live in dry conditions have to conserve water in their bodies. Therefore, they synthesize crystals of uric acid from ammonia. Uric acid crystals are non-toxic and almost insoluble in water. Hence, these can be retained in the body for a considerable time. Uricotelic animals include most insects, (*e.g.*, cockroach), land reptiles (*e.g.*, lizards and snakes) and birds.

21. (c) : A person who is on a long hunger strike and is surviving only on water, will have less urea in his urine. Urea, also called carbamide, is an organic chemical compound which essentially is the waste produced when the body metabolizes protein. Manufactured in the liver, by broken down protein or amino acids, and ammonia, the kidneys transfer urea from the blood to the urine. The average person excretes about 30 grams of urea a day. During total starvation with no food being eaten, the body must rely on its own tissues to provide the essential mixture of fuels to sustain life. The primary fuel is stored fat but we also need a continuous supply of glucose. The body has a very small store of glycogen that can provide glucose for about 36 hours, then the body must make its glucose. The body has three sources of glucose, one is the diet (but the person is starving), a second is glycogen (but this is all gone) and the third is a process called gluconeogenesis where the body makes glucose from amino acids. During starvation, the body must rely on body proteins for the amino acids. On high-protein diets the carbon skeletons of the amino acids are oxidized for energy or stored as fat and glycogen, but the amino nitrogen must be excreted. To facilitate this process, enzymes of the urea cycle are controlled at the gene level. When dietary proteins increase significantly, enzyme concentrations rise. On return to a balanced diet,

enzyme levels decline. Under conditions of starvation, enzyme levels rise as proteins are degraded and amino acid carbon skeletons are used to provide energy, thus increasing the quantity of nitrogen that must be excreted in the form of urea.

22. (d) : *Refer to answer 5.*

23. (c) : *Refer to answer 18.*

24. (c) : Walls of glomerular capillaries and Bowman's capsule are very thin and are semi-permeable due to the presence of pores in the former and slit-pores in the latter. They allow water and small molecules in the blood to pass through them. Fluid containing these materials is forced out of the glomerular capillaries into the Bowman's capsule by the high pressure of the blood in the glomerular capillaries. This pressure is about 70 mm Hg in man. The fluid tends to move in the reverse direction due to (i) the osmotic pressure of plasma proteins in the glomerular capillaries, and (ii) hydrostatic pressure of the fluid in the urinary tubule. These pressures in man are about 30 mm. Hg. and 20 mm. Hg. respectively. The net force moving the fluid from the glomerular capillaries, called the filtration pressure, is 70 – (30 + 20) or 20 mmHg.

25. (d) : Under fasting conditions which are associated with high rate of fatty acid oxidation, the liver produces large amount of ketone bodies *viz.* acetoacetate, β-hydroxybutyrate and acetone. The normal level of ketone blood level is 0.2 mmol/L. Presence of excess ketone bodies in urine is termed as ketonuria.

26. (d) : Reabsorption is a process by which useful constituents of glomerular filtrate are returned into the blood streams. It occurs in convoluted tubules (proximal convoluted tubule) as well as loop of Henle. Basically loop of Henle, in association with vasa rectae, plays an important role in the counter current mechanism (the process which makes urine hypertonic, *i.e.*, more concentrated). Therefore, if Henle's loop was absent from mammalian nephron the urine will be more dilute.

27. (a) : *Refer to answer 18.*

28. (b) : Concentration of urine depends upon the length of Henle's loop. Loop of Henle is the hairpin shaped section of a kidney tubule situated between the proximal and distal tubules in the nephron. It consists of a thin descending limb which is permeable to water and a thick ascending limb which is impermeable to water complex movements of ions and water across the walls of the loop enable it to function as a countercurrent multiplier, resulting in the production of concentrated urine in the collecting duct.

29. (a) : Anuria is the complete suppression of urine formation by the kidney. In this case most of the nephrons are destroyed. Uremia is the presence of an excessive amount of urea in the blood. Deamination is the removal of ammonia from amino acids.

30. (c) : A nephron is a unit of structure and function in a kidney. A kidney contains about a million nephrons, each approximately 3 cm long.

A nephron is a long tubule differentiated into four regions having different anatomical features and physiological role : Bowman's capsule, proximal convoluted tubule (PCT), loop of Henle, and distal convoluted tubule (DCT). The latter opens into one of the collecting ducts. Nephridia are the excretory organs of annelids.

31. (c) : Urea is formed of two molecules of ammonia and one molecule of CO_2.

During catabolism, proteins break up into amino acids. The amino acids are converted into keto-acids (such as α-keto-glutaric acid) with the removal of ammonia (deamination). The keto-acid enters the Krebs cycle to yield energy. Carbon dioxide is formed during decarboxylation.

Ornithine (amino acid) combines with one molecule of NH_3 and CO_2 producing citrulline (amino acid) and water. Citrulline combines with another molecule of ammonia and forms arginine (essential amino acid) and water. Arginine is broken into urea and ornithine in the presence of an enzyme arginase and water. Thus the cycle is repeated. This is called urea or ornithine or Krebs-Henseleit cycle after the names of its discoverers.

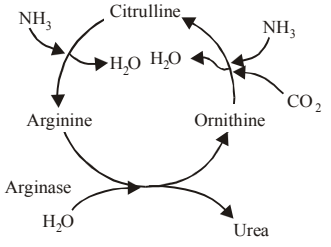


Fig. : Urea cycle

Most of the urea is produced in the liver. The liver cells continuously release urea into the blood and kidneys withdraw it from the blood to excrete it in urine.

32. (a)

33. (b) : *Refer to answer 30.*

34. (c) : Individual cells have no role to play in this process. Excess water in the blood affects the osmoreceptors present in hypothalamus and volume receptors present in left atrium, ventricles and pulmonary veins. This causes ADH release so that body hydration is regulated by removal of excess water by kidney.

35. (a) : Glucose is taken back from the glomerular filtrate by the proximal convoluted tubule by active transport.

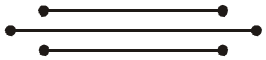
36. (b) : Ammonia is highly soluble in water, so in aquatic animals *e.g.*, tadpole of frog, the nitrogenous waste products are excreted in the form of ammonia. In terrestrial animals *e.g.*, adult frog, these wastes are excreted in the form of urea.

37. (d) : The cells lining the proximal convoluted tubule are well adapted for reabsorption of materials from the filtrate. They have abundant mitochondria and bear numerous microvilli on the free side thus giving brush border appearance. The cells reabsorb entire glucose, amino acids, most of the inorganic ions, much of the water as well as some urea from the filtrate.

38. (b) : *Refer to answer 30.*

39. (c)

40. (c) : *Refer to answer 37.*



Chapter
20

Locomotion and Movement

1. The pivot joint between atlas and axis is a type of
(a) cartilaginous joint (b) synovial joint
(c) saddle joint (d) fibrous joint.
(NEET 2017)

2. Out of '*X* ' pairs of ribs in humans only '*Y* ' pairs are true ribs. Select the option that correctly represents values of *X* and *Y* and provides their explanation.
(a) *X* = 12, *Y* = 5 — True ribs are attached dorsally to vertebral column and sternum on the two ends
(b) *X* = 24, *Y* = 2 — The true ribs are dorsally attached to vertebral column but are free on ventral side
(c) *X* = 24, *Y* = 12 — True ribs are dorsally attached to vertebral column but are free on ventral side
(d) *X* = 12, *Y* = 7 — True ribs are attached dorsally to vertebral column and ventrally to the sternum
(NEET 2017)

3. Name the ion responsible for unmasking of active sites for myosin for cross-bridge activity during muscle contraction.
(a) Calcium (b) Magnesium
(c) Sodium (d) Potassium
(NEET-II 2016)

4. Osteoporosis, an age-related disease of skeletal system, may occur due to
(a) immune disorder affecting neuromuscular junction leading to fatigue
(b) high concentration of Ca^{++} and Na^{+}
(c) decreased level of estrogen
(d) accumulation of uric acid leading to inflammation of joints. *(NEET-II 2016)*

5. Lack of relaxation between successive stimuli in sustained muscle contraction is known as
(a) tetanus (b) tonus
(c) spasm (d) fatigue.
(NEET-I 2016)

6. Which of the following is not a function of the skeletal system?
(a) Production of body heat
(b) Locomotion
(c) Production of erythrocytes
(d) Storage of minerals *(2015)*

7. Which of the following joints would allow no movements?
(a) Synovial joint
(b) Ball and Socket joint
(c) Fibrous joint
(d) Cartilaginous joint
(2015)

8. Sliding filament theory can be best explained as
(a) actin and myosin filaments do not shorten but rather slide pass each other
(b) when myofilaments slide pass each other, myosin filaments shorten while actin filaments do not shorten
(c) when myofilaments slide pass each other actin filaments shorten while myosin filaments do not shorten
(d) actin and myosin filaments shorten and slide pass each other.
(2015 Cancelled)

9. Glenoid cavity articulates
(a) clavicle with scapula
(b) humerus with scapula
(c) clavicle with acromion
(d) scapula with acromion.
(2015 Cancelled)

10. Select the correct matching of the type of the joint with the example in human skeletal system.

	Type of joint		Example
(a)	Cartilaginous joint	–	Between frontal and parietal
(b)	Pivot joint	–	Between third and fourth cervical vertebrae
(c)	Hinge joint	–	Between humerus and pectoral girdle
(d)	Gliding joint	–	Between carpals

(2014)

11. Stimulation of a muscle fiber by a motor neuron occurs at
(a) the neuromuscular junction
(b) the transverse tubules
(c) the myofibril
(d) the sacroplasmic reticulum. *(2014)*

12. Select the correct statement with respect to locomotion in humans.
(a) The vertebral column has 10 thoracic vertebrae.
(b) The joint between adjacent vertebrae is a fibrous joint.
(c) A decreased level of progesterone causes osteoporosis in old people.
(d) Accumulation of uric acid crystals in joints causes their inflammation. (*NEET 2013*)

13. The H-zone in the skeletal muscle fibre is due to
(a) the central gap between actin filaments extending through myosin filaments in the A-band
(b) extension of myosin filaments in the central portion of the A-band
(c) the absence of myofibrils in the central portion of A-band
(d) the central gap between myosin filaments in the A-band. (*NEET 2013*)

14. The characteristic and an example of a synovial joint in humans is

	Characteristics	Examples
(a)	Fluid filled synovial cavity between two bones	Joint between atlas and axis
(b)	Lymph filled between two bones, limited movement	Gliding joint between carpals
(c)	Fluid cartilage between two bones, limited movements	Knee joint
(d)	Fluid filled between two joints, provides cushion	Skull bones

(*NEET 2013*)

15. During muscle contraction in humans, the
(a) sarcomere does not shorten
(b) A band remains same
(c) A, H and I bands shorten
(d) actin filaments shorten.
(*Karnataka NEET 2013*)

16. Select the correct statement with respect to disorders of muscles in humans.
(a) Failure of neuromuscular transmission in myasthenia gravis can prevent normal swallowing.
(b) Accumulation of urea and creatine in the joints causes their inflammation.
(c) An overdose of vitamin D causes osteoporosis.
(d) Rapid contractions of skeletal muscles cause muscle dystrophy.
(*Karnataka NEET 2013*)

17. Select the correct statement regarding the specific disorder of muscular or skeletal system.
(a) Muscular dystrophy – Age related shortening of muscles
(b) Osteoporosis – Decrease in bone mass and higher chances of fractures with advancing age
(c) Myasthenia gravis – Autoimmune disorder which inhibits sliding of myosin filaments
(d) Gout – Inflammation of joints due to extra deposition of calcium *(2012)*

18. Which one of the following pairs of chemical substances, is correctly categorised?
(a) Calcitonin and thymosin - Thyroid hormones
(b) Pepsin and prolactin - Two digestive enzymes secreted in stomach
(c) Troponin and myosin - Complex proteins in striated muscles
(d) Secretin and rhodopsin - Polypeptide hormones
(2012)

19. The type of muscle present in our
(a) heart is involuntary and unstriated smooth muscle
(b) intestine is striated and involuntary
(c) thigh is striated and voluntary
(d) upper arm is smooth muscle and fusiform in shape. *(2011)*

20. Three of the following pairs of the human skeletal parts are correctly matched with their respective inclusive skeletal category and one pair is not matched. Identify the non-matching pair.

	Pair of skeletal parts	Category
(a)	Sternum and ribs	Axial skeleton
(b)	Clavicle and glenoid cavity	Pelvic girdle
(c)	Humerus and ulna	Appendicular skeleton
(d)	Malleus and stapes	Ear ossicles

(2011)

21. Which one of the following is the correct description of a certain part of a normal human skeleton?
(a) Parietal bone and the temporal bone of the skull are joined fibrous joint.
(b) First vertebra is axis which articulates with the occipital condyles.
(c) The 9th and 10th pairs of ribs are called the floating ribs.
(d) Glenoid cavity is a depression to which the thigh bone articulates. *(2010)*

22. Which one of the following is the correct matching of three items and their grouping category?

	Items	Group
(a)	Ilium, ischium, pubis	Coxal bones of pelvic girdle
(b)	Actin, myosin, rhodopsin	Muscle proteins
(c)	Cytosine, uracil, thiamine	Pyrimidines
(d)	Malleus, incus, cochlea	Ear ossicles

(2009)

23. Elbow joint is an example of
(a) hinge joint
(b) gliding joint
(c) ball and socket joint
(d) pivot joint. *(2009)*

24. Which one of the following items gives its correct total number?
(a) Types of diabetes-3
(b) Cervical vertebrae in humans-8
(c) Floating ribs in humans-4
(d) Amino acids found in proteins-16 *(2007)*

25. In human body, which one of the following is anatomically correct?
(a) Collar bones - 3 pairs
(b) Salivary glands - 1 pair
(c) Cranial nerves - 10 pairs
(d) Floating ribs - 2 pairs *(2007)*

26. The contractile protein of skeletal muscle involving ATPase activity is
(a) troponin (b) tropomyosin
(c) myosin (d) α-actinin. *(2006)*

27. An acromian process is characteristically found in the
(a) pelvic girdle of mammals
(b) pectoral girdle of mammals
(c) skull of frog
(d) sperm of mammals. *(2005)*

28. Which of the following pairs is correctly matched?
(a) Hinge joint - Between vertebrae
(b) Gliding joint - Between zygapophyses of the successive vertebrae
(c) Cartilaginous joint - Skull bones
(d) Fibrous joint - Between phalanges
(2005)

29. What will happen if ligaments are torn ?
(a) Bones will move freely at joint and no pain.
(b) Bone less movable at joint and pain.
(c) Bone will become unfixed.
(d) Bone will become fixed. *(2002)*

30. Which cartilage is present at the end of long bones?
(a) Calcified cartilage
(b) Hyaline cartilage
(c) Elastic cartilage
(d) Fibrous cartilage *(2002)*

31. Which statement is correct for muscle contraction?
(a) Length of H-zone decreases
(b) Length of A-band remains constant
(c) Length of I-band increases
(d) Length of two Z-line increases *(2001)*

32. What is sarcomere?
(a) Part between two H-line
(b) Part between two A-line
(c) Part between two I-band
(d) Part between two Z-line *(2001)*

33. Sternum is connected to ribs by
(a) bony matter
(b) white fibrous cartilage
(c) hyaline cartilage
(d) areolar tissue. *(2000)*

34. Bone related with skull is
(a) coracoid (b) arytenoid
(c) pterygoid (d) atlas. *(2000)*

35. What is the name of joint between ribs and sternum?
(a) Cartilaginous joint
(b) Angular joint
(c) Gliding joint
(d) Fibrous joint *(2000)*

36. The joint between atlas and axis is called
(a) angular joint (b) hinge joint
(c) pivot joint (d) saddle joint. *(1999)*

37. Which of the following is the contractile protein of a muscle?
(a) Tropomyosin (b) Tubulin
(c) Myosin (d) All of these *(1998)*

38. The functional unit of contractile system in striated muscle is
(a) sarcomere (b) Z-band
(c) cross bridges (d) myofibril. *(1998)*

39. Total number of bones in each limb of a man is
(a) 24 (b) 30
(c) 14 (d) 21. *(1998)*

40. When a muscle bends one part upon the other, it is called
(a) abductor (b) regulator
(c) extremor (d) flexor. *(1996)*

41. The number of floating ribs in the human body is
(a) 3 pairs (b) 2 pairs
(c) 6 pairs (d) 5 pairs. *(1995)*

42. Which of the following components is a part of the pectoral girdle?
(a) Sternum (b) Acetabulum
(c) Glenoid cavity (d) Ilium *(1994)*

43. The type of joint between the human skull bones is called
(a) cartilaginous joint
(b) hinge joint
(c) fibrous joint
(d) synovial joint. *(1994)*

44. The cervical vertebrae in human is
(a) same as in whale
(b) more than that in rabbit
(c) double than that of horse
(d) less than that in giraffe. *(1993)*

45. Long bones function in
(a) support
(b) support, erythrocyte and leucocyte synthesis
(c) support and erythrocyte synthesis
(d) erythrocyte formation. *(1993)*

46. Number of cervical vertebrae in camel is
(a) more than that of rabbit
(b) less than that of rabbit
(c) same as that of whale
(d) more than that of horse. *(1993)*

47. A deltoid ridge occurs in
(a) radius (b) ulna
(c) femur (d) humerus. *(1990)*

48. Extremities of long bones possess which of the following cartilages?
(a) Calcified (b) Fibrous
(c) Elastic (d) Hyaline *(1989)*

49. Intercostal muscles occur in
(a) abdomen (b) thigh
(c) ribs (d) diaphragm. *(1988)*

Answer Key

1.	(b)	**2.**	(d)	**3.**	(a)	**4.**	(c)	**5.**	(a)	**6.**	(a)	**7.**	(c)	**8.**	(a)	**9.**	(b)	**10.**	(d)
11.	(a)	**12.**	(d)	**13.**	(a)	**14.**	(a)	**15.**	(b)	**16.**	(a)	**17.**	(b)	**18.**	(c)	**19.**	(c)	**20.**	(b)
21.	(a)	**22.**	(a)	**23.**	(a)	**24.**	(c)	**25.**	(d)	**26.**	(c)	**27.**	(b)	**28.**	(b)	**29.**	(b)	**30.**	(b)
31.	(a,b)	**32.**	(d)	**33.**	(c)	**34.**	(c)	**35.**	(a)	**36.**	(c)	**37.**	(c)	**38.**	(a)	**39.**	(b)	**40.**	(d)
41.	(b)	**42.**	(c)	**43.**	(c)	**44.**	(a)	**45.**	(b)	**46.**	(c)	**47.**	(d)	**48.**	(d)	**49.**	(c)		

EXPLANATIONS

1. (b) **2. (d)**

3. (a) : Calcium ion plays an important role in muscle contraction. Calcium ions bind to troponin causing a change in its shape and position. Thus, in turn alters shape and position of tropomyosin to which troponin binds. This shift exposes the active sites on F-actin molecules. Myosin cross-bridge are then able to bind to these active sites.

4. (c) : Osteoporosis is reduction in bone mineral density, resulting in bones that are brittle and liable to fracture. Infection, injury and synovitis can cause localised osteoporosis of adjacent bone. Generalised osteoporosis is common in the elderly and in women after menopause. After menopause the estrogen levels in blood plasma are much reduced. Estrogen helps to regulate bone cells called osteoclasts which are responsible for building new bone. When estrogen levels drop fewer osteoclasts are produced resulting in osteoporosis.

5. (a) : Tetanus refers to continued state of contraction of a muscle resulting from the summation of a series of rapid muscular contractions (twitches) that are induced by repeated stimulation of the muscle.

6. (a)

7. (c) : Fibrous or immovable joints are the joints in which no movement occurs between the bones concerned. White fibrous tissue is present between the ends of the bones. Fibrous joint occurs between the bones of the skull called sutures and the joints between the teeth and the maxilla and the teeth and the mandible.

8. (a) : During muscle contraction, the laterally projecting heads (cross bridges) of the thick myosin myofilaments come in contact with the thin actin myofilaments and rotate on them. This pulls the thin myofilaments toward the middle of the sarcomere, past the thick myofilaments. The Z lines come closer together and the sarcomere becomes shorter. Length of the A band remains constant. Myofilaments (both actin and myosin) stay the same length. Free ends of actin myofilaments move closer to the centre of the sarcomere, bringing Z lines closer together. I bands shorten and H zone narrows. A similar action in all the sarcomeres results in shortening of the entire myofibril and thereby of the whole fibre and the whole muscle.

9. (b) : Upper rounded end of the humerus (bone of arm) is called head that articulates into the glenoid cavity of the pectoral girdle (shoulder girdle) of scapula or shoulder blade bone.

10. (d) :

Cartilaginous joint	–	Between the adjacent vertebrae in vertebral column
Pivot joint	–	Between atlas and axis
Hinge joint	–	Knee joint
Ball and socket joint	–	Between head of humerus and glenoid cavity of pectoral girdle
Fibrous joint	–	Between frontal and parietal bones of skull (sutures)

11. (a) : A neuron that transmits a stimulus to muscle tissue is called motor neuron. A motor unit consists of a single motor neuron (nerve cell) and the muscle fibres it innervates. The portion of the muscle plasma membrane (sarcolemma) that lies beneath the nerve endings (axon terminals) is called the motor end plate. The axon terminals and the motor end plate together constitute the neuro-muscular junction or neuromotor junction.

12. (d) : Thoracic vertebrae are 12 in numbers. Joints between adjacent vertebrae are cartilagenous joints and the opposing surfaces are connected by fibrocartilage which allows very little movement. Osteoporosis is a disease characterised by low bone mass and loss of bone tissue that may lead to weak and fragile bones. Osteoporosis occurs when there is an imbalance between new bone formation and old bone resorption. Generalised osteoporosis is common in elderly people and in women following menopause. In osteoporosis, the osteoblastic (bone forming) activity in the bone usually is less than normal and consequently the rate of bone deposition is depressed. Estrogens inhibit osteoclastic (bone resorption) activity in the bones and therefore stimulate bone growth. After menopause, almost no estrogens are secreted by ovaries. This estrogen deficiency leads to increased osteoclastic activity in the bones, decreased bone matrix and decreased deposition of bone calcium and phosphate. In some women, this effect result in osteoporosis.

13. (a) : Each muscle fibre has many parallelly arranged myofibrils. Each myofibril contains many serially arranged units called sarcomere which are the functional units. Each sarcomere has a central 'A' band made of thick myosin filaments and two half 'I'

bands made of thin actin filaments on either side of it marked by 'Z' lines. In a resting state, the edges of thin filaments on either side of the thick filaments partially overlap the free ends of the thick filaments leaving the central part of the thick filaments. This central part of thick filament, not overlapped by thin filaments is called the 'H' zone.

14. (a) : Joint between atlas and axis is a pivot joint, a type of synovial joint. Synovial joints are characterised by presence of fluid filled cavity between the articulating surface of the two bones.

15. (b) : According to sliding-filament theory of muscle contraction, the actin and myosin filaments slide past each other with the help of cross-bridge to reduce the length of the sarcomeres. The smallest unit of muscle contraction is a sarcomere (which is delineated by Z-lines). As a muscle contracts, the Z lines come closer together (shortening sarcomere), the width of the I bands decreases, the width of the H zones decreases, but there is no change in the width of the A band. During relaxation, cross-bridges disappear and actin filaments slide back from A-bands, the width of the I bands and H zones increases, but there is still no change in the width of the A band.

16. (a) : Myasthenia gravis is an autoimmune disorder in which autoantibodies bind to cholinergic receptors on muscle cells and impairs the ability of the neurotransmitter acetylcholine to induce muscular contraction. This leads to fatigue, weakening and paralysis of skeletal muscles of mouth and throat which may prevent normal swallowing. Gouty arthritis is caused either due to excessive formation of uric acid or inability to excrete it. It gets deposited in synovial joints and causes inflammation. Osteoporosis is a disease in which bone loses minerals and fibres from its matrix. Major causative factors of osteoporosis are imbalances of hormones like calcitonin of thyroid, parathormone of parathyroids, sex hormones and deficiencies of calcium and vitamin D. Muscular dystrophy is inborn abnormality of muscles associated with dysfunction and ultimately with deterioration.

17. (b) : Muscular dystrophy is characterised by progressive skeletal muscle weakness, defects in muscle proteins and the death of muscle cells and tissue.

Myasthenia gravis is an auto-immune neuromuscular disease in which muscle becomes weak, which is caused by circulating antibodies that block acetylcholine receptors at the postsynaptic neuromuscular junction inhibiting the excitatory effects of the acetylcholine.

Gout is inflammation of joints which is caused by elevated levels of uric acid in the blood which crystallises and the crystals are deposited in joints, tendons and surrounding tissues.

18. (c) : Skeletal muscle fibres occur in bundles and are normally attached to the skeleton. Each muscle fibre is an elongated cell surrounded externally by a delicate membrane, the sarcolemma. Just beneath the sarcolemma in each fibre many nuclei occur at irregular intervals. Thus, these fibres are mutlinucleated or syncytial in nature. The cytoplasm of each fibre (sarcoplasm) has a large number of myofibrils which are tightly packed. Each myofibril shows dark bands (A bands) containing myosin and light band (I bands) containing actin, alternating with each other. That is why these are named as striped muscle fibres. Actin filaments are thinner as compared to the myosin filaments. Each actin filament is made of two 'F' actins helically wound to each other. Each 'F' actin is a polymer of monomeric 'G' (globular) actins. Two filaments of another protein, tropomyosin also run close to the 'F' actins throughout its length. A complex protein troponin is distributed at regular intervals on the tropomyosin. In the resting state a subunit of troponin masks the active binding sites for myosin on the actin filaments. Each myosin filament is also a polymerised protein made up of many monomeric proteins called meromyosins.

19. (c) : Cardiac muscles are found in the wall of the heart. It is involuntary and slightly striated. Smooth muscles are found in gastrointestinal tract. These are non-striated and involuntary. Striated (or skeletal) muscles are found in the limbs and body walls. These muscles are voluntary (under the control of animal's will) and show dark and light bands thus are striated.

20. (b) : Each pectoral girdle consists of two bones, clavicle and scapula. The scapula (shoulder blade) consists of a sharp ridge, the spine and a triangular body. The end of the spine projects as a flattened and expanded process called acromion. This process articulates with the clavicle. At the lateral end of the superior of the scapula is projection of the anterior surface called the coracoid process, to which the tendons of the muscles attach. At the point where the superior and lateral borders of the scapula meet there is the lateral angle which presents a shallow articular surface termed as glenoid cavity into which the head of the humer is articulated.

21. (a) : The bones of skulls are joined by white fibrous tissue which sustain no movement between the skull bones. This kind of joint is classified as

fibrous or immovable joints. Thus, parietal and temporal bone of the skull are joined by fibrous joints.

First cervical vertebra, atlas, joins the second cervical vertebra axis to form a joint (pivot joint) which allows movement in one plane. The atlas supports the head and allows movement of head over neck.

The last two pairs of ribs are called floating ribs because their anterior ends are not attached to either the sternum or the cartilage of anterior rib.

Glenoid cavity is a depression to which humerus articulates.

22. (a) : The pelvic girdle is formed by two innominate bones (hip bones). Each innominate bones consists of three separate bones, ilium, ischium and the pubis.

23. (a) : Hinge joint is a form of diarthrosis (freely movable joint) that allows angular movement in one plane only, increasing or decreasing the angle between the bones. Examples are - knee joint and elbow joint.

24. (c) : There are twelve pairs of ribs which form the bony lateral walls of the thoracic cage. The first seven pairs are called true ribs; eight, ninth and tenth pairs are called false ribs. The last two pairs of ribs are called floating ribs because their anterior ends are not attached either to the sternum or the cartilage of another rib. The floating ribs protect the kidneys.

25. (d) :

Collar bones (Clavicle)	–	2 pairs
Salivary glands	–	3 pairs
Cranial nerves	–	12 pairs

26. (c) : Myosin is a contractile protein that interacts with actin to bring about contraction of muscle or cell movement. The type of myosin molecule found in muscle fibres consists of a tail, by which it aggregates with other myosin molecules to form so-called thick filaments and a globular head, which has sites for the attachment of actin and ATP molecule. Troponin, tropomyosin and a-actinin are the actin in the thin filament.

27. (b) : Each half of pectoral girdle is made up of two bones scapula and clavicle. At the outer angle of scapula is a shallow socket known as glenoid cavity into which fits head of humerus bone to form a shoulder joint. Above glenoid cavity project two processes - acromion process and coracoid process. Acromion process extends over the glenoid cavity and articulates with clavicle to form shoulder girdle. Coracoid process is like a hook and is smaller than acromion process.

28. (b) : Gliding joint permits sliding movements of two bones over each other. Hinge joint allows movements in one plane only. Knee joint, elbow joint, ankle joint are of this type. Cartilaginous joint is a slightly movable joint and is found between the centre of vertebrae, at the pubic symphysis and between ribs and sternum. Fibrous joint is an immovable joint which occur between the bones of cranium.

29. (b) : Ligaments join a bone with another bone in movable/synovial joints. Torn ligaments make movement at joints very painful and restricted.

30. (b) : Cartilage is an important component of skeleton. It consists of a firm matrix containing collagen and elastin fibres and cells in fluid-filled lacunae. Cartilage has many types. Elastic cartilage occurs in the pinna and external auditory canal of the ear, epiglottis, Eustachian tubes and tip of the nose to make these organs flexible. Fibrous cartilage is very strong yet has a degree of flexibility. It is found in the intervertebral discs where it acts as a cushion and in pubic symphysis where it allows parturition without damage to the girdle. Hyaline cartilage occurs in sternal ribs where it allows expansion of chest during inspiration. It also forms the tracheal and bronchial rings and supports larynx and nasal septum and also at the end of long bones.

31. (a, b) : In contraction, the laterally projecting heads (cross bridges) of the thick myosin myofilaments come in contact with the thin actin myofilaments and rotate on them. This pulls the thin myofilaments toward the middle of the sarcomere past the thick myofilaments. The Z lines come closer together and the sarcomere becomes shorter. Length of the A band remains constant. Myofilaments stay the same length. Free ends of actin myofilaments move closer to the centre of the sarcomere, bringing Z lines closer together. I bands shorten and H zone narrows. A similar action in all the sarcomeres results in shortening of the entire myofibril, and thereby of the whole fibre and the whole muscle.

32. (d) : A striated muscle fibre is bounded by sarcolemma. It shows alternating dark and light cross bands, the striations. Dark band is called A band which has at its middle a light zone termed H zone. Light band is known as I band which is crossed through its centre by a dark membrane called Z line. The part of the muscle fibre between two successive Z lines functions as a contractile unit called sarcomere.

33. (c) : Sternum is connected to ribs by hyaline cartilage (= giving a shiny glass like appearance and gives flexibility and support at the joints). Sternum is also called breast bone. It is a narrow, elongated and flattened structure, present just under the skin in the middle of front of the chest. It consists of three parts - manubrium, mesosternum and xiphoid process.

Manubrium is the thickest, strongest part and articulates with the clavicle of pectoral girdle and first pair of ribs. Mesosternum provide articulation to second to sixth pairs of ribs and xiphoid process (also called metasternum) articulates with seventh pair of ribs in association with mesosternum.

34. (c) : Pterygoid is a process that extends from sphenoid bone of skull to form a plate like structure. Above the glenoid cavity of scapula is present two processes - acromion and coracoid. Coracoid process is like a hook and is smaller that acromion process projecting upwards. Atlas is first cervical vertebra. Arytenoid is a cartilage that forms part of larynx.

35. (a) : Cartilaginous joint is present between ribs and sternum. It allows only limited movement. An angular joint allows movement in two directions - side to side and back and forth. Wrist and metacarpophalangeal joints are of this type. Gliding joint permits sliding movements of two bones over each other, *e.g.* joints between sternum and clavicles. Fibrous joints do not allow movement and are present between the bones of cranium.

36. (c) : Pivot joint is present between atlas and the axis in humans. In this joint articular end of one bone is fixed while the other can rotate over it. In angular joint, an oval condyle of one bone fits into an elliptical concavity of the other, *e.g.* wrist and meta-carpophalangeal joints. Hinge joint allows movements in one plane only, *e.g.* knee joint. In saddle joint, small projection of one bone fits into a saddle-like depression of another bone.

37. (c) : Myosin is a contractile protein of muscle. Primary myofilaments are made up of this protein. Each myosin filament is a polymerised protein made of many monomeric protein called meromyosins. Secondary myofilaments are composed of a protein actin, having with it two regulatory proteins : tropomyosin and troponin. Myosin interacts with actin to bring about contraction of muscle or cell movement. Tubulin is a protein of which the microtubules of cells are formed.

38. (a) : *Refer to answer 32.*

39. (b)

40. (d) : Flexor muscle bends one part of a limb on another at a joint, *e.g.*, biceps. It brings the fore arm towards the upper arm. Flexor work antagonistically with extensors. Abductor (levator) is a type of muscle whose function is to move a limb away from the body. *E.g.*, deltoides of shoulder.

41. (b) : *Refer to answer 24.*

42. (c) : The pectoral girdle lies on the posterolateral aspect of the upper region of the thorax. It consists of 2 bones : scapula and clavicle. The scapula, also called shoulder blade, is a large, flat, triangular bone placed at the back of the shoulder. It has at its lateral angle a shallow concavity, the glenoid cavity, for the articulation of the head of the humerus. Acetabulum and ilium are parts of pelvic girdle. Sternum is a long, narrow, flat vertical bone in the middle of the front wall of the chest.

43. (c) : Fibrous joint is present between the human skull bones. It does not allow movement because the bones are held firmly together by bundles of strong white collagen fibres. Cartilaginous joints are present between the centra of vertebrae, at the pubic symphysis and between ribs and sternum. Knee joint, elbow joint and ankle joint are types of hinge joint. Synovial joint occurs between limb and bones.

44. (a) : The number of cervical vertebrae are same in man and whale that is 7 in number.

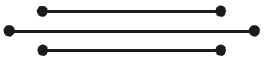
45. (b) : Long bones strengthen the legs and arms, provide support and also synthesise erythrocytes and leucocytes due to presence of bone marrow in their cavities.

46. (c) : The vast majority of mammals have seven cervical vertebrae (neck bones), including camel, bats, giraffes, whales and humans. The few exceptions include the manatee and the two-toed sloth, which each have only six cervical vertebrae and the three-toed sloth with nine cervical vertebrae.

47. (d) : In the humerus bone, pectoral and deltoid ridges are important points of muscle attachment.

48. (d) : Hyaline cartilage has a clear, homogeneous, translucent, bluish-green matrix. It often contains a good number of very fine collagen fibres, which are difficult to observe. This cartilage is flexible, elastic and compressible. It is found in the sternal ribs, extremities of leg bones, tracheal and bronchial rings, laryngeal wall, nasal septum and superscapula. Elastic cartilage is found in the pinna, epiglottis, Eustachian tubes and tip of nose. Calcified cartilage is found in the suprascapula of frog. Fibrous cartilage is found in the intervertebral discs and pubic symphysis.

49. (c) : Intercostal muscles (external intercostal and internal intercostal) are attached with the ribs which help in the movement of rib cage during breathing.



Chapter
21

Neural Control and Coordination

1. Myelin sheath is produced by
(a) astrocytes and Schwann cells
(b) oligodendrocytes and osteoclasts
(c) osteoclasts and astrocytes
(d) Schwann cells and oligodendrocytes.
(NEET 2017)

2. Receptor sites for neurotransmitters are present on
(a) pre-synaptic membrane
(b) tips of axons
(c) post-synaptic membrane
(d) membranes of synaptic vesicles.
(NEET 2017)

3. Good vision depends on adequate intake of carotene rich food.

Select the best option from the following statements.
(1) Vitamin A derivatives are formed from carotene.
(2) The photopigments are embedded in the membrane discs of the inner segment.
(3) Retinal is a derivative of vitamin A.
(4) Retinal is a light absorbing part of all the visual photopigments.
(a) (1), (3) and (4) (b) (1) and (3)
(c) (2), (3) and (4) (d) (1) and (2)
(NEET 2017)

4. Choose the correct statement.
(a) Nociceptors respond to changes in pressure.
(b) Meissner's corpuscles are thermoreceptors.
(c) Photoreceptors in the human eye are depolarised during darkness and become hyperpolarised in response to the light stimulus.
(d) Receptors do not produce graded potentials.
(NEET-II 2016)

5. Photosensitive compound in human eye is made up of
(a) opsin and retinol
(b) transducin and retinene
(c) guanosine and retinol
(d) opsin and retinal. *(NEET-I 2016)*

6. Destruction of the anterior horn cells of the spinal cord would result in loss of
(a) commissural impulses
(b) integrating impulses
(c) sensory impulses
(d) voluntary motor impulses. *(2015)*

7. In mammalian eye, the 'fovea' is the center of the visual field, where
(a) only rods are present
(b) more rods than cones are found
(c) high density of cones occur, but has no rods
(d) the optic nerve leaves the eye. *(2015)*

8. A gymnast is able to balance his body upside down even in the total darkness because of
(a) tectorial membrane
(b) organ of corti
(c) cochlea
(d) vestibular apparatus. *(2015 Cancelled)*

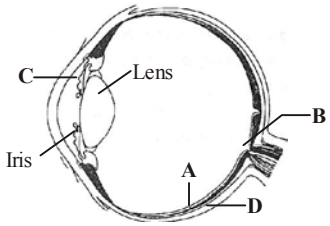
9. Which of the following regions of the brain is incorrectly paired with its function?
(a) Corpus callosum - communication between the left and right cerebral cortices
(b) Cerebrum - calculation and contemplation
(c) Medulla oblongata - homeostatic control
(d) Cerebellum - language comprehension
(2015 Cancelled)

10. Injury localized to the hypothalamus would most likely disrupt
(a) short - term memory
(b) co-ordination during locomotion
(c) executive functions, such as decision making
(d) regulation of body temperature. *(2014)*

11. Which one of the following statements is not correct?
(a) Retinal is the light absorbing portion of visual photo pigments.
(b) In retina the rods have the photopigment rhodopsin while cones have three different photopigments.

(c) Retinal is a derivative of vitamin C.
(d) Rhodopsin is the purplish red protein present in rods only.
(2014)

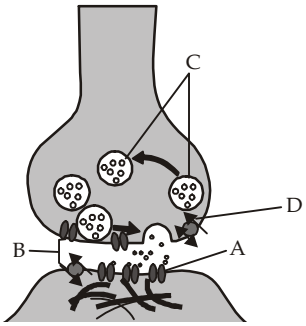
12. Parts A, B, C and D of the human eye are shown in the diagram. Select the option which gives correct identification along with its functions/ characteristics.



(a) C-Aqueous chamber-Reflects the light which does not pass through the lens.
(b) D - Choroid - Its anterior part forms ciliary body.
(c) A - Retina - Contains photoreceptors *i.e.*, rods and cones.
(d) B - Blind spot-Has only a few rods and cones. (*NEET 2013*)

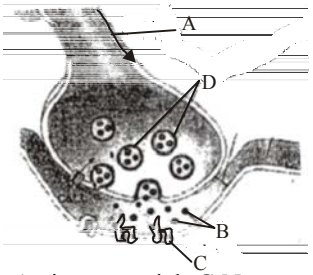
13. The most abundant intracellular cation is
(a) H^+ (b) K^+
(c) Na^+ (d) Ca^{++}.
(*NEET 2013*)

14. A diagram showing axon terminal and synapse is given. Identify correctly at least two of A - D.



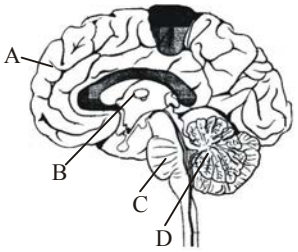
(a) A - Neurotransmitter, B - Synaptic cleft
(b) C - Neurotransmitter, D - Ca^{++}
(c) A - Receptor, C - Synaptic vesicles
(d) B - Synaptic connection, D - K^+
(*NEET 2013*)

15. The figure shows an axon terminal and synapse. Select the option giving correct identification of labels A-D.



(a) A-Action potential, C-Neurotransmitter
(b) B-Neurotransmitter, D- Receptor capsules
(c) C-Receptor, D-Synaptic vesicles
(d) A-Axon terminal, B- Serotonin complex
(*Karnataka NEET 2013*)

16. A sagittal section of human brain is shown here. Identify at least two labels from A-D.



(a) C-Mid brain, D-Cerebellum
(b) A-Cerebrum, C-Pons
(c) B-Corpus callosum, D-Medulla
(d) A-Cerebral hemispheres, B-Cerebellum
(*Karnataka NEET 2013*)

17. The human hind brain comprises three parts, one of which is
(a) spinal cord (b) corpus callosum
(c) cerebellum (d) hypothalamus.
(2012)

18. Which part of the human ear plays no role in hearing as such but is otherwise very much required?
(a) Eustachian tube
(b) Organ of Corti
(c) Vestibular apparatus
(d) Ear ossicles (*2012*)

19. When a neuron is in resting state *i.e.*, not conducting any impulse, the axonal membrane is
(a) comparatively more permeable to Na^+ ions and nearly impermeable to K^+ ions
(b) equally permeable to both Na^+ and K^+ ions
(c) impermeable to both Na^+ and K^+ ions
(d) comparatively more permeable to K^+ ions and nearly impermeable to Na^+ ions.
(*2011*)

20. The nerve centres which control the body temperature and the urge for eating are contained in
(a) hypothalamus (b) pons
(c) cerebellum (d) thalamus.
(*2010*)

21. Select the answer with correct matching of the structure, its location and function.

	Structure	Location	Function
(a)	Eustachian tube	Anterior part of internal ear	Equalizes air pressure on either sides of tympanic membrane
(b)	Cerebellum	Mid brain	Controls respiration and gastric secretions
(c)	Hypothal -amus	Fore brain	Controls body temperature, urge for eating and drinking
(d)	Blind spot	Near the place where optic nerve leaves the eye	Rods and cones are present but inactive here

(Mains 2010)

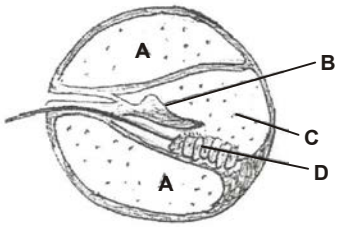
22. Alzheimer's disease in humans is associated with the deficiency of
(a) glutamic acid
(b) acetylcholine
(c) gamma aminobutyric acid (GABA)
(d) dopamine. *(2009)*

23. Which part of human brain is concerned with the regulation of body temperature?
(a) Cerebellum (b) Cerebrum
(c) Hypothalamus (d) Medulla oblongata
(*2009*)

24. Cornea transplant in humans is almost never rejected. This is because
(a) it is composed of enucleated cells
(b) it is a non-living layer
(c) its cells are least penetrable by bacteria
(d) it has no blood supply. *(2008)*

25. During the propagation of a nerve impulse, the action potential results from the movement of
(a) K^+ ions from intracellular fluid to extracellular fluid
(b) Na^+ ions from extracellular fluid to intracelluar fluid
(c) K^+ ions from extracellular fluid to extracellular fluid
(d) Na^+ ions from intracellular fluid to extracellular fluid. *(2008)*

26. Given below is a diagrammatic cross section of a single loop of human cochlea.



Which one of the following options correctly represents the names of three different parts?
(a) D : Sensory hair cells, A : Endolymph B : Tectorial membrane.
(b) A : Perilymph, B : Tectorial membrane, C: Endolymph
(c) B : Tectorial membrane, C : Perilymph, D: secretory cells
(d) C : Endolymph, D : Sensory hair cells, A : Serum *(2008)*

27. Which one of the following is the correct difference between rod cells and cone cells of our retina?

		Rod cells	Cone cells
(a)	Overall function	Vision in Poor light	Colour vision and detailed vision in bright light
(b)	Distribution	More concentrated in centre of retina	Evenly distributed all over retina
(c)	Visual acuity	High	Low
(d)	Visual pigment contained	Iodopsion	Rhodopsin

(2008)

28. During the transmission of nerve impulse through a nerve fibre, the potential on the inner side of the plasma membrane has which type of electric change?
(a) First positive, then negative and continue to be negative
(b) First negative, then positive and continue to be positive
(c) First positive, then negative and again back to positive
(d) First negative, then positive and again back to negative. *(2007)*

29. Bowman's glands are located in the
(a) Anterior pituitary
(b) Female reproductive system of cockroach
(c) Olfactory epithelium of our nose
(d) Proximal end of uriniferous tubules.
(2007)

30. Bowman's glands are found in
(a) juxtamedullary nephrons
(b) olfactory epithelium
(c) external auditory canal
(d) cortical nephrons only. *(2006)*

31. Which one of the following does not act as a neurotransmitter?
(a) Cortisone (b) Acetylcholine
(c) Epinephrine (d) Norepinephrine
(2006)

32. Which one of the following is the example of the action of the autonomous nervous system?
(a) Swallowing of food
(b) Pupillary reflex
(c) Peristalsis of the intestine
(d) Knee-jerk response *(2005)*

33. In a man, abducens nerve is injured. Which one of the following functions will be affected?
(a) Movement of the eyeball
(b) Movement of the tongue
(c) Swallowing
(d) Movement of the neck *(2005)*

34. Parkinson's disease (characterized by tremors and progressive rigidity of limbs) is caused by degeneration of brain neurons that are involved in movement control and make use of neurotransmitter
(a) acetylcholine (b) norepinephrine
(c) dopamine (d) GABA. *(2005)*

35. In the resting state of the neural membrane, diffusion due to concentration gradients, if allowed, would drive
(a) K^+ into the cell
(b) K^+ and Na^+ out of the cell
(c) Na^+ into the cell
(d) Na^+ out of the cell. *(2004)*

36. Injury to vagus nerve in humans is not likely to affect
(a) tongue movements
(b) gastrointestinal movements
(c) pancreatic secretion
(d) cardiac movements. *(2004)*

37. What used to be described as Nissl's granules in a nerve cell are now identified as
(a) cell metabolites (b) fat granules
(c) ribosomes (d) mitochondria.
(2003)

38. Which of the following statement is correct for node of Ranvier of nerve?
(a) Neurilemma is discontinuous
(b) Myelin sheath is discontinuous
(c) Both neurilemma and myelin sheath are discontinuous
(d) Covered by myelin sheath
(2002)

39. When we migrate from dark to light, we fail to see for sometime but after a time visibility becomes normal. It is example of
(a) accomodation (b) adaptation
(c) mutation (d) photoperiodism.
(2001)

40. Which of the following statements is the characteristics of human cornea?
(a) It is secreted by conjuctiva and glandular layer.
(b) It is a lacrimal gland which secrete tears.
(c) Blood circulation is absent in cornea.
(d) In old age it becomes the cause of cataract.
(2001)

41. Depolarization of axolema during nerve conduction takes place because of
(a) equal amount of Na^+ and K^+ move out across axolema
(b) Na^+ move inside and K^+ move more outside.
(c) more Na^+ outside
(d) none of these. *(2000)*

42. Which cranial nerve has the highest number of branches?
(a) Vagus nerve (b) Trigeminal nerve
(c) Facial nerve (d) None of these
(1999)

43. Sympathetic nervous system induces
(a) secretion of digestive juices
(b) heart beat
(c) secretion of saliva
(d) all of these. *(1999)*

44. The junction between the axon of one neuron and the dendrite of the next is called
(a) constant bridge (b) junction point
(c) a joint (d) a synapse.
(1999)

45. Which of the following is regarded as a unit of nervous tissue?
(a) Neurons (b) Myelin sheath
(c) Axons (d) Dendrites
(1999)

46. The Nissl's granules of nerves cell are made up of
(a) DNA (b) RNA
(c) ribosome (d) protein. *(1997)*

47. In the chemistry of vision in mammals, the photosensitive substance is called
(a) rhodopsin (b) melanin
(c) sclerotin (d) retinol. *(1997)*

48. The vagus nerve is the cranial nerve numbering
(a) 7 (b) 5
(c) 10 (d) 9. *(1997)*

49. By which nervous system and of what type, the blood is supplied into visceral organs?
(a) Both SNS and PNS, involuntary
(b) Para-sympathetic nervous system involuntary
(c) Sympathetic nervous system, involuntary
(d) Sympathetic nervous system, voluntary
(1996)

50. Ivan Pavlov performed experiments on
(a) simple reflexes
(b) conditioned reflexes
(c) cardiac reflexes
(d) origin of life.
(1993)

51. Light rays entering the eye is controlled by
(a) pupil (b) iris
(c) cornea (d) lens. *(1993)*

52. Retina is most sensitive at
(a) optic disc
(b) periphery
(c) macula lutea
(d) fovea centralis. *(1993)*

53. Function of iris is to
(a) move lens forward and backward
(b) refract light rays
(c) bring about movements of eye lids
(d) alter the size of pupil.
(1993)

54. Iris is part of
(a) sclerotic
(b) choroid
(c) choroid and retina
(d) sclerotic and choroid. *(1993)*

55. Afferent nerve fibres carry impulses from
(a) effector organs to CNS
(b) receptors to CNS
(c) CNS to receptors
(d) CNS to muscles. *(1992)*

56. Vagus nerve is
(a) X (b) IX
(c) VII (d) V. *(1992)*

57. Third ventricle of brain is also known as
(a) metacoel (b) rhinocoel
(c) paracoel (d) diacoel.
(1990)

58. One function of parasympathetic nervous system is
(a) contraction of hair muscles
(b) stimulation of sweat glands
(c) acceleration of heart beat
(d) constriction of pupil. *(1990)*

59. Which of the following cranial nerves can regulate heart beat?
(a) X (b) IX
(c) VIII (d) VII *(1989)*

60. Sensitive pigmented layer of eye is
(a) cornea (b) retina
(c) sclerotic (d) iris. *(1989)*

Answer Key

1.	(d)	**2.**	(c)	**3.**	(b)	**4.**	(c)	**5.**	(d)	**6.**	(d)	**7.**	(c)	**8.**	(d)	**9.**	(d)	**10.**	(d)
11.	(c)	**12.**	(c)	**13.**	(b)	**14.**	(c)	**15.**	(c)	**16.**	(b)	**17.**	(c)	**18.**	(c)	**19.**	(d)	**20.**	(a)
21.	(c)	**22.**	(b)	**23.**	(c)	**24.**	(d)	**25.**	(b)	**26.**	(b)	**27.**	(a)	**28.**	(d)	**29.**	(c)	**30.**	(b)
31.	(a)	**32.**	(c)	**33.**	(a)	**34.**	(c)	**35.**	(c)	**36.**	(a)	**37.**	(c)	**38.**	(b)	**39.**	(b)	**40.**	(c)
41.	(b)	**42.**	(b)	**43.**	(b)	**44.**	(d)	**45.**	(a)	**46.**	(c)	**47.**	(a)	**48.**	(c)	**49.**	(a)	**50.**	(b)
51.	(a)	**52.**	(d)	**53.**	(d)	**54.**	(d)	**55.**	(b)	**56.**	(a)	**57.**	(d)	**58.**	(d)	**59.**	(a)	**60.**	(b)

EXPLANATIONS

1. (d) : Schwann cells and oligodendrocytes form myelin sheath around the axon. Myelin sheath serves as an insulating layer, preventing loss of energy of the nerve impulse during its passage along the fibre.

2. (c) : Neurotransmitter is a chemical substance responsible for transmission of nerve impulse across synapse. It is released by synaptic vesicle into the synaptic cleft. Neurotransmitter binds with protein receptor molecule present on post synaptic membrane causing its depolarisation and generation of action potential.

3. (b)

4. (c) : Photoreceptors in human eye are unique because they are only type of sensory cells that are relatively depolarised (about –35mV) when it is at rest (*i.e.,* in the dark), and hyperpolarised (to about –70mV) in response to adequate light stimulus. Nociceptors respond to potentially damaging stimuli that result in pain. Meissner's corpuscles are a type of mechanoreceptor, responsible for touch sensitivity. Receptors generally produce graded potentials called receptor potentials.

5. (d) : The rods contain a photosensitive pigment called the rhodopsin. Rhodopsin is composed of opsin and retinene. The opsin is a protein and is called scotopsin in rhodopsin. The retinene is an aldehyde of vitamin A and is called retinal.

6. (d) : The anterior horns of spinal cord contains cells with fibres that form the anterior (motor) root end and are essential for the voluntary and reflex activity of muscles they innervate. If the anterior horn motor cells are destroyed, the nerves cannot regenerate and muscles are never useful again.

7. (c) : A small oval, yellowish area of the retina lying exactly opposite the centre of the cornea is named the macula lutea or yellow spot which has at its middle a shallow depression, the fovea centralis. The fovea centralis has cone cells only. It is devoid of rods and blood vessels. The fovea centralis is the place of most distinct vision.

8. (d) : Vestibular apparatus is a part of inner ear which is located above the cochlea. It consists of three semicircular canals, which detect movements of the head, and the utriculus and sacculus which detect the position of head. It does not play any role in hearing, but is responsible for maintaining the balance of the body and posture.

9. (d) : Language comprehension is a function of cerebrum. Cerebellum coordinates and controls rapid muscular activities such as running, typing etc. Although it does not initiate such voluntary movements, but it is an important centre for coordinating movements and for controlling posture and balance. Cerebellum's function is almost exclusively motor; but it is also implicated in some forms of learning.

10. (d) : Hypothalamus lies at the base of the thalamus. It provides anatomical connection between the nervous and endocrine systems by its relationship to the pituitary gland. Hypothalamus is thermoregulatory centre. Hence, it is called "thermostat" of the body. It keeps body temperature at roughly 37°C by means of a complex thermostat system. Any localised injury to hypothalamus will, hence, disrupt regulation of body temperature.

11. (c) : Retinal pigment is an aldehyde of vitamin A.

12. (c) : In the given figure, A is retina which is the innermost layer, containing photoreceptors rods and cones. B is blind spot. Optic nerves pierce through retina at blind spot. It has no visual cells. C is aqueous humor. It nourishes cornea and lens both of which are avascular. D is sclera. It is the outermost covering and maintains shape of eyeball. It also protects inner layers of the eye.

13. (b) : K^+ ions predominate in the intracellular fluid whereas Na^+ ions predominate in extracellular fluid.

14. (c)

15. (c) : A - Action potential
B - Neurotransmitter
C - Receptor
D - Synaptic vesicles

16. (b) : A - Cerebral hemisphere
B - Thalamus
C - Pons varolii
D - Cerebellum

17. (c) : Brain is the anterior most part of central nervous system. Human brain can be divided into three parts: forebrain, midbrain and hindbrain. Human hindbrain comprises pons, cerebellum and medulla (also called the medulla oblongata).

18. (c) : Vestibular apparatus is a part of inner ear which is located above the cochlea. It consists of three semicircular canals, which detect movements of the head, and the utriculus and sacculus which detect the position of head. It does not play any role in hearing but is responsible for maintaining the balance of the body and posture, thus necessary.

19. (d) : When a neuron is not conducting any impulse, *i.e.*, resting, the axonal membrane is comparatively more permeable to potassium ions (K^+) and nearly impermeable to sodium ions (Na^+).

20. (a) : Hypothalamus is the region of the forebrain in the floor of the third ventricle, linked with the thalamus above and the pituitary gland below. It contains several important centres controlling body temperature, thirst, hunger, and eating, water balance, and sexual function. It is also closely connected with emotional activity and sleep and functions as a centre for the integration of hormonal and autonomic nervous activity through its control of the pituitary secretions.

21. (c) : *Refer to answer 20.*

22. (b) : Alzheimer's disease is a neurological disease characterized by progressive loss of intellectual ability. The disease, which is named after German physician Alois Alzheimer (1864-1915), is associated with general shrinkage of the brain tissue, with deposits of β-amyloid protein and abnormal filaments composed of tau protein in the brain, and changes in the neurotransmitter systems within the brain that include a loss in the activity of cholinergic neurons (neurons releasing acetylcholine). Some inherited forms are associated with a genetic locus on chromosome 21.

23. (c) : Hypothalamus is the thermoregulatory center of the body. It keeps body temperature at 37°C by means of a complex thermostat system.

24. (d) : Cornea is a transparent portion that forms the anterior one-sixth of the eye ball. The cornea admits and helps to focus light waves as they enter the eye. The cornea is avascular (*i.e.*, has no blood supply). This part of eye absorbs oxygen from the air. The cornea was one of the first organs to be successfully transplanted because it lacks blood vessels.

25. (b) : Action potential is the change in electrical potential that occurs across a plasma membrane during the passage of a nerve impulse. As an impulse travels in a wavelike manner along the axon of a nerve, it causes a localized and transient switch in electric potential across the membrane from – 60 mV (millivolts; the resting potential) to + 45 mV. It is due to the fact that the sodium channels open and the potassium channels remain closed. As a result, sodium channels permit the influx of Na^+ by diffusion from extracellular fluid to intracellular fluid.

26. (b) : A → Perilymph
B → Tectorial membrane
C → Endolymph
D → Sensory hair cells

27. (a) : Rod cell is a type of light-sensitive receptor cell present in the retina of vertebrates. Rods contain the pigment rhodopsin and are essential for vision in dim light. They are not evenly distributed on the retina, being absent in the fovea and occupying all of the retinal margin. Cone cell is a type of light-sensitive receptor cell, found in the retina of all diurnal vertebrates. Cones are specialized to transmit information about colour and are responsible for the visual acuity of the eye. They function best in bright light. They contain pigment iodopsin. They are not evenly distributed on the retina.

28. (d) : Nerve is a strand of tissue comprising many nerve fibres plus supporting tissue enclosed in a connective tissue sheath. The signal that travels along the length of a nerve fibre and is the means by which information is transmitted through the nervous system is called nerve impulse. It is marked by the flow of ions across the membrane of the axon caused by changes in the permeability of the membrane, producing a reduction in potential difference that can be detected as the action potential. The strength of the impulse produced in any nerve fibre is constant.

29. (c) : Bowman's gland, also called olfactory gland is any of the branched tubuloalveolar glands situated in the mucous membrane of the olfactory region of the nasal cavity that produce mucus to moisten the olfactory epithelium and dissolve odour-containing gases.

30. (b) : *Refer to answer 29.*

31. (a) : Neurotransmitters are chemicals that are used to relay, amplify and modulate electrical signals between a neuron and another cell. Substances that act as neurotransmitters can be categorized into three major groups: (1) amino acids (primarily glutamic acid, GABA, aspartic acid and glycine), (2) peptides (vasopressin, somatostatin, neurotensin, etc.), and (3) monoamines (norepinephrine, dopamine and serotonin) plus acetylcholine. Cortisone is a

glucocorticoid steroid hormone, produced by the adrenal glands and has anti-inflammatory and immune-system suppressing properties.

32. (c) : Options (a), (b) and (d) are reflex actions.

Autonomic nervous system is involved in peristalsis of intestine which is effected through mysentric plexus.

Sympathetic fibres decrease peristaltic movements while parasympathetic fibres increase these movements.

33. (a) : Abducens is the sixth cranial nerve which innervates the external rectus muscle of the eye ball. It is responsible for turning the eye outwards. Movement of the tongue is controlled by the hypoglossal nerve. Neck movements is controlled by the facial nerve. Swallowing is by glossopharyngeal.

34. (c) : Parkinsonism is caused by degenerations of neurons in Substantia nigra tract which are essentially dopaminergic. This striatum controls muscle tones and coordinates movements. An imbalance is caused by deficiency of dopamine (an inhibitory neurotransmitter) *vis-a-vis*.

35. (c) : In the resting nerve fibre, in the external medium (tissue fluid), sodium ions (Na^+) predominate, whereas within the fibre (intracellular fluid) potassium ions (K^+) predominate. Due to different concentrations of ions on the two sides of the membrane, sodium ions tend to passively diffuse into the nerve fibre and potassium ions tend to diffuse out of the nerve fibre down their electrochemical gradients. The membrane of a resting nerve fibre is, however, more permeable to potassium than to sodium. Because of this selective permeability of the membrane, potassium leaves the nerve fibre faster than sodium enters it. This makes the membrane of the resting nerve fibre polarized, extracellular fluid outside it being electropositive (positively charged) with respect to the cell contents inside it.

36. (a) : Vagus nerve arises from the side of medulla oblongata. It innervates the larynx, trachea, oesophagus, stomach, lungs, heart and intestines. It is a mixed nerve. It controls the visceral sensations and visceral movements, *i.e.*, heart beat, respiratory movements, peristalsis, sound production, etc. Movement of the tongue is controlled by hypoglossal nerve as it innervates the muscles of the tongue.

37. (c) : Cell body of a nerve cell contains basophilic granules called Nissl's granules. These granules appear to be cisternae of rough endoplasmic reticulum with numerous attached and free ribosomes. They probably synthesize proteins for the cell.

38. (b) : At the level of node of Ranvier the myelin sheath is discontinuous but not the neurilemma lining. Actually myelin sheath is an integral part of Schwann cell – which form a continuous neurilemmal covering. Each Schwann cell wrap-around the neurite to form concentric layers of plasma membrane. But at the level of junction between two Schwann cells myelin cannot be formed and thus a gap appears.

39. (b) : The rod cells of eye contain a purplish pigment called visual purple, or rhodopsin. They function in dim light and at night. Bright light splits rhodopsin into a lipoprotein scotopsin and a carotenoid pigment retinene. The splitting of rhodopsin depolarizes the rod cell. In the dark, rhodopsin is resynthesized from scotopsin and retinene. This process is called "dark adaptation." It makes the rods functional. It takes some time for rhodopsin to be reformed. This is why on entering a dark room at daytime or on coming out of a well lighted room at night, we feel blind for a while. When we go from darkness into bright light, we feel difficulty in seeing properly for a moment till rhodopsin is bleached and cones become functional.

40. (c) : Cornea forms the anterior one-sixth of the fibrous coat. It is transparent, circular and fully visible from infront. It is composed of a peculiar variety of connective tissue covered externally by stratified non-keratinized squamous epithelium and internally by simple squamous epithelium. It lacks blood vessels. It is nourished by lymph from adjacent area.

41. (b) : Depolarization of a nerve cell membrane occurs during the passage of an action potential along the axon where the nerve is transmitting an impulse. During depolarization, the activation gates of Na^+ channels open, and the K^+ channels remain closed. Na^+ rush into the axon. Entry of sodium ions leads to depolarization (reversal of polarity) of the nerve membrane, so that the nerve fibre contents become electropositive with respect to the extracellular fluid.

42. (b) : Trigeminal nerve is the largest 5^{th} cranial nerve. It has 3 branches –

(i) Ophthalamic, a sensory branch from skin of the nose, eyelids, forehead and scalp, and from the conjunctiva and lacrimal glands.

(ii) Maxillary, also sensory branch from skin and mucous membrane of cheeks and upper lip, and from lower eyelids.

(iii) Mandibular, a mixed branch innervating the lower jaw, lower lip, pinna and tongue.

Vagus nerve is the 10th cranial nerve and innervates larynx, trachea, oesophagus, stomach, lungs, heart and intestines. Facial nerve is the 7th cranial nerve and innervates muscles of face and back, taste buds and salivary glands.

43. (b) : Sympathetic nervous system is a component of autonomic nervous system consisting of a pair of sympathetic trunks, preganglionic sympathetic fibres, postganglionic sympathetic fibres and collateral ganglia. It quickens rate and force of heart beat while it inhibits secretion of saliva and gastric juice.

44. (d) : Synapse is the close proximity of the axon of one neuron and the dendrite or cyton of another neuron with a gap of just about 200 Å in between. A nerve impulse is transmitted across the synapse by the release from the presynaptic membrane of neurotransmitter, which diffuses across the synaptic cleft to the post synaptic membrane. This triggers the propagation of the impulse from the dendrite along the length of the post synaptic neuron.

45. (a) : Neurons or nerve cells are the structural and functional unit of nervous system. These have a special structure but vary greatly in size and shape. Each neuron has a cell body which encloses cytoplasm and has a nucleus. A number of processes arise from the cell body. There is usually a single axon and a variable number of dendrites. The medullated nerve fibres is composed of a shining, white, fatty substance called myelin.

46. (c) : *Refer to answer 37* .

47. (a) : Photosensitive means sensitive to light. The rod cells of retina contain a purplish pigment called rhodopsin. They function in dim light and at night. Rhodopsin consists of a protein component, opsin, linked to a nonprotein chromophore, retinal (or retinene), a derivative of vitamin A. Light falling on the rod is absorbed by the retinal, which changes its form and separates from the opsin component. This initiates the transmission of a nerve impulse to the brain.

48. (c) : Vagus nerve is the tenth cranial nerve. It arises from the side of medulla oblongata. It innervates the larynx, trachea, oesophagus, stomach, lungs, heart and intestines. It is a mixed nerve. It controls the visceral sensations and visceral movements, *i.e.*, heart beat, respiratory movements, peristalsis, sound production, etc.

49. (a) : The blood is supplied into visceral organs by both SNS (sympathetic nervous system) and PNS (parasympathetic nervous system) involuntarily. The sympathetic fibres increase the rate and force of heart beat, constrict most blood vessels and raise the arterial blood pressure. The parasympathetic fibres decrease the rate and force of heart beat, dilate many blood vessels and lower the arterial blood pressure.

50. (b) : By training, a particular response can be obtained to a stimulus other than the one which normally evokes that response. Such a reflex is known as the conditioned reflex.

The conditioned reflexes were first demonstrated in 1920's by the Russian physiologist I.P. Pavlov. He found that the sight and smell of food reflexly cause flow of saliva in hungry animals. He rang a bell every time he offered food to a dog. The bell did not induce salivation by itself in the beginning of the experiment. Gradually, the dog learnt to associate the bell with food. Eventually, mere ringing of bell, without presenting food, induced salivation in the dog. Thus, ringing of bell can substitute sight of food to cause salivation. Pavlov called sound of the bell as conditioned stimulus, salivation in response to bell a conditioned response, food itself as unconditioned stimulus, and salivation in response to food an unconditioned response. A conditioned reflex is established when a new sensory clue (the bell) becomes associated with an inborn reflex (salivation).

51. (a) : Pupil is the opening which controls the amount of light entering in eye. When light intensity is high, it decrease in size and when light intensity is low it dilates to allow more light in the eye to make eye enable to see the object.

52. (d) : A small area of the optical part of the retina lying exactly opposite to the centre of the cornea is called the macula lutea, or yellow spot which has a yellow pigment (xanthophyll). The macula lutea has at its middle a shallow depression, the fovea centralis. The fovea has cone cells only, and is the place of most distinct vision. Away form the fovea, the rod and cone cells occur in equal numbers, and at the periphery of the retina, the rods are more numerous than the cones. This is why we see better in dimlight by looking out of the corner of the eye. The point on the retina from where the optic nerve starts is called the blind spot, or optic disc, as it lacks the receptor cells and is insensitive to light.

53. (d) : At the junction of the sclera and the cornea, the vascular coat sharply bends into the cavity of the eyeball to form a thin, coloured partition. This partition is called iris. It is perforated at the middle by an aperture called pupil. The iris contains two sets of smooth muscles: sphincters and dilators. These muscles regulate the amount of light entering the

eyeball by varying the size of the pupil. The sphincter muscles are arranged in rings. Their contraction makes the pupil smaller in bright light so that less light enters the eye. The dilator muscles are arranged in a radial manner. Their contraction widens the pupil in dim light to let in more light. Iris, by regulating the size of the pupil, allows light to pass only through the centre of the lens, which is optically the most effective part.

54. (d) : *Refer to answer 53.*

55. (b) : Afferent nerve fibres carry impulses from the receptors to the central nervous system. Efferent nerve fibres conduct nerve impulses from the central nervous system to the effector organs such as muscles and glands.

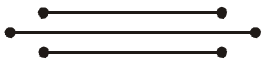
56. (a) : *Refer to answer 48.*

57. (d) : The ventricles consist of four hollow, fluid filled spaces inside the brain. The third ventricle is also known as diacoel. The third ventricle consists of a narrow channel between the hemispheres through the area of the thalamus. It is connected by the cerebral aqueduct or aqueduct of Sylvius or iter in the midbrain portion of the brainstem to the fourth ventricle in the pons and medulla. Metacoel is the IV ventricle, rhinocoel is the I ventricle and paracoel is the II ventricles.

58. (d) : The action of the parasympathetic nervous system is opposite to that of the sympathetic nervous system. If the sympathetic nervous system accelerates an action, the parasympathetic nervous system slows it. However, neither system is exclusively exitatory or inhibitory. The parasympathetic fibres constrict the pupil, decrease the rate and force of heart beat, dilate many blood vessels, lower the arterial blood pressure, quicken the peristaltic movements, and contract the urinary bladder.

59. (a) : *Refer to answer 48.*

60. (b) : The retina consists of both pigmented layer and the sensory layer. The pigment cells reinforce the light absorbing property of choroid in reducing the scattering of light in the eye. The sensory layer consists of rods and cones required for vision.



Chapter

22

Chemical Coordination and Integration

1. GnRH, a hypothalamic hormone, needed in reproduction, acts on
(a) anterior pituitary gland and stimulates secretion of LH and FSH
(b) posterior pituitary gland and stimulates secretion of oxytocin and FSH
(c) posterior pituitary gland and stimulates secretion of LH and relaxin
(d) anterior pituitary gland and stimulates secretion of LH and oxytocin.
(NEET 2017)

2. Hypersecretion of growth hormone in adults does not cause further increase in height, because
(a) epiphyseal plates close after adolescence
(b) bones loose their sensitivity to growth hormone in adults
(c) muscle fibres do not grow in size after birth
(d) growth hormone becomes inactive in adults.
(NEET 2017)

3. A temporary endocrine gland in the human body is
(a) corpus cardiacum (b) corpus luteum
(c) corpus allatum (d) pineal gland.
(NEET 2017)

4. Graves' disease is caused due to
(a) hyposecretion of thyroid gland
(b) hypersecretion of thyroid gland
(c) hyposecretion of adrenal gland
(d) hypersecretion of adrenal gland.
(NEET-II 2016)

5. Name a peptide hormone which acts mainly on hepatocytes, adipocytes and enhances cellular glucose uptake and utilisation.
(a) Insulin (b) Glucagon
(c) Secretin (d) Gastrin
(NEET -II 2016)

6. The posterior pituitary gland is not a 'true' endocrine gland because
(a) it is provided with a duct
(b) it only stores and releases hormones
(c) it is under the regulation of hypothalamus
(d) it secretes enzymes. *(NEET-II 2016)*

7. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other?
(a) Aldosterone Atrial Natriuretic Factor
(b) Relaxin Inhibin
(c) Parathormone Calcitonin
(d) Insulin Glucagon
(NEET-I 2016)

8. The amino acid tryptophan is the precursor for the synthesis of
(a) estrogen and progesterone
(b) cortisol and cortisone
(c) melatonin and serotonin
(d) thyroxine and triiodothyronine.
(NEET-I 2016)

9. Which one of the following hormones is not involved in sugar metabolism?
(a) Insulin (b) Glucagon
(c) Cortisone (d) Aldosterone
(2015)

10. Which one of the following hormones though synthesised elsewhere, is stored and released by the master gland?
(a) Prolactin
(b) Melanocyte stimulating hormone
(c) Antidiuretic hormone
(d) Luteinising hormone *(2015)*

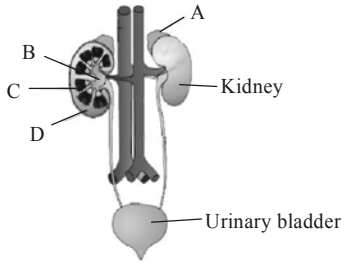
11. A chemical signal that has both endocrine and neural roles is
(a) epinephrine (b) cortisol
(c) melatonin (d) calcitonin.
(2015 Cancelled)

12. Identify the hormone with its correct matching of source and function.
(a) Oxytocin - posterior pituitary, growth and maintenance of mammary glands.

(b) Melatonin - pineal gland, regulates the normal rhythm of sleepwake cycle.
(c) Progesterone - corpus luteum, stimulation of growth and activities of female secondary sex organs.
(d) Atrial natriuretic factor - ventricular wall, increases the blood pressure.
(2014)

13. Fight-or-flight reactions cause activation of
(a) the parathyroid glands, leading to increased metabolic rate
(b) the kidney, leading to suppression of renin-angiotensin-aldosterone pathway
(c) the adrenal medulla, leading to increased secretion of epinephrine and norepinephrine
(d) the pancreas leading to a reduction in the blood sugar levels. *(2014)*

14. Figure shows human urinary system with structures labelled A to D. Select option which correctly identifies them and gives their characteristic and/ or functions.



(a) C - Medulla - inner zone of kidney and contains complete nephrons.
(b) D - Cortex - outer part of kidney and do not contain any part of nephrons.
(c) A - Adrenal gland - located at the anterior part of kidney. Secrete catecholamines which stimulate glycogen breakdown.
(d) B - Pelvis - broad funnel shaped space inner to hilum, directly connected to loops of Henle. *(NEET 2013)*

15. A pregnant female delivers a baby who suffers from stunted growth, mental retardation, low intelligence quotient and abnormal skin. This is the result of
(a) cancer of the thyroid gland
(b) oversecretion of pars distalis
(c) deficiency of iodine in diet
(d) low secretion of growth hormone.
(NEET 2013)

16. Which of the following statements is correct in relation to the endocrine system?
(a) Non-nutrient chemicals produced by the body in trace amounts that act as intercellular messenger are known as hormones.
(b) Releasing and inhibitory hormones are produced by the pituitary gland.
(c) Adenohypophysis is under direct neural regulation of the hypothalamus.
(d) Organs in the body like gastrointestinal tract, heart, kidney and liver do not produce any hormones. *(NEET 2013)*

17. Select the answer which correctly matches the endocrine gland with the hormone it secretes and its function/deficiency symptom.

	Endocrine gland	**Hormone**	**Function/ Deficiency symptoms**
(a)	Thyroid gland	Thyroxine	Lack of iodine in diet results in goitre
(b)	Corpus luteum	Testos -terone	Stimulates spermatogenesis
(c)	Anterior pituitary	Oxytocin	Stimulates uterus contraction during child birth
(d)	Posterior pituitary	Growth hormone (GH)	Oversecretion stimulates abnormal growth

(NEET 2013)

18. Select the option which correctly matches the endocrine gland with its hormone and its function.

	Endocrine gland	**Hormone**	**Function**
(a)	Placenta	Estrogen	Initiates secretion of the milk
(b)	Corpus luteum	Estrogen	Essential for maintenance of endometerium
(c)	Leydig's cells	Androgen	Initiates the production of sperms
(d)	Ovary	FSH	Stimulates follicular development and the secretion of estrogens

(Karnataka NEET 2013)

19. Norepinephrine
(i) is released by sympathetic fibers
(ii) is released by parasympathetic fibers
(iii) increases the heart rate
(iv) decreases blood pressure.
Which of the above statements are correct?
(a) (i) and (iii) (b) (ii) and (iii)
(c) (ii) and (iv) (d) (i) and (iv)
(Karnataka NEET 2013)

20. Which of the following represents the action of insulin?
(a) Increases blood glucose level by stimulating glucagon production.
(b) Decreases blood glucose levels by forming glycogen.
(c) Increases blood glucose levels by promoting cellular uptake of glucose.
(d) Increases blood glucose levels by hydrolysis of glycogen.
(Karnataka NEET 2013)

21. A person entering an empty room suddenly finds a snake right in front on opening the door. Which one of the following is likely to happen in his neuro-hormonal control system?
(a) Sympathetic nervous system is activated releasing epinephrine and norepinephrine from adrenal medulla.
(b) Neurotransmitters diffuse rapidly across the cleft and transmit a nerve impulse.
(c) Hypothalamus activates the para-sympathetic division of brain.
(d) Sympathetic nervous system is activated releasing epinephrine and norepinephrine from adrenal cortex. *(2012)*

22. Which one of the following pairs of hormones are the examples of those that can easily pass through the cell membrane of the target cell and bind to a receptor inside it (mostly in the nucleus)?
(a) Insulin, glucagon
(b) Thyroxine, insulin
(c) Somatostatin, oxytocin
(d) Cortisol, testosterone *(2012)*

23. What is correct to say about the hormone action in humans?
(a) Glucagon is secreted by β-cells of islets of Langerhans and stimulates glycogenolysis.
(b) Secretion of thymosins is stimulated with aging.
(c) In females, FSH first binds with specific receptors on ovarian cell membrane.
(d) FSH stimulates the secretion of estrogen and progesterone. *(2012)*

24. Match the source gland with its respective hormone and function and select the correct option.

	Source gland	**Hormone**	**Function**
(a)	Anterior pituitary	Oxytocin	Contraction of uterus muscles during child birth
(b)	Posterior pituitary	Vasopressin	Stimulates reabsorption of water in the distal tubules in the nephron
(c)	Corpus luteum	Estrogen	Supports pregnancy
(d)	Thyroid	Thyroxine	Regulates blood calcium level

(2011)

25. Given below is an incomplete table on hormones, their source glands and one major effect of each human body. Identify the option representing correct grouping of hormone its gland and effect.

Gland	**Secretion**	**Effect on body**
A	Estrogen	Maintenance of secondary sexual characters
Alpha cells of Islets of Langerhans	B	Raises blood sugar level
Anterior pituitary	C	Over secretion leads to gigantism

	A	**B**	**C**
(a)	Ovary	Glucagon	Growth hormone
(b)	Placenta	Insulin	Vasopressin
(c)	Ovary	Insulin	Calcitonin
(d)	Placenta	Glucagon	Calcitonin

(2011)

26. The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone
(a) calcitonin (b) prolactin
(c) adrenaline (d) melatonin.
(Mains 2011)

27. Injury to adrenal cortex is not likely to affect the secretion of which one of the following?
(a) Aldosterone
(b) Both androstenedione and dehydroepiandrosterone
(c) Adrenaline
(d) Cortisol *(2010)*

28. Low Ca^{++} in the body fluid may be the cause of
(a) tetany (b) anaemia
(c) angina pectoris (d) gout. *(2010)*

29. Which one of the following pairs is incorrectly matched?
(a) Glucagon – Beta cells (source)
(b) Somatostatin – Delta cells (source)
(c) Corpus luteum – Relaxin (secretion)
(d) Insulin – Diabetes mellitus (disease)
(2010)

30. Toxic agents present in food which interfere with thyroxine synthesis lead to the development of
(a) toxic goitre (b) cretinism
(c) simple goitre (d) thyrotoxicosis.
(2010)

31. Select the correct matching of a hormone, its source and function.

	Hormone	Source	Function
(a)	Vasopressin	Posterior pituitary	Increases loss of water through urine
(b)	Norepine-phrine	Adrenal medulla	Increases heart beat, rate of respiration and alterness
(c)	Glucagon	Beta-cells of Islets of Langerhans	Stimulates glycogenolysis
(d)	Prolactin	Posterior pituitary	Regulates growth of mammary glands and milk formation in females

(2010)

32. A health disorder that results from the deficiency of thyroxine in adults and characterised by (i) a low metabolic rate, (ii) increase in body weight and (iii) tendency to retain water in tissues is
(a) simple goitre (b) myxoedema
(c) cretinism (d) hypothyroidism.
(2009)

33. Which one of the following pair of organs includes only the endocrine glands?
(a) Thymus and testes
(b) Adrenal and ovary
(c) Parathyroid and adrenal
(d) Pancreas and parathyroid *(2008)*

34. The blood calcium level is lowered by the deficiency of
(a) both calcitonin and parathormone
(b) calcitonin
(c) parathormone
(d) thyroxine. *(2008)*

35. Feeling the tremors of an earthquake a scared resident of seventh floor of a multistoryed building starts climbing down the stairs rapidly. Which hormone initiated this action?
(a) Adrenaline (b) Glucagon
(c) Gastrin (d) Thyroxine
(2007)

36. A person is having problems with calcium and phosphorus metabolism in his body. Which one of the following glands may not be functioning properly?
(a) Parotid (b) Pancreas
(c) Thyroid (d) Parathyroid
(2007)

37. Which hormone causes dilation of blood vessels, increased oxygen consumption and glucogenesis?
(a) Glucagon (b) ACTH
(c) Insulin (d) Adrenaline
(2006)

38. Which of the following is an accumulation and release centre of neurohormones?
(a) Anterior pituitary lobe
(b) Posterior pituitary lobe
(c) Intermediate lobe of the pituitary
(d) Hypothalamus *(2006)*

39. A steroid hormone which regulates glucose metabolism is
(a) cortisone
(b) cortisol
(c) corticosterone
(d) 11-deoxycorticosterone. *(2006)*

40. Which one of the following is not a secondary messenger in hormone action?
(a) cAMP (b) cGMP
(c) Calcium (d) Sodium *(2006)*

41. Which one of the following statements is correct?
(a) Endocrine glands regulate neural activity, but not *vice versa.*
(b) Neurons regulate endocrine activity, but not *vice versa.*

(c) Endocrine glands regulate neural activity, and nervous system regulates endocrine glands.
(d) Neither hormones control neural activity nor the neurons control endocrine activity. *(2006)*

42. Which one of the following hormones is modified amino acid?
(a) Epinephrine (b) Progesterone
(c) Prostaglandin (d) Estrogen *(2004)*

43. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency?
(a) Luteinizing hormone - Failure of ovulation
(b) Insulin - Diabetes insipidus
(c) Thyroxine - Tetany
(d) Parathyroid hormone - Diabetes mellitus *(2004)*

44. Chemically hormones are
(a) biogenic amines only
(b) proteins, steroids and biogenic amines
(c) proteins only
(d) steroids only. *(2004)*

45. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency ?
(a) Relaxin – Gigantism
(b) Prolactin – Cretinism
(c) Parathyroid hormone – Tetany
(d) Insulin – Diabetes insipidus *(2003)*

46. Acromegaly is caused by
(a) excess of STH
(b) excess of thyroxine
(c) deficiency of thyroxine
(d) excess of adrenaline. *(2002)*

47. Adrenaline directly affects on
(a) S.A. node
(b) β-cells of Langerhans
(c) dorsal root of spinal nerve
(d) epithelial cells of stomach. *(2002)*

48. When both ovaries are removed from rat then which hormone is decreased in blood?
(a) Oxytocin
(b) Prolactin
(c) Estrogen
(d) Gonadotropin releasing factor *(2002)*

49. Mainly which type of hormones control the menstrual cycle in human beings?
(a) FSH (b) LH
(c) FSH, LH, estrogen
(d) progesterone *(2002)*

50. Which set is similar?
(a) Corpus luteum - Graafian follicles
(b) Sebum - Sweat
(c) Bundle of His - Pace maker
(d) Vitamin B_7 - Niacin *(2001)*

51. Melatonin is secreted by
(a) pineal body (b) skin
(c) pituitary gland (d) thyroid. *(2000)*

52. Which gland secretes odorous secretion in mammals?
(a) Bartholins (b) Prostate
(c) Anal gland (d) Liver *(2000)*

53. MSH is secreted by
(a) anterior lobe of pituitary
(b) middle lobe of pituitary
(c) posterior lobe of pituitary
(d) endostyle. *(2000)*

54. Cholecystokinin and duocrinin are secreted by
(a) adrenal cortex (b) thyroid gland
(c) intestine (d) pancreas. *(1999)*

55. The function of oxytocin is to help in
(a) child birth (b) gametogenesis
(c) growth (d) lactation. *(1999)*

56. Secretion of progesterone by corpus luteum is initiated by
(a) testosterone (b) thyroxine
(c) MSH (d) LH. *(1999)*

57. The gonadotrophic hormones are secreted by
(a) anterior lobe of pituitary
(b) interstitial cells of testes
(c) adrenal cortex
(d) posterior part of thyroid. *(1999)*

58. Diabetes is due to
(a) enzyme deficiency
(b) iodine deficiency
(c) Na^+ deficiency
(d) hormonal deficiency. *(1999)*

59. Calcitonin is a thyroid hormone which
(a) elevates calcium level in blood
(b) has no effect on calcium
(c) elevates potassium level in blood
(d) lowers calcium level in blood. *(1998)*

60. The hormone that stimulates the stomach to secrete gastric juice is
(a) enterokinase (b) enterogastrone
(c) gastrin (d) renin. *(1998)*

61. The contraction of gall bladder is due to
(a) cholecystokinin (b) enterogastrone
(c) gastrin (d) secretin. *(1998)*

62. The hormone which regulates the basal metabolism in our body is secreted from
(a) adrenal cortex (b) pancreas
(c) pituitary (d) thyroid. *(1998)*

63. Hormones thyroxine, adrenaline and the pigment melanin are formed from
(a) tyrosine (b) proline
(c) tryptophan (d) glycine. *(1997)*

64. Which hormone stimulates the secretion of milk from female?
(a) Oxytocin (b) Progesterone
(c) LH (d) Prolactin *(1996)*

65. Which one of the following endocrine glands stores its secretion in the extracellular space before discharging it into the blood?
(a) Testis (b) Thyroid
(c) Pancreas (d) Adrenal *(1995)*

66. According to the accepted concept of hormone action, if receptor molecules are removed from target organs, then the target organ will
(a) continue to respond to the hormone without any difference
(b) not respond to the hormone
(c) continue to respond to the hormone but will require higher concentration
(d) continue to respond to the hormone but in the opposite way. *(1995)*

67. The immediate cause of induction of ovulation in human female is the large plasma surge of
(a) LH (b) FSH
(c) progesterone (d) estradiol. *(1994)*

68. Testosterone is produced by
(a) sertoli cells (b) Leydig's cells
(c) oxyntic cells (d) pituitary gland. *(1993)*

69. Gastric secretion is stopped by hormone
(a) enterogastrone (b) gastrin
(c) pancreozymin (d) cholecystokinin. *(1993)*

70. ADH or vasopressin is
(a) enzyme that hydrolyses peptides
(b) hormone secreted by pituitary that promotes reabsorption of water from glomerular filtrate
(c) hormone that promotes glycogenolysis
(d) energy rich compound connected with muscle contraction. *(1991)*

71. Occurrence of Leydig's cells and their secretion is
(a) ovary and estrogen
(b) liver and cholesterol
(c) pancreas and glucagon
(d) testis and testosterone. *(1991)*

72. Insulin is a
(a) vitamin (b) lipid
(c) hormone (d) enzyme. *(1990)*

73. Addition of a trace of thyroxine or iodine in water containing tadpoles will
(a) keep them in larval stage
(b) hasten their metamorphosis
(c) slow down their metamorphosis
(d) kill the tadpoles. *(1990)*

74. Which hormone possesses anti-insulin effect?
(a) Cortisol (b) Calcitonin
(c) Oxytocin (d) Aldosterone *(1988)*

75. MSH of pars intermedia of middle pituitary is responsible for
(a) darkening of skin in lower vertebrates
(b) light colouration of skin in lower vertebrates
(c) both A and B
(d) darkening of skin in human beings. *(1988)*

Answer Key

1.	(a)	**2.**	(a)	**3.**	(b)	**4.**	(b)	**5.**	(a)	**6.**	(b)	**7.**	(b)	**8.**	(c)	**9.**	(d)	**10.**	(c)
11.	(a)	**12.**	(b)	**13.**	(c)	**14.**	(c)	**15.**	(c)	**16.**	(a)	**17.**	(a)	**18.**	(c)	**19.**	(a)	**20.**	(b)
21.	(a)	**22.**	(d)	**23.**	(c)	**24.**	(b)	**25.**	(a)	**26.**	(d)	**27.**	(c)	**28.**	(a)	**29.**	(a)	**30.**	(c)
31.	(b)	**32.**	(b)	**33.**	(c)	**34.**	(c)	**35.**	(a)	**36.**	(d)	**37.**	(d)	**38.**	(d)	**39.**	(b)	**40.**	(d)
41.	(c)	**42.**	(a)	**43.**	(a)	**44.**	(b)	**45.**	(c)	**46.**	(a)	**47.**	(a)	**48.**	(c)	**49.**	(c)	**50.**	(a)
51.	(a)	**52.**	(c)	**53.**	(b)	**54.**	(c)	**55.**	(d)	**56.**	(d)	**57.**	(a)	**58.**	(d)	**59.**	(d)	**60.**	(c)
61.	(a)	**62.**	(d)	**63.**	(a)	**64.**	(d)	**65.**	(b)	**66.**	(b)	**67.**	(a)	**68.**	(b)	**69.**	(a)	**70.**	(b)
71.	(d)	**72.**	(c)	**73.**	(b)	**74.**	(a)	**75.**	(a)										

EXPLANATIONS

1. (a) : Gonadotropin releasing hormone (GnRH) is secreted by the hypothalamus which stimulates the anterior lobe of pituitary gland to secrete luteinising hormone (LH) and Follicle Stimulating Hormone (FSH).

2. (a) : Epiphyseal plate is a hyaline cartilage plate in the metaphysis at each end of long bone. It is part of long bone where new bone growth takes place. In adults, elevated levels of GH results in acromegaly where no increase in height occurs because of ossified epiphyseal plate.

3. (b) : Corpus luteum is a temporary endocrine gland in human females. It secretes progesterone which stimulates the uterine glands to produce increased amount of watery mucus and is also essential for maintenance of endothelium. In absence of fertilisation, corpus luteum disintegrate leading to menstruation.

4. (b) : Exophthalmic goitre or Graves' disease is a thyroid enlargement (goitre) in which the thyroid secretes excessive amount of thyroid hormone. It is characterised by exophthalmia (protrusion of eye balls because of fluid accumulation behind them), loss of weight, slightly rise in the body temperature, excitability, rapid heart beat, nervousness and restlessness.

5. (a) : Insulin is a peptide hormone, secreted by the β cells of the islets of Langerhans in the pancreas, that promotes the uptake of glucose by body cells, particularly in the liver (hepatocytes) and muscles (adipocytes), and thereby controls its concentration in the blood.

6. (b) : Posterior lobe of pituitary gland does not secrete any hormone. Its hormones are synthesised by the hypothalamus. It only stores and releases these hormones. Hence, it cannot be considered as true gland.

7. (b) : Relaxin hormone is secreted by ovary and placenta during pregnancy, which relaxes ligaments in pelvis and softens and widens cervix during childbirth. Inhibin secreted by granulosa cells in the ovaries inhibits secretion of FSH by anterior pituitary. Thus, relaxin and inhibin have different functions and are not antagonistic.

8. (c) : Tryptophan is an essential amino acid which is precursor for the synthesis of melatonin and serotonin.

9. (d) : Aldosterone (salt-retaining hormone) is the principal mineralocorticoid in humans, secreted by adrenal cortex. Its main function is to regulate sodium content of the body.

10. (c) : Two hormones *viz* oxytocin (OT) and antidiuretic hormone (ADH) are synthesised in the hypothalamus, but stored and released by the posterior lobe of pituitary gland.

11. (a) : Hormones epinephrine and norepinephrine are secreted from adrenal medulla. They are emergency hormones released in condition of stress, emergency etc. Epinephrine and norepinephrine are also released by adrenergic nerve fibres of sympathetic nervous system where they act as neurotransmitters.

12. (b) : Oxytocin is produced by hypothalamus and generally secreted by posterior pituitary. It stimulates secretion of milk from mammary glands; causes contraction of uterus at the time of child birth.
Progesterone is secreted by corpus luteum. It stimulates uterus for pregnancy, implantation, formation of placenta and development of mammary glands.
Atrial natriuretic factor is secreted by atrial wall in response to an increased return of the venous blood. This hormone regulates the blood volume through increased excretion of ions and water.

13. (c) : *Refer to answer 11.*

14. (c) : In the given figure, A is adrenal gland which secretes two catecholamines; adrenaline (epinephrine) and noradrenaline (norepinephrine). Adrenaline increases the conversion of glycogen to glucose providing quick energy for "fight or flight" response. B is renal pelvis which is a sac like cavity of the kidney leading to ureters, is not directly connected to loop of Henle. C is medulla, the inner region of kidney containing loop of Henle, collecting ducts and ducts of Bellini. D is cortex which has proximal and distal convoluted tubules and contains Malpighian corpuscles.

15. (c) : Iodine is needed for the synthesis of T_3 and T_4. Iodine binds to the tyrosine residues in thyroglobulin, which is then hydrolysed into iodotyrosines that combine to form triiodothyronine (T_3) or thyroxine (tetra-iodothyronine or T_4). Therefore, deficiency of iodine in the diet of a pregnant female will lead to improper synthesis of thyroid hormones in newly borne infant. The

deficiency of thyroid hormones in infants causes 'cretinism' whose symptoms are slow heart beat, lower blood pressure, decrease in temperature, stunted growth, low intelligence quotient and abnormal skin.

16. (a) : Releasing and inhibiting factors are released by hypothalamus. The hypothalamus is connected to adenohypophysis by hypophysial portal vein and is connected to the neurohypophysis by axons of neurosecretory cells. Hence, neurohypophysis is directly under the neural control. The cardiocytes of atria of the heart secrete peptide hormone, called atrial natriuretic factor (ANF) in response to an increased return of the deoxygenated (venous) blood. The liver produces angiotensinogen which is changed to angiotensin II by an enzyme renin secreted by juxtaglomerular apparatus (JGA).

17. (a) : Iodine is required for production of thyroxine, thus lack of iodine results in hyposecretion of thyroxine. To compensate, thyroid gland enlarges and the condition is known as goitre. Corpus luteum secretes progesterone which maintains uterine endothelium and mucus secretion in uterus, Fallopian tubes and vagina. Oxytocin stimulates uterine contractions but is secreted by posterior pituitary. Anterior pituitary secretes GH, whose oversecretion causes abnormal growth.

18. (c) : Interstitial cells (or Leydig 's cells) are the cells interspersed between the seminiferous tubules of the testis. They secrete androgens including testosterone in response to stimulation by luteinizing hormone from the anterior pitutary gland. Androgens produce and maintain male characteristics and stimulate germinal epithelium to undergo spermatogenesis.

19. (a) : Norepinephrine is secreted by some neurons of the sympathetic nervous system and also by adrenal medulla. It accelerates heart rate.

20. (b) : *Refer to answer 5.*

21. (a) : *Refer to answer 11.*

22. (d) : Steroid hormones such as cortisol, testosterone, estradiol and progesterone, mostly regulate gene expression or chromosome function by the interaction of hormone-receptor complex with the genome. So, these easily pass through the cell membrane of the target cell and bind to a receptor inside it.

23. (c) : Hormone action involves their reception by target cells. Specific proteins called hormone receptors that are located in target tissues only bind with these hormones. Hormone receptor may be of two types: membrane bound receptor and intracellular receptors. Steroid hormones etc., bind with intracellular receptors while some hormones *e.g.*, pituitary hormones like FSH etc., bind with membrane bound receptors.

24. (b) : Posterior lobe of pituitary stores and releases two hormones, called oxytocin and vasopressin. These hormones are actually produced by the neurosecretary cells in the hypothalamus and stand in the terminals of their axons that pass into the posterior lobe through a stalk. They are released *via* posterior lobe when required. Vasopressin is also called antidiuretic hormone (ADH). It decreases the loss of water in the urine by increasing reabsorption of water in the distal convoluted tubules, collecting tubules and collecting ducts in the kidneys.

25. (a) : The correct option for the three blanks A, B and C are ovary, glucagon and growth hormone respectively.

26. (d) : Melatonin is a hormone secreted by the pineal gland and retinas of vertebrates. Melatonin secretion by the pineal gland is linked to the dark-light cycle of the organism's environment, being greatest at night and lowest by day. The hormone is involved in regulating certain diurnal and seasonal changes in the body, such as the reproductive cycle in seasonally breeding animals. It is used as a drug to treat sleep disorders and symptoms of jet lag.

27. (c) : Adrenal glands or (suprarenal glands) are two triangular endocrine glands, each of which covers the superior surface of a kidney. Each gland has two parts, the medulla and cortex. The medulla forms the grey core of the gland; it consists mainly of chromaffin tissue and is stimulated by the sympathetic nervous system to produce adrenaline and noradrenaline. The cortex is a yellowish tissue surrounding the medulla. It is stimulated by pituitary hormones (principally ACTH) to produce three kinds of corticosteroid hormones, which affect carbohydrate metabolism (*e.g.*, cortisol), electrolyte metabolism (*e.g.*, aldosterone), and the sex glands (oestrogens and androgens). Thus injury to adrenal cortex is not likely to affect the secretion of adrenaline.

28. (a) : Tetany is a spasm and twitching of the muscles, particularly those of the face, hands, and feet. Tetany is usually caused by a reduction in the blood calcium level, which may be due to underactive parathyroid glands, rickets, or alkalosis.

29. (a) : Glucagon is a hormone, secreted by the cells of the islets of Langerhans in the pancreas, that increases the concentration of glucose in the blood

by stimulating the metabolic breakdown of glycogen. It thus antagonizes the effects of insulin.

30. (c) : *Refer to answer 17.*

31. (b) : Vasopressin reduces water loss through urine by stimulating resorption of water by the distal tubules of the kidney. Glucagon is released from α-cells. Prolactin is produced from anterior pituitary.

32. (b) : Myxoedema is caused by deficiency of thyroid hormone or thyroxine in adults. It is characterized by low metabolic rate, body gain, puffy appearance, low body temperature etc. This disease can be treated by administration of thyroid hormones.

33. (c) : Parathyroid and adrenal glands are the endocrine glands because they manufacture hormones and secretes them directly into the blood stream to act at distant sites in the body. Thyroid and pituitary are its other examples.

34. (c) : Parathormone is secreted by chief cells of the parathyroid that regulates the metabolism of calcium and phosphate. It increases calcium absorption from the intestine and also increases calcium resorption from the nephrons of the kidneys. So its deficiency leads to low blood calcium level.

35. (a) : Adrenaline (epinephrine), also called emergency hormone, is a hormone, produced by the medulla of the adrenal glands, that increases heart activity, improves the power and prolongs the action of muscles, and increases the rate and depth of breathing to prepare the body for 'fright, flight, or fight'. At the same time it inhibits digestion and excretion. Similar effects are produced by stimulation of the sympathetic nervous system.

36. (d) : *Refer to answer 34.*

37. (d) : Adrenaline is the hormone secreted by adrenal medulla. It prepares the animal to face special conditions created by physical stress. All these conditions require more energy which is provided by increasing heart beat, blood pressure, respiratory rate, sugar level of blood, blood supply of heart and skeletal muscles and brain through dilation of their small arteries, and oxidative metabolism. It also stimulates the breakdown of liver and muscle glycogen (glucogenesis) to provide glucose for respiration.

38. (d) : *Refer to answer 16.*

39. (b) : *Refer to answer 27.*

40. (d) : Secondary messengers are low-weight diffusible molecules that are used to relay signals within a cell. They are synthesized or released by specific enzymatic reactions, usually as a result of an external signal that is received by a transmembrane receptor. cAMP, cGMP and Ca^{2+} act as secondary messengers and are located within the cytoplasm. Sodium is an essential nutrient which helps to maintain blood volume and keeps nerves functioning.

41. (c) : The endocrine system links the brain to the organs that control body metabolism, growth and development, and reproduction. The endocrine system is regulated by feedback. For example, the hormones that are regulated by the pituitary gland, a signal is sent from the hypothalamus to the pituitary gland in the form of a "releasing hormone," which stimulates the pituitary to secrete a "stimulating hormone" into the circulation. The stimulating hormone then signals the target gland to secrete its hormone. As the level of this hormone rises in the circulation, the hypothalamus and the pituitary gland shut down secretion of the releasing hormone and the stimulating hormone, which in turn slows the secretion by the target gland. This system results in stable blood concentrations of the hormones that are regulated by the pituitary gland.

42. (a) : Epinephrine is synthesized from tyrosine which is a non-essential amino acid possessing cyclic structure with a straight side chain bearing carboxylic and amino group. The conversion of tyrosine to epinephrine involves 4 steps – (i) ring hydroxylation (ii) decarboxylation, (iii) side-chain hydroxylation (iv) N-methylation.

Tyrosine $\rightarrow$ Dopa $\rightarrow$ Dopamine $\rightarrow$ Norepinephrine $\rightarrow$ Epinephrine.

43. (a) : Ovulation occurs under the influence of luteinizing hormone and FSH (follicle stimulating hormone) of anterior pituitary gland. Thus, deficiency of luteinizing hormone results in failure of ovulation.

44. (b) : Hormones are chemical messengers produced by the ductless glands (sometimes by neurons) and transported in the circulation to target cells. They regulate metabolic processes. Chemically hormones are of different nature like biogenic amines (like thyroxine, adrenaline etc), proteinaceous or polypeptide (like hypothalamic hormones etc.) and steroids (like sex hormones and adrenocorticoids).

45. (c) : *Refer to answer 28.*

46. (a) : Acromegaly is caused by excess of STH (somatotrophic hormone), released by anterior lobe of pituitary after adolescence. The bones of the lower jaw and limbs become abnormally enlarge but the body does not attain a giant stature. Excess of thyroxine causes cretinism and myxoedema. Excess of adrenaline causes increased BMR, heart beat, excitement etc.

47. (a) : Adrenaline directly affects the SA node to increase rate of heartbeat. Adrenaline prepares the body for emergency reactions like fight and flight. Thus there is increase in heart rate, breathing rate, blood pressure, glucose level in blood, peripheral circulation, etc.

48. (c) : Ovary secretes two hormones. Oestrogen before ovulation and progesterone after ovulation. Oxytocin, prolaction are pituitary hormones and gonadotropin releasing factor is secreted by hypothlalamus of brain to stimulate pituitary for the secretion of gonadotropic hormones.

49. (c) : Menstrual cycle is controlled by several endocrinal parameters.

In beginning of the cycle FSH (follicle stimulating hormone) of pituitary initiates development of an ovarian follicle. A growing ovarian follicle gradually secretes increasing amount of estrogen. This in turn leads to sudden surge of LH secretion by the pituitary. As the LH (leutinising hormone) level in blood suddenly increases there is ovulation.

Thus only FSH or LH cannot control all the events of menstrual cycle. Progesteron is released by a corpus luteum after ovulation which actually prepares the uterus for a possible pregnancy.

If there is no fertilisation progesteron level falls and there is beginning of a new cycle.

50. (a) : After ovulation many of the follicular cells remain in the collapsed Graafian follicle on the surface of the ovary. The antrum (cavity) of the collapsed follicle fills with a partially clotted fluid. The follicular cells enlarge and fill with a yellow pigment, lutein. Such a follicle is called a corpus luteum.

51. (a) : *Refer to answer 26.*

52. (c) : The anal glands are small paired sacs located on either side of the anus between the external and internal sphincter muscles. These sebaceous glands within the lining secrete a foul smelling liquid that is used for identification of members within a species. These glands are found in all carnivora except bears.

53. (b) : Middle lobe of pituitary secretes a hormone named melanocyte-stimulating hormone. It stimulates the synthesis of black pigment melanin in the skin, and also causes dispersal of melanin granules in the pigment cells, thereby darkening the colour in certain animals (fishes amphibians). In man it has no such role. Anterior lobe of pituitary secretes FSH, LH, TSH, ACTH and STH. Posterior lobe of pituitary secretes oxytocin and vasopressin.

54. (c) : Cholecystokinin and duocrinin are secreted by intestine. It stimulates pancreas to release enzymes in pancreatic juice and stimulates gall bladder to release bile. Duocrinin causes release of viscous mucus from Brunner's glands into intestinal juice.

55. (d) : *Refer to answer 12.*

56. (d) : Luteinsing Hormone (LH) in the male, induces the interstitial cells of the testes to produce male sex hormones named androgens such as testosterone. In the female, the luteinising hormone causes ovulation, secretion of female sex hormone, estrogen from the maturing ovarian follicle, and progesterone by the corpus luteum.

57. (a) : Gonadotrophic hormones are secreted by anterior lobe of pituitary gland. They are as follows:

(i) Follicle-stimulating hormone (FSH): It stimulates growth of ovarian follicles and their secretion of estrogens in the female, and spermatogenesis (formation of sperms) in the male.

(ii) Interstitial cell stimulating hormone (ICSH): It activates the Leydig's (interstitial) cells of the testis to secrete androgens. In female, it stimulates the corpus luteum of the ovary to secrete progesterone. In female it is termed luteinizing hormone (LH).

58. (d) : Diabetes mellitus is caused by the deficiency of hormone insulin which is secreted by pancreas. Insulin lowers the blood-glucose level. Deficiency of antidiuretic hormone (ADH) leads to diabetes insipidus.

59. (d) : Calcitonin is secreted by the C cells. It regulates the concentration of calcium and phosphorus in the blood. It is under the feedback control of plasma calcium concentration, and is secreted when concentration of calcium rises in the blood. It then lowers the concentration of calcium and phosphorus in the plasma by decreasing their release from the bones.

60. (c) : Gastrin hormone is secreted by mucosa of stomach and it stimulates secretion of gastric juice. Enterogastrone is secreted by duodenal epithelium. Enterokinase is an enzyme that converts trypsinogen into trypsin. Renin is secreted by kidneys. It acts on angiotensinogen to form angiotensin-II.

61. (a) : *Refer to answer 54.*

62. (d) : The basal metabolism is the minimum amount of energy the body uses in order to maintain vital processes of the body. Generally, this expenditure of energy is expressed in terms of heat production per unit of body surface per day on the basal metabolic rate (BMR). Thyroid is the largest endocrine gland

secreting three hormones thyroxine, triiodothyronine and calcitonin. Thyroxine and triiodothyronine control BMR of the body by regulating the rate of oxidation and production of energy.

63. (a) : Hormones thyroxine, adrenaline and the pigment melanin are formed from tyrosine. Tyrosine is transformed into dopa through the enzyme tyrosinase. Then through different metabolic pathways it produces thyroxine, adrenaline, melanin etc.

64. (d) : Prolactin hormone stimulates the growth of milk glands during pregnancy and the secretion of milk after delivery. Oxytocin causes release of milk during sucking by the infant. LH causes ovulation and secretion of estrogen and progesterone from ovarian follicle and corpus luteum respectively. Oxytocin, LH and prolactin are released by anterior lobe of pituitary gland. Progesterone is secreted by corpus luteum.

65. (b) : The thyroid gland secretes three hormones: thyroxine or tetraiodothyronine (T_4), triiodothyronine (T_3) and calcitonin. Thyroxine and Triiodothyronine are iodinated forms of the amino acid tyrosine. They are stored in the colloid that fills the follicles, and are released to the blood when needed. The storage occurs in an unusual place, the extracellular colloid.

66. (b) : The molecules of hormones that are amino acid derivatives, peptides or proteins are large and insoluble in lipids, and cannot enter the target cell. Therefore, they act at the cell surface. They bind to specific receptor molecules located on the surface of the cell membrane. Therefore, if receptor molecules are removed from target organs, then the target organ will not respond to the hormone.

67. (a) : *Refer to answer 64.*

68. (b) : *Refer to answer 18.*

69. (a) : Enterogastrone is secreted by duodenal epithelium and it slows gastric contractions to delay its emptying and also stops secretion of gastric juice. Gastrin stimulates secretion of gastric juice. Cholecystokinin stimulates release of enzymes in pancreatic juice and release of bile from gall bladder. Cholecystokinin is also known as pancreozymin.

70. (b) : *Refer to answer 24.*

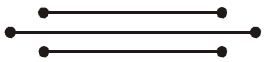
71. (d) : *Refer to answer 18.*

72. (c) : *Refer to answer 5.*

73. (b) : In 1912, Gudernatsch discovered that metamorphosis in frog's tadpole is increased by the thyroxine hormone which has the iodine as the main constituent. If thyroxine or iodine in added in water having tadpoles in it, then it increases the rate of metamorphosis in tadpole.

74. (a) : Insulin decreases the level of glucose in the blood while cortisol (secreted by middle region of adrenal cortex) increases the blood-glucose level by converting proteins and fats into carbohydrates which are, in turn, converted to glucose.

75. (a) : Pars intermedia is the boundary between the anterior and posterior lobes of the pituitary. It contains three types of cells - basophils, chromophobes and colloid-filled cysts. This area produces melanocyte stimulating hormone or MSH. It stimulates the synthesis of black pigment melanin in the skin and also causes dispersion of melanin granules in the pigment cells, thereby darkening the colour in certain animals (fishes; amphibians). In man it has no such role.



Chapter
23
Reproduction in Organisms

1. Which one of the following statements is not correct?
(a) Offspring produced by the asexual reproduction are called clone.
(b) Microscopic, motile, asexual reproductive structures are called zoospores.
(c) In potato, banana and ginger, the plantlets arise from the internodes present in the modified stem.
(d) Water hyacinth, growing in the standing water, drains oxygen from water that leads to the death of fishes. *(NEET-II 2016)*

2. Which one of the following generates new genetic combinations leading to variation?
(a) Vegetative reproduction
(b) Parthenogenesis
(c) Sexual reproduction
(d) Nucellar polyembryony *(NEET-II 2016)*

3. Match column I with column II and select the correct option using the codes given below.

Column I	**Column II**
A. Pistils fused together	(i) Gametogenesis
B. Formation of gametes	(ii) Pistillate
C. Hyphae of higher Ascomycetes	(iii) Syncarpous
D. Unisexual female flower	(iv) Dikaryotic

(a) A-(iv), B-(iii), C-(i), D-(ii)
(b) A-(ii), B-(i), C-(iv), D-(iii)
(c) A-(i), B-(ii), C-(iv), D-(iii)
(d) A-(iii), B-(i), C-(iv), D-(ii)
(NEET-II 2016)

4. Which of the following pairs is not correctly matched?

	Mode of reproduction	**Example**
(a)	Binary fission	*Sargassum*
(b)	Conidia	*Penicillium*
(c)	Offset	Water hyacinth
(d)	Rhizome	Banana

(2015)

5. In ginger, vegetative propagation occurs through
(a) bulbils (b) runners
(c) rhizome (d) offsets.
(2015 Cancelled)

6. In oogamy, fertilization involves
(a) a small non-motile female gamete and a large motile male gamete
(b) a large non-motile female gamete and a small motile male gamete
(c) a large non-motile female gamete and a small non-motile male gamete
(d) large motile female gamete and a small non-motile male gemete. *(2004)*

7. During regeneration, modification of an organ to other organ is known as
(a) morphogenesis (b) epimorphosis
(c) morphallaxis
(d) accretionary growth. *(2001)*

8. The process of series of changes from larva to adult after embryonic development is called
(a) regeneration (b) growth
(c) metamorphosis (d) ageing. *(1999)*

9. 'Nothing lives forever, but life continues'. What does it mean?
(a) Older die but new are produced due to reproduction.
(b) Nothing can produce without death.
(c) Death has nothing to do with the continuation of life.
(d) Parthenogenesis is must for sexual reproduction. *(1995)*

Answer Key

1. (c) **2.** (c) **3.** (d) **4.** (a) **5.** (c) **6.** (b) **7.** (b) **8.** (c) **9.** (a)

EXPLANATIONS

1. (c) : Potato, banana and ginger propagate vegetatively by their modified stems. Potato propagates by tuber which has buds over its eyes or nodes. These buds produce new plantlets. Banana and ginger propagate with the help of rhizomes which also have buds on nodes for the formation of new plantlets.

2. (c) : Sexual reproduction involves formation and fusion of male and female gametes. Gamete formation is accomplished through meiotic cell division which involves crossing over between non-sister chromatids of homologous chromosomes leading to new genetic recombination in gametes. Random fusion of these male and female gametes lead to the genetic variability in the offspring which although resemble their parents but also exhibit new traits of their own.

3. (d)

4. (a) : *Sargassum* is a brown alga. In brown algae, asexual reproduction occurs by means of spores and sexual reproduction varies from isogamy, anisogamy to oogamy.

5. (c) : The rhizome is a thickened, underground, dorsiventral stem that grows horizontally at a particular depth within the soil. It is brown in colour and shows cymose branching. It can be distinguished from the modified root by the presence of nodes, internodes, terminal buds, axillary buds and scale leaves. The rhizome are perennial and propagate vegetatively. They store food materials and appear tuberous. *E.g., Zingiber officinale* (ginger), *Curcuma longa* (turmeric), *Canna indica.*

6. (b) : Oogamy is the sexual reproduction involving the formation and subsequent fusion of a large, usually stationary, female gamete and a small motile male gamete. The female gamete may contain nourishment for the development of the embryo, which is often retained and protected by the parent organism.

7. (b) : There are two mechanisms of regeneration: morphallaxis and epimorphosis.
(i) Morphallaxis - It involves the reconstruction of the whole body from a small fragment by reorganizing the existing cells. The regenerated organism is smaller than the original one, *e.g.*, *Amoeba*. However, after the completion of the process it grows and attains normal size after some time.
(ii) Epimorphosis - It replaces a lost organ of the body by proliferating new cells from the surface of the wound or injured part. Regeneration of an appendage in an arthropod, arm in a starfish, and tail in a lizard occurs by the process of epimorphosis.

8. (c) : Metamorphosis is a process of series of changes of form from larva to adult after embryonic development.
Regeneration is defined as replacement, repair or restoration of the lost or damaged structures or reconstitution of the whole body from a small fragment of it during the post-embryonic life of an organism. Growth is the result of greater anabolic (synthetic) processes over the catabolic (destructive) processes in the organism. Ageing may be defined as the progressive deterioration in the structure and functions of the cells, tissues and organs of an organism with the advancing age.

9. (a) : Death is a natural process by which the individuals die either naturally or due to illness, accident etc. But, before dying generally, individuals leave new individuals of their own kind through reproduction and thus the life continues.

Chapter

24

Sexual Reproduction in Flowering Plants

1. Functional megaspore in an angiosperm develops into an
(a) endosperm (b) embryo sac
(c) embryo (d) ovule.
(NEET 2017)

2. Attractants and rewards are required for
(a) entomophily (b) hydrophily
(c) cleistogamy (d) anemophily.
(NEET 2017)

3. Flowers which have single ovule in the ovary and are packed into inflorescence are usually pollinated by
(a) bee (b) wind
(c) bat (d) water.
(NEET 2017)

4. A dioecious flowering plant prevents both
(a) autogamy and geitonogamy
(b) geitonogamy and xenogamy
(c) cleistogamy and xenogamy
(d) autogamy and xenogamy. *(NEET 2017)*

5. Double fertilisation is exhibited by
(a) algae (b) fungi
(c) angiosperms (d) gymnosperms.
(NEET 2017)

6. In majority of angiosperms
(a) egg has a filiform apparatus
(b) there are numerous antipodal cells
(c) reduction division occurs in the megaspore mother cells
(d) a small central cell is present in that embryo sac. *(NEET-II 2016)*

7. Pollination in water hyacinth and water lily is brought about by the agency of
(a) water (b) insects or wind
(c) birds (d) bats.
(NEET-II 2016)

8. The ovule of an angiosperm is technically equivalent to
(a) megasporangium
(b) megasporophyll
(c) megaspore mother cell
(d) megaspore. *(NEET-II 2016)*

9. The coconut water from tender coconut represents
(a) free nuclear proembryo
(b) free nuclear endosperm
(c) endocarp
(d) fleshy mesocarp. *(NEET-I 2016)*

10. Which one of the following statements is not true?
(a) Pollen grains of many species cause severe allergies.
(b) Stored pollen in liquid nitrogen can be used in the crop breeding programmes.
(c) Tapetum helps in the dehiscence of anther.
(d) Exine of pollen grains is made up of sporopollenin. *(NEET-I 2016)*

11. Seed formation without fertilisation in flowering plants involves the process of
(a) somatic hybridisation
(b) apomixis (c) sporulation
(d) budding. *(NEET-I 2016)*

12. Which of the following statements is not correct?
(a) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.
(b) Some reptiles have also been reported as pollinators in some plant species.
(c) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.
(d) Insects that consume pollen or nectar without bringing about pollination are called pollen/ nectar robbers.
(NEET-I 2016)

13. Proximal end of the filament of stamen is attached to the
(a) placenta (b) thalamus or petal
(c) anther (d) connective.
(NEET-I 2016)

14. Filiform apparatus is characteristic feature of
(a) aleurone cell (b) synergids
(c) generative cell (d) nucellar embryo.
(2015)

15. In angiosperms, microsporogenesis and megasporogenesis
(a) involve meiosis (b) occur in ovule
(c) occur in anther
(d) form gametes without further divisions.
(2015)

16. Flowers are unisexual in
(a) China rose (b) onion
(c) pea (d) cucumber.
(2015)

17. Coconut water from a tender coconut is
(a) innermost layers of the seed coat
(b) degenerated nucellus
(c) immature embryo
(d) free nuclear endosperm. *(2015)*

18. Which one of the following fruits is parthenocarpic?
(a) Jackfruit (b) Banana
(c) Brinjal (d) Apple
(2015)

19. Male gametophyte in angiosperms produces
(a) single sperm and two vegetative cells
(b) three sperms
(c) two sperms and a vegetative cell
(d) single sperm and a vegetative cell.
(2015)

20. Which of the following are the important floral rewards to the animal pollinators ?
(a) Floral fragrance and calcium crystals
(b) Protein pellicle and stigmatic exudates
(c) Colour and large size of flower
(d) Nectar and pollen grains
(2015 Cancelled)

21. Which one of the following may require pollinators, but is genetically similar to autogamy?
(a) Apogamy (b) Cleistogamy
(c) Geitonogamy (d) Xenogamy
(2015 Cancelled)

22. Which one of the following statements is not true?
(a) The flowers pollinated by flies and bats secrete foul odour to attract them.
(b) Honey is made by bees by digesting pollen collected from flowers.
(c) Pollen grains are rich in nutrients and they are used in the form of tablets and syrups.
(d) Pollen grains of some plants cause severe allergies and bronchial afflictions in some people. *(2015 Cancelled)*

23. The hilum is a scar on the
(a) fruit, where style was present
(b) seed, where micropyle was present
(c) seed, where funicle was attached
(d) fruit, where it was attached to pedicel.
(2015 Cancelled)

24. Transmission tissue is characteristic feature of
(a) dry stigma (b) wet stigma
(c) hollow style (d) solid style.
(2015 Cancelled)

25. Which one of the following shows isogamy with non-flagellated gametes?
(a) *Sargassum* (b) *Ectocarpus*
(c) *Ulothrix* (d) *Spirogyra*
(2014)

26. Geitonogamy involves
(a) fertilization of a flower by the pollen from another flower of the same plant
(b) fertilization of a flower by the pollen from the same flower
(c) fertilization of a flower by the pollen from a flower of another plant in the same population
(d) fertilization of a flower by the pollen from a flower of another plant belonging to a distant population. *(2014)*

27. An aggregate fruit is one which develops from
(a) multicarpellary syncarpous gynoecium
(b) multicarpellary apocarpus gynoecium
(c) complete inflorescence
(d) multicarpellary superior ovary. *(2014)*

28. Pollen tablets are available in the market for
(a) *in vitro* fertilization
(b) breeding programmes
(c) supplementing food
(d) *ex situ* conservation. *(2014)*

29. Function of filiform apparatus is to
(a) recognize the suitable pollen at stigma
(b) stimulate division of generative cell
(c) produce nectar
(d) guide the entry of pollen tube. *(2014)*

30. Non-albuminous seed is produced in
(a) maize (b) castor
(c) wheat (d) pea. *(2014)*

31. Meiosis takes place in
(a) gemmule (b) megaspore
(c) meiocyte (d) conidia.
(NEET 2013)

32. Seed coat is not thin, membranous in
(a) groundnut (b) gram
(c) maize (d) coconut.
(NEET 2013)

33. Perisperm differs from endosperm in
(a) being a diploid tissue
(b) its formation by fusion of secondary nucleus with several sperms
(c) being a haploid tissue
(d) having no reserve food. *(NEET 2013)*

34. Advantage of cleistogamy is
(a) no dependence on pollinators
(b) vivipary
(c) higher genetic variability
(d) more vigorous offspring. *(NEET 2013)*

35. Megasporangium is equivalent to
(a) nucellus (b) ovule
(c) embryo sac (d) fruit.*(NEET 2013)*

36. Which one of the following statements is correct?
(a) Endothecium produces the microspores.
(b) Tapetum nourishes the developing pollen.
(c) Hard outer layer of pollen is called intine.
(d) Sporogenous tissue is haploid.
(NEET 2013)

37. Product of sexual reproduction generally generates
(a) new genetic combination leading to variation
(b) large biomass
(c) longer viability of seeds
(d) prolonged dormancy. (*NEET 2013*)

38. Animal vectors are required for pollination in
(a) *Vallisneria* (b) mulberry
(c) cucumber (d) maize.
(Karnataka NEET 2013)

39. Albuminous seeds store their reserve food mainly in
(a) endosperm (b) cotyledons
(c) hypocotyl (d) perisperm.
(Karnataka NEET 2013)

40. Megaspores are produced from the megaspore mother cells after
(a) mitotic division
(b) formation of thick wall
(c) differentiation
(d) meiotic division.
(Karnataka NEET 2013)

41. Which one of the following statements is correct?
(a) Cleistogamous flowers are always autogamous.
(b) Xenogamy occurs only by wind pollination.
(c) Chasmogamous flowers do not open at all.
(d) Geitonogamy involves the pollen and stigma of flowers of different plants.
(Karnataka NEET 2013)

42. Which of the following statements is correct?
(a) Sporopollenin can be degraded by enzymes.
(b) Sporopollenin is made up of inorganic materials.
(c) Sporopollenin can withstand high temperatures as well as strong acids and alkalis.
(d) Sporopollenin can withstand high temperatures but not strong acids.
(Karnataka NEET 2013)

43. Both, autogamy and geitonogamy are prevented in
(a) papaya (b) cucumber
(c) castor (d) maize. *(2012)*

44. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is
(a) cuticle (b) sporopollenin
(c) lignin (d) cellulose.
(2012)

45. Which one of the following is correctly matched?
(a) Onion–Bulb
(b) Ginger–Sucker
(c) *Chlamydomonas*–Conidia
(d) Yeast–Zoospores *(2012)*

46. Even in absence of pollinating agents seed-setting is assured in
(a) *Commelina* (b) *Zostera*
(c) *Salvia* (d) fig. *(2012)*

47. What is the function of germ pore?
(a) Emergence of radicle
(b) Absorption of water for seed germination
(c) Initiation of pollen tube
(d) Release of male gametes *(Mains 2012)*

48. Which one of the following statements is wrong?
(a) When pollen is shed at two-celled stage, double fertilization does not take place.
(b) Vegetative cell is larger than generative cell.

(c) Pollen grains in some plants remain viable for months.
(d) Intine is made up of cellulose and pectin.
(Mains 2012)

49. Plants with ovaries having only one or a few ovules, are generally pollinated by
(a) bees (b) butterflies
(c) birds (d) wind.
(*Mains 2012*)

50. Filiform apparatus is a characteristic feature of
(a) suspensor (b) egg
(c) synergid (d) zygote. *(2011)*

51. Nucellar polyembryony is reported in species of
(a) *Citrus* (b) *Gossypium*
(c) *Triticum* (d) *Brassica. (2011)*

52. Which one of the following pollinations is autogamous?
(a) Geitonogamy (b) Xenogamy
(c) Chasmogamy (d) Cleistogamy
(2011)

53. The "eyes" of the potato tuber are
(a) root buds (b) flower buds
(c) shoot buds (d) axillary buds.
(2011)

54. Wind pollination is common in
(a) legumes (b) lilies
(c) grasses (d) orchids. *(2011)*

55. In angiosperms, functional megaspore develops into
(a) embryo sac (b) ovule
(c) endosperm (d) pollen sac.
(Mains 2011)

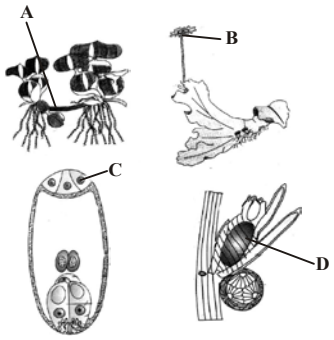
56. What is common between vegetative reproduction and apomixis?
(a) Both are applicable to only dicot plants
(b) Both bypass the flowering phase
(c) Both occur round the year
(d) Both produce progeny identical to the parent
(Mains 2011)

57. Apomictic embryos in *Citrus* arise from
(a) synergids
(b) maternal sporophytic tissue in ovule
(c) antipodal cells
(d) diploid egg. *(2010)*

58. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called
(a) xenogamy (b) geitonogamy
(c) karyogamy (d) autogamy.
(2010)

59. Wind pollinated flowers are
(a) small, brightly coloured, producing large number of pollen grains
(b) small, producing large number of dry pollen grains
(c) large producing abundant nectar and pollen
(d) small, producing nectar and dry pollen.
(*2010*)

60. Examine the figures (A-D) given below and select the right option out of (a – d), in which all the four structures A, B, C and D are identified correctly.



	A	B	C	D
(a)	Rhizome	Sporangiophore	Polar cell	Globule
(b)	Runner	Archegoniophore	Synergid	Antheridium
(c)	offset	Antheridiophore	Antipodals	Oogonium
(d)	Sucker	Seta	Megaspore mother cell	Gemma cup

(Mains 2010)

61. Vegetative propagation in *Pistia* occurs by
(a) stolon (b) offset
(c) runner (d) sucker.
(*Mains 2010*)

62. Vegetative propagation in mint occurs by
(a) offset (b) rhizome
(c) sucker (d) runner. *(2009)*

63. Which one of the following pairs of plant structures has haploid number of chromosomes?
(a) Nucellus and antipodal cells
(b) Egg nucleus and secondary nucleus
(c) Megaspore mother cell and antipodal cells
(d) Egg cell and antipodal cells *(2008)*

64. What does the filiform apparatus do at the entrance into ovule?
(a) It brings about opening of the pollen tube.
(b) It guides pollen tube from a synergid to egg.
(c) It helps in the entry of pollen tube into a synergid.
(d) It prevents entry of more than one pollen tube into the embryo sac. *(2008)*

65. Unisexuality of flowers prevents
(a) geitonogamy, but not xenogamy
(b) autogamy and geitonogamy
(c) autogamy, but not geitonogamy
(d) both geitonogamy and xenogamy.
(2008)

66. Which one of the following is resistant to enzyme action?
(a) Pollen exine (b) Leaf cuticle
(c) Cork (d) Wood fibre
(Mains 2008)

67. Male gametes in angiosperms are formed by the division of
(a) generative cell (b) vegetative cell
(c) microspore mother cell
(d) microspore. *(2007)*

68. Two plants can be conclusively said to belong to the same species if they
(a) have more than 90 percent similar genes
(b) look similar and possess identical secondary metabolites
(c) have same number of chromosomes
(d) can reproduce freely with each other and form seeds. *(2007)*

69. Which one of the following is surrounded by a callose wall?
(a) Male gamete
(b) Egg
(c) Pollen grain
(d) Microspore mother cell *(2007)*

70. Parthenocarpic tomato fruits can be produced by
(a) treating the plants with phenylmercuric acetate
(b) removing androecium of flowers before pollen grains are released
(c) treating the plants with low concentrations of gibberellic acid and auxins
(d) raising the plants from vernalized seeds.
(*2006*)

71. In a cereal grain the single cotyledon of embryo is represented by
(a) coleoptile (b) coleorhiza
(c) scutellum (d) prophyll. *(2006)*

72. The arrangement of the nuclei in a normal embryo sac in the dicot plants is
(a) 3 + 3 + 2 (b) 2 + 4 + 2
(c) 3 + 2 + 3 (d) 2 + 3 + 3. *(2006)*

73. In a type of apomixis known as adventive embryony, embryos develop directly from the
(a) nucellus or integuments
(b) zygote
(c) synergids or antipodals in an embryo sac
(d) accessory embryo sacs in the ovule.
(2005)

74. Which one of the following represents an ovule, where the embryo sac becomes horse-shoe shaped and the funiculus and micropyle are close to each other?
(a) Amphitropous
(b) Circinotropous
(c) Atropous
(d) Anatropous *(2005)*

75. Through which cell of the embryo sac, does the pollen tube enter the embryo sac?
(a) Egg cell
(b) Persistant synergid
(c) Degenerated synergids
(d) Central cell *(2005)*

76. When a diploid female plant is crossed with a tetraploid male, the ploidy of endosperm cells in the resulting seed is
(a) tetraploidy (b) pentaploidy
(c) diploidy (d) triploidy.
(2004)

77. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is
(a) hemitropous (b) campylotropous
(c) anatropous (d) orthotropous.
(2004)

78. Anthesis is a phenomenon which refers to
(a) reception of pollen by stigma
(b) formation of pollen
(c) development of anther
(d) opening of flower bud. *(2004)*

79. In a flowering plant, archesporium gives rise to
(a) only the wall of the sporangium
(b) both wall and the sporogenous cells
(c) wall and the tapetum
(d) only tapetum and sporogenous cells.
(2003)

80. In angiosperms pollen tube liberate their male gametes into the
(a) central cell (b) antipodal cells
(c) egg cell (d) synergids.
(2002)

81. In angiosperm all the four microspores of tetrad are covered by a layer which is formed by
(a) pectocellulose (b) callose
(c) cellulose (d) sporopollenin.
(*2002*)

82. What is the direction of micropyle in anatropous ovule?
(a) Upward (b) Downward
(c) Right (d) Left. *(2002)*

83. Adventive embryony in *Citrus* is due to
(a) nucellus (b) integuments
(c) zygotic embryo (d) fertilized egg.
(*2001*)

84. In grasses what happens in microspore mother cell for the formation of mature pollen grains?
(a) One meiotic and two mitotic divisions
(b) One meiotic and one mitotic divisions
(c) One meiotic division
(d) One mitotic division *(2001)*

85. Anemophily type of pollination is found in
(a) *Salvia* (b) bottle brush
(c) *Vallisneria* (d) coconut. *(2001)*

86. Endosperm is formed during the double fertilization by
(a) two polar nuclei and one male gamete
(b) one polar nuclei and one male gamete
(c) ovum and male gamete
(d) two polar nuclei and two male gametes.
(*2000*)

87. Eight nucleated embryo sac is
(a) only monosporic (b) only bisporic
(c) only tetrasporic (d) any of these.
(2000)

88. The endosperm of gymnosperm is
(a) diploid (b) polyploid
(c) triploid (d) haploid. *(1999)*

89. An interesting modification of flower shape for insect pollination occurs in some orchids in which a male insect mistakes the pattern on the orchid flower for the female species and tries to copulate with it, thereby pollinating the flower. This phenomenon is called
(a) pseudopollination
(b) pseudoparthenocarpy
(c) mimicry
(d) pseudocopulation. *(1998)*

90. The embryo in sunflower has
(a) two cotyledons (b) many cotyledons
(c) no cotyledon (d) one cotyledon.
(*1998*)

91. The role of double fertilization in angiosperms is to produce
(a) cotyledons (b) endocarp
(c) endosperm (d) integuments.
(1998)

92. If an angiospermic male plant is diploid and female plant tetraploid, the ploidy level of endosperm will be
(a) tetraploid (b) pentaploid
(c) haploid (d) triploid. *(1997)*

93. The role of double fertilization in angiosperms is to produce
(a) cotyledons (b) endocarp
(c) endosperm (d) hormones.
(1996)

94. If there are 4 cells in anthers, what will be the number of pollen grains?
(a) 16 (b) 12
(c) 8 (d) 4 *(1996)*

95. The anthesis is a phenomenon, which refers to
(a) development of anthers
(b) opening of flower bud
(c) stigma receptors
(d) all of these. *(1995)*

96. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains?
(a) 75 (b) 100
(c) 25 (d) 50 *(1995)*

97. The polyembryony commonly occurs in
(a) tomato (b) potato
(c) *Citrus* (d) turmeric. *(1995)*

98. When pollen of a flower is transferred to the stigma of another flower of the same plant, the pollination is referred to as
(a) autogamy (b) geitonogamy
(c) xenogamy (d) allogamy. *(1994)*

99. Embryo sac represents
(a) megaspore (b) megagametophyte
(c) megasporophyll (d) megagamete.
(*1994*)

100. Number of meiotic divisions required to produce 200/400 seeds of pea would be
(a) 200/400 (b) 400/800
(c) 300/600 (d) 250/500. *(1993)*

101. Double fertilization is characteristic of
(a) angiosperms (b) anatropous
(c) gymnosperms (d) bryophytes.
(1993)

102. Ovule is straight with funiculus, embryo sac, chalaza and micropyle lying on one straight line. It is
(a) orthotropous (b) anatropous
(c) campylotropous (d) amphitropous.
(*1993*)

103. Study of formation, growth and development of new individual from an egg is
(a) apomixis (b) embryology
(c) embryogeny (d) cytology. *(1993)*

104. Meiosis is best observed in dividing
(a) cells of apical meristem
(b) cells of lateral meristem
(c) microspores and anther wall
(d) microsporocytes. *(1992)*

105. Double fertilization is fusion of
(a) two eggs
(b) two eggs and polar nuclei with pollen nuclei
(c) one male gamete with egg and other with synergid
(d) one male gamete with egg and other with secondary nucleus. *(1991)*

106. Syngamy means
(a) fusion of gametes
(b) fusion of cytoplasms
(c) fusion of two similar spores
(d) fusion of two dissimilar spores. *(1991)*

107. Point out the odd one.
(a) Nucellus (b) Embryo sac
(c) Micropyle (d) Pollen grain *(1991)*

108. Which of the following pair have haploid structures?
(a) Nucellus and antipodal cells
(b) Antipodal cells and egg cell
(c) Antipodal cells and megaspore mother cell
(d) Nucellus and primary endosperm nucleus *(1991)*

109. Embryo sac occurs in
(a) embryo (b) axis part of embryo
(c) ovule (d) endosperm. *(1991)*

110. Pollination occurs in
(a) bryophytes and angiosperms
(b) pteridophytes and angiosperms
(c) angiosperms and gymnosperms
(d) angiosperms and fungi. *(1991)*

111. Entry of pollen tube through micropyle is
(a) chalazogamy (b) mesogamy
(c) porogamy (d) pseudogamy. *(1990)*

112. Sperm and egg nuclei fuse due to
(a) base pairing of their DNA and RNA
(b) formation of hydrogen bonds
(c) mutual attraction due to differences in electrical charges
(d) attraction of their protoplasts. *(1990)*

113. Female gametophyte of angiosperms is represented by
(a) ovule
(b) megaspore mother cell
(c) embryo sac
(d) nucellus. *(1990)*

114. Male gametophyte of angiosperms/monocots is
(a) microsporangium
(b) nucellus
(c) microspore
(d) stamen. *(1990)*

115. Which ones produce androgenic haploids in anther cultures?
(a) Anther wall
(b) Tapetal layer of anther wall
(c) Connective tissue
(d) Young pollen grains *(1990)*

116. Which is correct?
(a) Gametes are invariably haploid
(b) Spores are invariably haploid
(c) Gametes are generally haploid
(d) Both spores and gametes are invariably haploid *(1989)*

117. Generative cell was destroyed by laser but a normal pollen tube was still formed because
(a) vegetative cell is not damaged
(b) contents of killed generative cell stimulate pollen growth
(c) laser beam stimulates growth of pollen tube
(d) the region of emergence of pollen tube is not harmed. *(1989)*

118. Nucellar embryo is
(a) amphimictic haploid
(b) amphimictic diploid
(c) apomictic haploid
(d) apomictic diploid. *(1989)*

119. Development of an organism from female gamete/egg without involving fertilization is
(a) adventitive embryony
(b) polyembryony
(c) parthenocarpy
(d) parthenogenesis. *(1989)*

120. Perisperm is
(a) remnant of endosperm
(b) persistent nucellus
(c) peripheral part of endosperm
(d) disintegrated secondary nucleus.
(1989, 1988)

121. Double fertilization and triple fusion were discovered by
(a) Hofmeister
(b) Nawaschin and Guignard
(c) Leeuwenhoek
(d) Strasburger. *(1988)*

122. Total number of meiotic divisions required for forming 100 zygotes/100 grains of wheat is
(a) 100 (b) 75
(c) 125 (d) 50. *(1988)*

123. Male gametophyte of angiosperms is shed at
(a) four celled pollen grain
(b) three celled pollen grain
(c) microspore mother cell
(d) anther. *(1988)*

124. Parthenogenesis is
(a) development of embryo without fertilization
(b) development of fruit without fertilization
(c) development of fruit without hormones
(d) development of embryo from egg without fertilization. *(1988)*

125. Formation of gametophyte directly from sporophyte without meiosis is
(a) apospory (b) apogamy
(c) parthenogenesis (d) amphimixis.
(1988)

Answer Key

1.	(b)	**2.**	(a)	**3.**	(b)	**4.**	(a)	**5.**	(c)	**6.**	(c)	**7.**	(b)	**8.**	(a)	**9.**	(b)	**10.**	(c)
11.	(b)	**12.**	(c)	**13.**	(b)	**14.**	(b)	**15.**	(a)	**16.**	(d)	**17.**	(d)	**18.**	(b)	**19.**	(c)	**20.**	(d)
21.	(c)	**22.**	(b)	**23.**	(c)	**24.**	(d)	**25.**	(d)	**26.**	(a)	**27.**	(b)	**28.**	(c)	**29.**	(d)	**30.**	(d)
31.	(c)	**32.**	(d)	**33.**	(a)	**34.**	(a)	**35.**	(a)	**36.**	(b)	**37.**	(a)	**38.**	(c)	**39.**	(a)	**40.**	(d)
41.	(a)	**42.**	(c)	**43.**	(a)	**44.**	(b)	**45.**	(a)	**46.**	(a)	**47.**	(c)	**48.**	(a)	**49.**	(d)	**50.**	(c)
51.	(a)	**52.**	(d)	**53.**	(d)	**54.**	(c)	**55.**	(a)	**56.**	(d)	**57.**	(b)	**58.**	(b)	**59.**	(b)	**60.**	(c)
61.	(b)	**62.**	(c)	**63.**	(d)	**64.**	(b)	**65.**	(c)	**66.**	(a)	**67.**	(a)	**68.**	(d)	**69.**	(d)	**70.**	(c)
71.	(c)	**72.**	(c)	**73.**	(a)	**74.**	(a)	**75.**	(c)	**76.**	(a)	**77.**	(a)	**78.**	(d)	**79.**	(b)	**80.**	(d)
81.	(a)	**82.**	(b)	**83.**	(a)	**84.**	(b)	**85.**	(d)	**86.**	(a)	**87.**	(d)	**88.**	(d)	**89.**	(d)	**90.**	(a)
91.	(c)	**92.**	(b)	**93.**	(c)	**94.**	(a)	**95.**	(b)	**96.**	(c)	**97.**	**(c)**	**98.**	(b)	**99.**	(b)	**100.**	(d)
101.	(a)	**102.**	**(a)**	**103.**	(b)	**104.**	(d)	**105.**	(d)	**106.**	(a)	**107.**	**(d)**	**108.**	(b)	**109.**	(c)	**110.**	(c)
111.	(c)	**112.**	(d)	**113.**	(c)	**114.**	**(c)**	**115.**	(d)	**116.**	(a)	**117.**	(a)	**118.**	**(d)**	**119.**	(d)	**120.**	(b)
121.	(b)	**122.**	(c)	**123.**	**(b)**	**124.**	(d)	**125.**	(a)										

EXPLANATIONS

1. (b) : In angiosperms, the functional megaspore is the first cell of female gametophyte. It enlarges and undergoes few mitotic divisions to form embryo sac.

2. (a) : Entomophily is the most common type of zoophily where pollination takes place through the agency of insects. Entomophilous flowers are brightly coloured and secrete nectar to attract visiting insects.
Anemophily (wind pollination) and hydrophily (water pollination) do not require attractants or rewards due to the involvement of abiotic pollinating agents. Cleistogamy is self pollination in closed flowers.

3. (b) : Single ovule in the ovary and flowers packed into inflorescence are characteristics of wind pollinated flowers.

4. (a) : Dioecious plants are those plants in which male flowers and female flowers are borne on different plants. Therefore, they prevent both autogamy and geitonogamy.

5. (c) : Double fertilisation is the characteristic feature of angiosperms. Here, two male gametes are released in the embryo sac or female gametophyte. One male gamete fuses with the egg cell to form zygote that gives rise to embryo whereas the other male gamete fuses with the secondary nucleus to form primary endosperm nucleus (PEN) that gives rise to endosperm.

6. (c)

7. (b) : In aquatic plants with emergent flowers *e.g.*, water lily, water hyacinth pollination takes place by wind or insects.

8. (a) : The ovule of an angiosperm is equivalent to integumented megasporangium.

9. (b) : Coconut has multicellular endosperm (called coconut meal) in the outer part and free nuclear as well as vacuolate endosperm (called coconut milk or coconut water) in the centre.

10. (c) : Tapetum is the innermost wall layer of microsporangium that nourishes developing pollen grains.

11. (b) : Apomixis is a reproductive process which does not involve gametic fusion. In apomictic flowering plants there is no fertilisation and embryos develop simply by division of a cell of ovule.

12. (c) : Pollen-pistil interaction is the group of events that occur from the time of pollen deposition over the stigma to the time of pollen tube entry into ovule. It is a safety measure to ensure that illegitimate crossing does not occur. Pollen grains of number of plants may settle over a stigma. The pollens belonging to same species would germinate while other fail to do so but the pollen tube of the compatible pollen will grow through the style to reach the ovule whereas growth of incompatible pollens will be arrested at stigmatic disc or sometimes in the beginning part of style.

13. (b)

14. (b) : Filliform apparatus is a mass of finger like projections of the wall into the cytoplasm. It is present in synergids (help cells) of the embryo sac, in the micropylar region. It guards the pollen tube inside the ovule towards the embryo sac.

15. (a) : In angiosperms, microsporogenesis *i.e.*, formation of microspores (or pollen grains) occurs by the meiotic divisions of diploid microspore mother cells (or pollen mother cells). Microsporogenesis takes place in the anther. Megasporogenesis *i.e.* formation of megaspores occurs by the meiotic divisions of diploid megaspore mother cells. Megasporogenesis takes place in the ovule.

16. (d) : In cucumber, unisexual flowers *i.e.,* separate male and female flowers are present on the same plant (monoecious plant).

17. (d) : *Refer to answer 9.*

18. (b) : Parthenocarpic fruits are the fruits which are formed without fertilisation. These fruits are naturally seedless, *e.g.*, banana.

19. (c) : The protoplast of the male gametophyte divides mitotically to produce two unequal cells — a small generative cell and a large vegetative cell. The generative cell divides later into two non-motile male gametes (or sperms). Thus, the male gametophyte in angiosperms produces two sperms and a vegetative cell. The vegetative cell, later on, grows to produce pollen tube.

20. (d)

21. (c) : Geitonogamy involves transfer of the pollen from one flower of a plant to the stigma of another flower of the same plant. As the pollen has to move from one flower to another flower, it requires a pollinating agent. Yet it is genetically similar to autogamy, as both the flowers of the plant, share the same genotype of the plant.

22. (b) : Honey is made from nectar through a process of regurgitation and evaporation.

Honeybees transform saccharides (carbohydrates) into honey by regurgitating it a number of times, until it is partially digested. The bees do the regurgitation and digestion as a group. After the last regurgitation, the aqueous solution is still high in water, the process continues by evaporation of much of the water and enzymatic transformation. Honey is produced by bees as a food source.

23. (c) : Ovule is an integumented megasporangium found in spermatophytes which develops into seed after fertilization. An angiospermic ovule is typically an ovoid and whitish structure. It occurs inside ovary where it is attached to a parenchymatous cushion called placenta either singly or in a cluster. The ovule is stalked. The stalk is called funiculus or funicle. The point of attachment of the body of the ovule with the funiculus is known as hilum. It is present as a scar on a mature seed.

24. (d) : Style is traversed by the pollen tube to reach the ovule.It is of two types - hollow and solid. In hollow styles, the stylar canal is lined by glandular cells, which are usually multinucleate and polyploid whereas solid style has a core of transmitting tissue, composed of thin walled cells, through which, the pollen tube moves.

25. (d) : Sexual reproduction in algae takes place through fusion of two gametes. In *Spirogyra*, the gametes are similar in size (isogamy) and non-flagellated (non-motile).

26. (a) : Geitonogamy is the pollination taking place between the two flowers of the same plant or genetically similar plant. Hence, genetically it is self pollination but since the agency is involved, it is ecologically, cross pollination.

27. (b) : An aggregate fruit or etaerio is a group of simple fruitlets that develop from free ovaries (apocarpus condition) of a single flower (single gynoecium).

28. (c) : Pollen grains are believed to be rich in nutrients (protein 7-26 % carbohydrates 24-48%, fats 0.9-14.5%). They are taken as tablets or syrups to improve health. They also enhance performance of athletes and race horses.

29. (d) : In the ovule, the pollen tube is attracted by secretions of synergids. Usually the pollen tube enters the embryo sac by passing into one of the two synergids and is guided by the filiform apparatus of the synergids in their movement. Pollen tube then breaks open and releases its contents in the embryo sac. Antipodals and synergids later degenerate.

30. (d) : In majority of dicot seeds, including pea, the endosperm is consumed during seed development and the food is stored in cotyledons and other regions. They are called non-endospermic or exalbuminous seeds.

31. (c) : Gemmule and conidia are asexual propagules thus no meiosis takes place in them. Megaspores are haploid which are formed as a result of meiosis of diploid megaspore mother cell. Meiocyte is any cell that undergoes meiosis.

32. (d)

33. (a) : Both perisperm and endosperm are nutritive layers. Perisperm is residual persistent nucellus of seed prior to fertilization while endosperm develops when one of the sperm cells fuses with two haploid polar nuclei. Thus perisperm is diploid while endosperm is a triploid tissue.

34. (a) : Cleistogamy is the process of pollination and fertilization before the flower has opened. In such flowers, the anther and stigma lie close to each other. When anthers dehisce in the flower buds, pollen grains come in contact with the stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

35. (a) : In angiosperms, body of the ovule consists of a mass of parenchymatous cells called nucellus, which is equivalent to megasporangium. A megasporangium alongwith its protective integuments is called as an ovule.

36. (b) : A microsporangium is generally surrounded by four wall layers – the epidermis, endothecium, middle layers and the tapetum. The outer three wall layers perfom the function of protection and help in dehiscence of anther to release the pollen. The innermost wall layer is the tapetum. It nourishes the developing pollen grains. Cells of the tapetum are food rich and possess dense cytoplasm and generally have more than one nucleus. They disintegrate to liberate the contents which is absorbed by the developing spores.

37. (a) : Sexual reproduction always involves meiosis (zygotic in case of haploid individuals and gametic in case of diploid individuals). Meiosis results in crossing over between chromosomes during prophase I generating new recombinations. Besides, sexual reproduction generally involves combination of genes from two different organisms. Thus, sexual reproduction generates new genetic combinations leading to variations.

38. (c) : In *Vallisneria*, water pollination occurs while mulberry and maize undergo wind pollination. In cucumber, animal pollination is observed.

39. (a) : In some seeds, the endosperm persists in the seed as food storage tissue. Such seeds are called endospermic or albuminous, *e.g.*, castor, maize, wheat, barley, rubber, coconut.

40. (d) : *Refer to answer 15.*

41. (a) : In cleistogamy, as the flowers never open so there is no alternative of self pollination. It is invariably autogamous. In xenogamy, pollination takes between two flowers of different plants (genetically and ecologically). It can ocur by wind, water, insects and animals.
Chasmogamy occurs when the flowers expose their mature anther and stigma to the pollinating agents. Geitonogamy is the pollination taking place between the two flowers of the same plant or genetically similar plant. Genetically, it is self pollination but as the agency is involved it is ecologically cross pollination.

42. (c) : Pollen grain is a haploid, unicellular body. It is cuticularised and the cutin is of special type called sporopollenin, which is resistant to chemical and biological decomposition. It can withstand high temperatures as well as strong acids and alkalis. This is why, pollen wall is preserved for long periods in fossil deposits. In addition pollen wall possesses proteins for enzymatic and compatability reactions.

43. (a) : Autogamy and geitonogamy are two forms of self pollination. In autogamy, pollen falls on stigma of the same flower. While in geitonogamy pollens from a flower fall on the stigma of some other flower on the same plant. Papaya is a dioecious plants thus both autogamy and geitonogamy are prevented in it.

44. (b) : Sporopollenin is a major component of the tough outer (exine) walls of spores and pollen grains. It is chemically very stable and is usually well preserved in soils and sediments. It can withstand environmental extremes and cannot be degraded by enzymes and strong chemical reagents.

45. (a) : Yeast and other ascomycetes characteristically produce ascospores. *Chlamydomonas* is an alga and conidia are not found in algae. Ginger propagates by rhizome not by sucker. Onion propagates by bulb which is an underground, modified stem.

46. (a) : Some plants such as *Viola* (common pansy), *Oxalis*, and *Commelina* produce two types of flowers- chasmogamous flowers which are similar to flowers of other species with exposed anthers and stigma, and cleistogamous flowers which do not open at all. In such flowers, the anthers and stigma lie close to each other. When anthers dehisce in the flower buds, pollen grains come in contact with the stigma to effect pollination. Thus, cleistogamous flowers are invariably autogamous as there is no chance of cross-pollen landing on the stigma. Cleistogamous flowers produce assured seed-set even in the absence of pollinators.

47. (c) : In a pollen grain, exine is thin or absent at certain places. These areas may have thickened intine or deposition of callose. They are called germ pores (if rounded) or germinal furrows (if elongated). After pollination, the pollen grain on the stigma absorbs water and nutrients from the stigmatic secretion through its germ pores. The tube or vegetative cell enlarges and comes out of pollen grains through germ pore to form a pollen tube.

48. (a) : In 60% of flowering plants, the pollen grains are shed at two-celled stage (tube cell + generative cell). Further, development of male gametophyte (pollen grain) occurs on stigma. Pollen grain gives rise to pollen tube which absorbs nourishment from the cells of style for its growth. Generative cell divides to give rise to two male gametes. Out of these, one fuses with the egg to form diploid zygote (generative fertilization or syngamy) whereas the second male gamete fuses with the two haploid polar nuclei or diploid secondary nucleus of the central cell to form primary endosperm nucleus (vegetative fertilization or triple fusion). These two acts of fertilization occur in the same embryo sac and are referred to as double fertilization.

49. (d) : Anemophily is an abiotic means of pollination by wind and, being non-directional, a wasteful process as the pollen would reach the stigma through wind is a hit-or-miss affair. During the transit of pollen through wind, a considerable amount of pollen is lost because it never reaches a proper stigma. To stand this loss, anemophilous plants have to produce enormous quantities of pollen. Anemophily is also associated with reduction in the number of ovules per ovary. Some models predict that plants benefit from numerous inexpensive flowers distributed throughout the inflorescence, each with a single ovule or a few ovules. In grasses there is just one ovule per ovary. This is to increase the probability of successful pollination of each ovule.

50. (c) : *Refer to answer 14.*

51. (a) : In nucellar polyembryony, some of the nucellar cells surrounding the embryo sac start dividing. Then it protrudes into the embryo sac and develop into the embryos. In such species, each ovule contains many embryos. Occurrence of more than one embryo in a seed is referred as polyembryony. Nucellar polyembryony is found in many of the *Citrus* and mango varieties.

52. (d) : Autogamy is a kind of pollination in which the pollen from the anthers of a flower are transferred to stigma of the same flower. Cleistogamy, homogamy, bud pollination are three methods of the autogamy. Cleistogamy occurs in those plants, which never open and ensure complete self-pollination. *E.g.*, *Commelina bengalensis*, *Oxalis*, *Viola* etc.

53. (d) : Potato is the common example of stem-tuber. It stores starch as reserve food material. The potato-tubers are used for vegetative propagation. These possess axillary buds over their nodes or eyes. The buds produce new plantlets when a stem-tuber or a part of it having an eye is placed in the soil.

54. (c) : Anemophily is pollination of a flower in which the pollen is carried by the wind. Examples of anemophilous flowers are those of grasses and conifers.

55. (a) : *Refer to answer 1.*

56. (d) : Apomixis is a reproductive process in plants that superficially resembles normal sexual reproduction but in which there is no fusion of gametes. The embryos develop simply by division of a diploid cell the ovule. So, the progenies produced are identical to the parent. In vegetative reproduction also progenies produced are identical to the parent.

57. (b) : Apomixis is abnormal kind of sexual reproduction in which egg or other cells associated with egg (synergids, antipodals, etc.) develop into embryo without fertilization and meiosis. Development of embryos directly from sporophytic tissues like nucellus and integuments is called adventive embryony which is also a type of apoximis. *E.g., Citrus*, mango.

58. (b) : Geitonogamy is the transfer of pollen grains from the anther to stigma of another flower on the same plant or genetically similar plant, *e.g.*, in maize.

59. (b) : Pollination by wind is called anemophily and such plants in which pollination occurs by wind are called anemophilous plants. Anemophilous plants are characteristized by small flowers, pollens present in large number which are small, dry and light in weight (carried upto 1300 Km by wind), number of ovules generally reduced in ovary (biological significance), feathery or brushy stigma (to receive the pollen). Grasses and palms are generally anemophilous.

60. (c) : A – offset of water hyacinth (*Eichhornia*)
B – Antheridiophore of *Marchantia*
C – Antipodals of the mature embryo sac
D – Oogonium of *Chara*

61. (b) : In *Pistia* (water lettuce) vegetative propagation occurs by offset where one internode long runners grows horizontally along the soil surface and gives rise to new plants either from axillary or terminal buds.

62. (c) : Vegetative propagation in mint occurs through sucker.

63. (d)

64. (b) : Within the embryo sac three cells are grouped together at the micropylar end and constitute the egg apparatus. The egg apparatus, in turn, consists of two synergids and one egg cell. The synergids have special cellular thickenings at the micropylar tip called filiform apparatus, which plays an important role in guiding the pollen tubes into the synergid. Three cells are at the chalazal end and are called the antipodals. The large central cell, has two polar nuclei.

65. (c) : Unisexuality or dicliny is a condition in which two types of unisexual flowers are present *i.e.*, staminate (male flower) and pistillate (female flower). The plant may be monoecious or dioecious. This is a device for cross pollination (or xenogamy). Both xenogamy and geitonogamy (*i.e.* transfer of pollen from anther of one flower to stigma of another flower of either the same or genetically similar plant) are included under allogamy/cross pollination. Autogamy or self pollination (*i.e.* transfer of pollen from anther to stigma of the same flower) occurs in bisexual flower.

66. (a) : *Refer to answer 44.*

67. (a) : In the pollen sac (microsporangium) of the anther, haploid microspores are formed by mitosis. Mitosis then follows to produce a two-celled pollen grain with a small generative cell and a large vegetative cell. This generative cell will undergo further mitosis to form two male gametes (nuclei). The pollen tube grows through a spore in the pollen grain, with the tube (vegetative) nucleus at its tips and the male nuclei behind.

68. (d) : If two plants can reproduce freely with each other and form seeds, they are concluded to

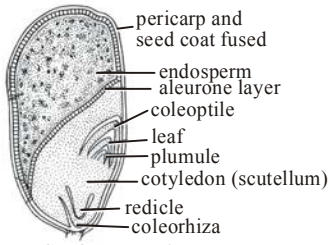
belong to same species. Plants belonging to same species have mostly every character common and will be able to reproduce freely with each other to produce new generations.

69. (d) : Anther consists of microsporangia or pollen sacs. The archesporium gives rise to parietal cells and primary sporogenous tissue. Sporogenous cells divide to form pollen grain or microspore mother cells. They are diploid and connected by plasmodesmata. The microspore, mother cells consists of a callose wall inner to the cell wall. The mother cell then undergoes meiosis and forms tetrads of microspores. Finally the wall of the mother cell degenerates and pollen grains are separated.

70. (c) : Development of fruits without fertilization is called parthenocarpy and such fruits are called parthenocarpic fruits. Parthenocarpic fruits are seedless. A flower is emasculated and auxins are applied to the stigma of the flower, it forms a parthenocarpic fruit. For parthenocarpy induction by auxins, these should be applied after anthesis (first opening of flower) and by gibberellins, these should be applied earlier *i.e.*, at anthesis.

71. (c) : The cotyledons are known as seed leaves, they are attached to the embryonic axis. Dicotyledons typically have two cotyledons and monocotyledons have only one cotyledon. The single shield shaped cotyledon in grains is known as scutellum.

The scutellum does not contain food and its function is to absorb food from the endosperm and transfer it to the growing parts of the embryo. The plumule consists of growing tip of the shoot along with few young leaf primordia. It is covered by a sheath called coleoptile. The radicle which lies at the base of the grain is also covered with a sheath called coleorhiza. The hypocotyl is very short and is represented by a short axis in between radicle and plumule.



L. S. of corn grain

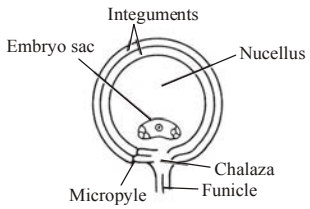
72. (c)

73. (a) : Normal type of sexual reproduction having two regular features, *i.e.*, meiosis and fertilization, is called amphimixis. But in some plants, this normal sexual reproduction (amphimixis) is replaced by some abnormal type of sexual reproduction called apomixis.

Apomixis may be defined as, 'abnormal kind of sexual reproduction in which egg or other cells associated with egg (synergids, antipodals, etc.) develop into embryo without fertilization and with or without meiosis'.

Adventive embryony is a type of apomixis in which development of embryos directly takes place from sporophytic tissues like nucellus and integuments, *e.g.*, *Citrus*, mango, etc.

74. (a) : Depending upon position of micropyle in relation to chalaza, ovules are of 6 types in angiosperms. In amphitropous type the curvature is observed both in body of ovule and embryo sac. The embryo sac assumes horse shoe-shape. Micropyle is directed downwards. It is commonly found in families Papaveracerae, Alismaceae and Butomaceae.



Amphitropous

Circinotropous ovule is characteristic of family Cactaceae. Here the ovule is straight first but due to more growth on one side gets inverted and later becomes straight again.

Orthotropous ovule is the most primitive and of simplest type. It is also known as atropous or straight ovule.

Anatropous ovule is the most common type of ovule found in angiosperms. Here the body of the ovule gets inverted and micropyle is on lower side.

75. (c) : The pollen tube enters into the embryo sac at the micropylar end. This entry may be between egg and one synergid or between wall of embryo sac and synergid or through one synergid. So one synergid is always degenerated to allow the entry of the pollen tube.

76. (a) : Endosperm is formed due to fusion of the haploid male gamete with the polar nucleus of the embryo sac. But in this case the male plant is tetraploid so that its gametes would be diploid. When these diploid gametes fuse with two polar nuclei of the embryo sac the resultant endosperm would be tetraploid.

77. (a) : In hemianatropous or hemitropous ovule, the nucellus and integuments are at right angles to stalk or funiculus so that the ovule becomes curved. It is commonly found is Primulaceae and *Ranunculus*. In campylotropous ovule the body of the ovule gets curved and micropyle is directed downwards. Atropous ovule is erect and micropyle, chalaza and funiculus are in the same straight line. Anatropous ovule is the most common type of ovule in angiosperms. In this the body of the ovule gets inverted and the micropyle is on lower side.

78. (d) : Anthesis is the process of opening floral buds. Reception of pollen by stigma is called pollination. Formation of pollen is called microsporogenesis.

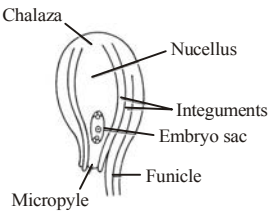
79. (b) : In flowering plants, archesporial cells are vertical rows of hypodermal cells at four angles of anther. These undergo periclinal (transverse) division to form an outer primary parietal cell and inner sporogenous cell. Primary parietal wall after few more periclinal divisions forms anther wall and sporogenous cells give rise to sporogenous tissue.

80. (d) : On reaching of pollen tube inside the embryo sac, the 2 male gametes are discharged through a sub-terminal pore in pollen tube. The contents of pollen tube are discharged in the synergid and the pollen tube does not grow beyond it in the embryo sac. Further the cytoplasm of pollen tube is restricted to chalazal end of this synergid cell.

81. (a) : Each microspore or pollen is having a two layered wall. Outer layer is thick tough cuticularised called exine, which is chiefly composed of a material called 'sporopollenin'. Inner layer is thin, delicate and smooth called intine, which is made of pectocellulose.

Exine is not uniform but is thin at one or more places in the form of germ pores. Whereas intine made of pectocellulose covers the entire surface of pollen grains.

82. (b) : Anatropus ovule is the most common type of ovule found in angiosperms. Here the body of the ovule gets inverted and micropyle is on lower side. It comes very close to the hilum and the chalaza is upwardly directed.



Anatropous

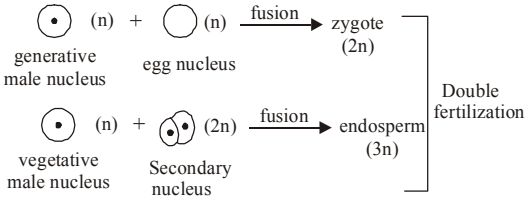
83. (a) : Presence of more than one embryo inside the seed is called polyembryony. It is more common in gymnosperms than angiosperms. In angiosperms, it is generally present as an unusual feature in few cases like *Citrus*, mango etc.
In *Citrus* many embryos are formed from the structures outside the embryo (like nucellus). This is commonly called adventive polyembryony.
In *Citrus* upto 10 nucellar embryos are formed.

84. (b) : Grass is a monocot plant. Primary sporogenous cell gives rise to microspore mother cells or pollen mother cells. Each MMC on reduction division gives rise to 4 microspores or pollens and this formation of microspores or pollens is called microsporogenesis. Karyokinesis is of successive type. The successive type of cytokinesis is common in monocots. Here both meiotic I and II nuclear divisions are followed by wall formation and it leads to isobilateral tetrad.

85. (d) : Anemophily is the pollination by wind. Anemophilous plants are characterized by small flowers, pollens present in large number which are small, dry and light in weight, number of ovules generally reduced in ovary, feathery or brushy stigma to recieve the pollen. All these features are shown by coconut flower.
In *Vallisneria* pollination occurs outside water called epihydrophily. *Callistemon* (Bottle brush) is pollinated by birds and is an example of ornithophily. *Salvia* is insect pollinated and is an example of entomophily.

86. (a) : Double fertilization is the simultaneous occurrence of syngamy and triple fusion. Syngamy involves fusion of one male gamete with egg cell to form zygote. The result of syngamy is zygote (2n) which ultimately develops into embryo.

The second male gamete fuses with 2 polar nuclei or secondary nucleus to form triploid primary endosperm nucleus and this is called triple fusion. This primary endosperm nucleus (3n) ultimately develops into a nutritive tissue for developing embryo called endosperm.



87. (d) : On the basis of number of megaspore nuclei taking part in development of female gametophyte or embryo sac, there are 3 types of embryo sacs–

(i) Monosporic type – In this type the single nucleus of functional megaspore undergoes 3 mitotic divisions to form 8 nuclei, 7 cells.
(ii) Bisporic type – Here embryo sac develops from 2 megaspore nuclei out of 4 nuclei formed after reduction division of MMC. It is also 8 nucleated.
(iii) Tetrasporic type – Here all the 4 megaspore nuclei formed after reduction division of megaspore mother cell are functional and take part in development of embryo sac. It is further of different types. Fritillaria type, Plumbago type and Adoxa type are 8 nucleated.

88. (d) : The endosperm of gymnosperms is haploid. It is a pre-fertilisation tissue and is equivalent to female gametophyte, hence it is haploid in nature but in angiosperms it is post-fertilization tissue and is generally triploid in nature.

89. (d) : In an orchid *Ophrys speculum*, there is most interesting and unique mechanism of pollination. Here pollination occurs by a wasp called *Culpa aurea*. In this orchid, pollination occurs by act of pseudocopulation. The appearance and odour of *Ophrys* is similar to female wasp and are mistake by male wasps and they land on *Ophrys* flowers to perform act of pseudo-copulation and thus pollination takes place. This plant-insect relationship is useful only to plant.

90. (a) : Sunflower (*Helianthus*) belongs to Family Asteraceae of dicotyledons. A dicot embryo has an embryonal axis and 2 cotyledons attached to it laterally. So the number of cotyledons in sunflower will be two.

91. (c) : *Refer to answer 86.*

92. (b) : If the female plant is tetraploid, then the central cell of embryo sac, which is a fused polar nuclei, will also be tetraploid. Fusion of the tetraploid central cell to the haploid male gamete forms a pentaploid endosperm in the given example.

93. (c)

94. (a) : Pollen grains or microspores are formed inside anther, which is the fertile portion of stamen or microsporophyll. Inside the anther, primary sporogenous cell gives rise to microspore mother cells or pollen mother cells (MMC or PMC). Each MMC on reduction division gives rise to 4 microspores or pollens. So, these four cells will give rise to $4 \times 4 = 16$ pollen grains.

95. (b) : *Refer to answer 78.*

96. (c) : Pollen grains or microspores are formed inside anther, which is the fertile portion of stamen or microsporophyll. The formation of microspores or pollens is called microsporogenesis. The primary sporogenous cell gives rise to microspore mother cells or pollen mother cells. Each microspore mother cell on reduction division gives rise to 4 microspores or pollens. So for the formation of 100 pollen grains, 25 MMC are required. It involves karyokinesis followed by cytokinesis.

97. (c) : *Refer to answer 83.*

98. (b) : *Refer to answer 58.*

99. (b)

100. (d) : Number of meiotic divisions required to produce 200/400 seeds of pea would be 250/500. 200 seeds of pea would be produced from 200 pollen grains and 200 eggs. 200 pollen grains will be formed by 50 microspore mother cell while 200 eggs will be formed by 200 megaspore mother cell so 250/500.

101. (a) : Double fertilisation is the characteristic feature of angiosperms. This phenomenon first observed by Nawaschin, 1898 in *Lilium* and *Fritillaria*. In angiosperms one male gamete fuses with the two polar nuclei to form triploid primary endosperm nucleus. The process is called triple fusion. These two acts together are known as double fertilisation.

102. (a) : *Refer to answer 77.*

103. (b) : Study of formation, growth and development of new individual from an egg is embryology. Study of an individuals life cycle after the fertilization takes place till it develops into a new organism.

104. (d) : Meiosis is best observed in dividing microsporocytes. Microsporocytes or microspore mother cell after meiosis give rise to microspore. Other cells do not divide by meiosis.

105. (d) : *Refer to answer 86.*

106. (a) : Syngamy means fusion of gametes. Syngamy is the phenomenon in which male gamete fuses with an egg.

107. (d) : Pollen grain is odd one among all the other three. Pollen grain is a male gametophytic structure whereas all the other three are found inside ovule (nucellus, micropyle and embryo sac).

108. (b) : Antipodal cells and egg cell are haploid structures as they are formed after meiosis while the others nucellus, megaspore mother cell and primary endosperm nucleus are diploid structures.

109. (c) : Embryo sac occurs in ovule. Ovule is integumented megasporangium. It consists of nucleus covered by one or two integuments, mounted on a funicle, chalaza and micropyle. The ovule is vascularised.

110. (c) : The term pollination refers to the transfer of pollen from anther to stigma. Because pollens are found only in angiosperms and gymnosperms so this phenomenon relates to angiosperms and gymnosperms only.

111. (c) : In most of the plants the pollen tube enters the ovule through the micropyle and the phenomenon is called as porogamy. Entry through chalaza is chalazogamy and through integuments or funiculus is mesogamy.

112. (d) : The two gametes *i.e.*, sperm released by pollen tube and egg move in opposite direction by an unknown mechanism but most probably by streaming currents of cytoplasm *i.e.*, due to attraction of their protoplasts. The nucleus of one male gamete fuses with the egg nucleus and the phenomenon is called fertilisation.

113. (c) : Female gametophyte of angiosperms is represented by embryo sac. The polygonum type of embryo sac contains 8-nuclei and 7-cells. It is found in more than 80% plant families. The nucleus of megaspore undergoes division and give rise to embryosac or female gametophyte by the process of megagametogenesis.

114. (c) : Male gametophyte of angiosperms is microspore. Microspore is haploid, uninucleate, minute spores produced in large numbers as a result of meiosis in microspore mother cell inside the microsporangia. These are the first cell of gametophytic generations in angiosperms.

115. (d) : Young pollen grains produce androgenic haploids in anther cultures. Because rest all *i.e.*, anther wall, tapetal layer of anther wall and connective tissue are the diploid tissue as they are part of anther pollen grains produced by meiosis.

116. (a) : Gametes are invariably haploid. Spores are formed in lower plants by mitotic division and they may be diploid but gametes are always be made by meiosis and they are always haploid.

117. (a) : Generative cell was destroyed by laser but a normal pollen tube was still formed because vegetative cell is not damaged. Each microspore divide by mitotic division making a smaller generative cell and a larger vegetative cell or tube cell. If generative cell is damaged then the normal pollen tube will be formed because pollen tube is formed by vegetative cell not by generative cell of microspore.

118. (d) : Nucellar embryo is apomictic diploid. Substitution of usual sexual reproduction by a form of reproduction which does not include meiosis and syngamy is called apomixis. In this process, embryo is developed by some other tissue without fertilisation *e.g.*, nucellus or integuments or infertilised egg. Nucellus is a diploid tissue so nucellar embryo is apomictic diploid.

119. (d) : Development of an organism from female gamete/egg without involving fertilisation is parthenogenesis and when a fruit is developed by this technique it is called parthenocarpy.

120. (b) : Perisperm is persistent nucellus. Endosperm formation is accompanied by degeneration of nucellus.

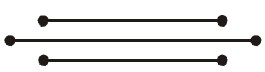
121. (b) : *Refer to answer 101.*

122. (c) : For formation of 100 zygotes, 100 male gametes and 100 female gametes (eggs) are required. 100 male gametes are developed from 100 microspores (from 25 meiotic divisions) and 100 eggs are developed from 100 megaspores (from 100 meiotic division).
Hence, number of meiotic divisions necessary for 100 zygotes formation = 25 + 100 = 125.

123. (b) : The male gametophyte or microspore is shed at 3-nucleate stage. The microspore undergoes only two mitotic divisions.

124. (d) : *Refer to answer 119.*

125. (a) : Formation of gametophyte directly from sporophyte without meiosis and spore formation is apospory. The gametophyte thus has diploid number of chromosomes. Such gametophyte may form viable gametes which fuse to form tetraploid sporophyte. Apogamy is development of sporophyte directly from gametophytic tissue without fusion of gametes. Amphimixis is normal sexual reproduction. Parthenogenesis is development of embryo from egg without fertilisation.



Chapter

25

Human Reproduction

1. Capacitation occurs in
(a) epididymis
(b) vas deferens
(c) female reproductive tract
(d) rete testis. *(NEET 2017)*

2. Which of the following depicts the correct pathway of transport of sperms?
(a) Rete testis → Efferent ductules → Epididymis → Vas deferens
(b) Rete testis → Epididymis → Efferent ductules → Vas deferens
(c) Rete testis → Vas deferens → Efferent ductules → Epididymis
(d) Efferent ductules → Rete testis → Vas deferens → Epididymis
(NEET-II 2016)

3. Match column I with column II and select the correct option using the codes given below.

Column I	Column II
A. Mons pubis	(i) Embryo formation
B. Antrum	(ii) Sperm
C. Trophectoderm	(iii) Female external genitalia
D. Nebenkern	(iv) Graafian follicle

(a) A-(iii), B-(iv), C-(ii), D-(i)
(b) A-(iii), B-(iv), C-(i), D-(ii)
(c) A-(iii), B-(i), C-(iv), D-(ii)
(d) A-(i), B-(iv), C-(iii), D-(ii)
(NEET-II 2016)

4. Several hormones like hCG, hPL, estrogen, progesterone are produced by
(a) ovary (b) placenta
(c) Fallopian tube (d) pituitary.
(NEET-II 2016)

5. Changes in GnRH pulse frequency in females is controlled by circulating levels of
(a) progesterone only
(b) progesterone and inhibin
(c) estrogen and progesterone
(d) estrogen and inhibin. *(NEET-I 2016)*

6. Fertilisation in humans is practically feasible only if
(a) the ovum and sperms are transported simultaneously to ampullary–isthmic junction of the cervix
(b) the sperms are transported into cervix within 48 hrs of release of ovum in uterus
(c) the sperms are transported into vagina just after the release of ovum in Fallopian tube
(d) the ovum and sperms are transported simultaneously to ampullary–isthmic junction of the Fallopian tube.
(NEET-I 2016)

7. Select the incorrect statement.
(a) LH and FSH decrease gradually during the follicular phase.
(b) LH triggers secretion of androgens from the Leydig cells.
(c) FSH stimulates the sertoli cells which help in spermiogenesis.
(d) LH triggers ovulation in ovary.
(NEET-I 2016)

8. Identify the correct statement on 'inhibin'.
(a) Is produced by granulosa cells in ovary and inhibits the secretion of LH
(b) Is produced by nurse cells in testes and inhibits the secretion of LH
(c) Inhibits the secretion of LH, FSH and prolactin
(d) Is produced by granulosa cells in ovary and inhibits the secretion of FSH
(NEET-I 2016)

9. In human females, meiosis-II is not completed until
(a) uterine implantation
(b) birth
(c) puberty
(d) fertilisation. *(2015)*

10. Which of the following layers in an antral follicle is acellular?
(a) Stroma (b) Zona pellucida
(c) Granulosa (d) Theca interna
(2015)

11. Which of the following events is not associated with ovulation in human female?
(a) Release of secondary oocyte
(b) LH surge
(c) Decrease in estradiol
(d) Full development of Graafian follicle
(2015)

12. Ectopic pregnancies are referred to as
(a) implantation of defective embryo in the uterus
(b) pregnancies terminated due to hormonal imbalance
(c) pregnancies with genetic abnormality
(d) implantation of embryo at site other than uterus. *(2015)*

13. Which of the following cells during gametogenesis is normally diploid ?
(a) Spermatogonia
(b) Secondary polar body
(c) Primary polar body
(d) Spermatid *(2015 Cancelled)*

14. Capacitation refers to changes in the
(a) ovum after fertilisation
(b) sperm after fertilisation
(c) sperm before fertilisation
(d) ovum before fertilisation.
(2015 Cancelled)

15. Hysterectomy is surgical removal of
(a) vas deferens (b) mammary glands
(c) uterus (d) prostate gland.
(2015 Cancelled)

16. Which of these is not an important component of initiation of parturition in humans?
(a) Release of oxytocin
(b) Release of prolactin
(c) Increase in estrogen and progesterone ratio
(d) Synthesis of prostaglandins
(2015 Cancelled)

17. The shared terminal duct of the reproductive and urinary system in the human male is
(a) urethra (b) ureter
(c) vas deferens (d) vasa efferentia.
(2014)

18. The main function of mammalian corpus luteum is to produce
(a) estrogen only
(b) progesterone
(c) human chorionic gonadotropin
(d) relaxin only. *(2014)*

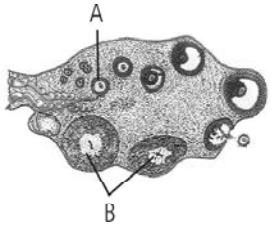
19. Select the correct option describing gonadotropin activity in a normal pregnant female.
(a) High level of FSH and LH stimulates the thickening of endometrium.
(b) High level of FSH and LH facilitates implantation of the embryo.
(c) High level of hCG stimulates the synthesis of estrogen and progesterone.
(d) High level of hCG stimulates the thickening of endometrium. *(2014)*

20. What is the correct sequence of sperm formation?
(a) Spermatogonia, spermatozoa, spermatocytes, spermatids
(b) Spermatogonia,spermatocytes, spermatids, spermatozoa
(c) Spermatids, spermatocytes, spermatogonia, spermatozoa
(d) Spermatogonia, spermatocytes, spermatozoa, spermatids *(NEET 2013)*

21. Which one of the following is not the function of placenta?
(a) Facilitates removal of carbon dioxide and waste material from embryo
(b) Secretes oxytocin during parturition
(c) Facilitates supply of oxygen and nutrients to embryo
(d) Secretes estrogen *(NEET 2013)*

22. Menstrual flow occurs due to lack of
(a) oxytocin (b) vasopressin
(c) progesterone (d) FSH.
(NEET 2013)

23. The figure shows a section of human ovary. Select the option which gives the correct identification of either A or B with function/ characteristic.



(a) B- Corpus luteum - Secretes progesterone
(b) A- Tertiary follicle - Forms Graafian follicle
(c) B- Corpus luteum - Secretes estrogen
(d) A- Primary oocyte - It is in the prophase I of the meiotic division
(Karnataka NEET 2013)

24. In our society women are blamed for producing female children. Choose the correct answer for the sex-determination in humans.
(a) Due to some defect like aspermia in man
(b) Due to the genetic make up of the particular sperm which fertilizes the egg
(c) Due to the genetic make up of the egg
(d) Due to some defect in the women
(Karnataka NEET 2013)

25. The foetal ejection reflex in humans triggers the release of
(a) oxytocin from foetal pituitary
(b) human chorionic gonadotropin (hCG) from placenta
(c) human placental lactogen (hPL) from placenta
(d) oxytocin from maternal pituitary.
(Karnataka NEET 2013)

26. Which one of the following statements is false in respect of viability of mammalian sperm?
(a) Sperm is viable for only up to 24 hours.
(b) Survival of sperm depends on the pH of the medium and is more active in alkaline medium.
(c) Viability of sperm is determined by its motility.
(d) Sperms must be concentrated in a thick suspension. *(2012)*

27. Signals for parturition originate from
(a) both placenta as well as fully developed foetus
(b) oxytocin released from maternal pituitary
(c) placenta only
(d) fully developed foetus only. *(2012)*

28. In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was
(a) high level of circulating FSH and LH in the uterus to stimulate implantation of the embryo
(b) high level of circulating hCG to stimulate endometrial thickening
(c) high levels of FSH and LH in uterus to stimulate endometrial thickening
(d) high level of circulating hCG to stimulate estrogen and progesterone synthesis.
(2012)

29. The Leydig's cells as found in the human body are the secretory source of
(a) progesterone (b) intestinal mucus
(c) glucagon (d) androgens.
(2012)

30. Identify the human developmental stage shown below as well as the related right place of its occurrence in a normal pregnant woman, and select the right option for the two, together.

	Developmental stage	Site of occurrence
(a)	Late morula	– Middle part of Fallopian tube
(b)	Blastula	– End part of Fallopian tube
(c)	Blastocyst	– Uterine wall
(d)	8-celled morula	– Starting point of Fallopian tube

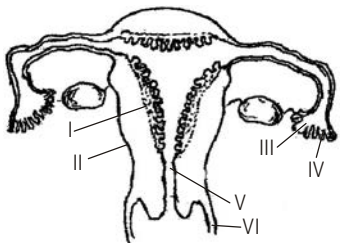
(Mains 2012)

31. The secretory phase in the human menstrual cycle is also called
(a) luteal phase and lasts for about 6 days
(b) follicular phase and lasts for about 6 days
(c) luteal phase and lasts for about 13 days
(d) follicular phase and lasts for about 13 days.
(Mains 2012)

32. If for some reason, the vasa efferentia in the human reproductive system get blocked, the gametes will not be transported from
(a) testes to epididymis
(b) epididymis to vas deferens
(c) ovary to uterus
(d) vagina to uterus.
(2011)

33. The testes in humans are situated outside the abdominal cavity inside a pouch called scrotum. The purpose served is for
(a) maintaining the scrotal temperature lower than the internal body temperature
(b) escaping any possible compression by the visceral organs
(c) providing more space for the growth of epididymis
(d) providing a secondary sexual feature for exhibiting the male sex.
(2011)

34. The figure given below depicts a diagrammatic sectional view of the human female reproductive system. Which set of three parts out of I-VI have been correctly identified?



(a) (II) endometrium, (III) infundibulum, (IV) fimbriae
(b) (III) infundibulum, (IV) fimbriae, (V) cervix
(c) (IV) oviducal funnel, (V) uterus, (VI) cervix
(d) (I) perimetrium, (II) myometrium, (III) Fallopian tube *(2011)*

35. What happens during fertilization in humans after many sperms reach close to the ovum?
(a) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida.
(b) All sperms except the one nearest to the ovum lose their tails.
(c) Cells of corona radiata trap all the sperms except one.
(d) Only two sperms nearest the ovum penetrate zona pellucida. *(Mains 2011)*

36. About which day in a normal human menstrual cycle does rapid secretion of LH (popularly called LH surge) normally occurs?
(a) 14^{th} day (b) 20^{th} day
(c) 5^{th} day (d) 11^{th} day
(Mains 2011)

37. Sertoli cells are found in
(a) ovaries and secrete progesterone
(b) adrenal cortex and secrete adrenaline
(c) seminiferous tubules and provide nutrition to germ cells
(d) pancreas and secrete cholecystokinin.
(2010)

38. Vasa efferentia are the ductules leading from
(a) testicular lobules to rete testis
(b) rete testis to vas deferens
(c) vas deferens to epididymis
(d) epididymis to urethra. *(2010)*

39. Seminal plasma in human males is rich in
(a) fructose and calcium
(b) glucose and calcium
(c) DNA and testosterone
(d) ribose and potassium. *(2010)*

40. The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy?
(a) Fourth month (b) Fifth month
(c) Sixth month (d) Third month
(2010)

41. The second maturation division of the mammalian ovum occurs
(a) shortly after ovulation before the ovum makes entry into the Fallopian tube
(b) until after the ovum has been penetrated by a sperm
(c) until the nucleus of the sperm has fused with that of the ovum
(d) in the Graafian follicle following the first maturation division. *(2010)*

42. Which one of the following statements about human sperm is correct?
(a) Acrosome has a conical pointed structure used for piercing and penetrating the egg, resulting in fertilisation.
(b) The sperm lysins in the acrosome dissolve the egg envelope facilitating fertilisation.
(c) Acrosome serves as a sensory structure leading the sperm towards the ovum.
(d) Acrosome serves no particular function.
(2010)

43. Which one of the following statements about morula in humans is correct?
(a) It has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA.
(b) It has far less cytoplasm as well as less DNA than in an uncleaved zygote.
(c) It has more or less equal quantity of cytoplasm and DNA as in uncleaved zygote.
(d) it has more cytoplasm and more DNA than an uncleaved zygote. *(2010)*

44. The part of Fallopian tube closest to the ovary is
(a) isthmus (b) infundibulum
(c) cervix (d) ampulla. *(2010)*

45. Signals from fully developed foetus and placenta ultimately lead to parturition which requires the release of
(a) estrogen from placenta
(b) oxytocin from maternal pituitary
(c) oxytocin from foetal pituitary
(d) relaxin from placenta. *(Mains 2010)*

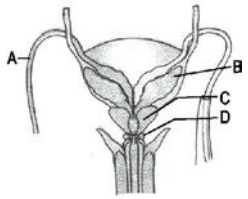
46. In human female the blastocyst
(a) forms placenta even before implantation
(b) gets implanted into uterus 3 days after ovulation
(c) gets nutrition from uterine endometrial secretion only after implantation
(d) gets implanted in endometrium by the trophoblast cells.
(Mains 2010)

47. Secretions from which one of the following are rich in fructose, calcium and some enzymes?
(a) Male accessory glands
(b) Liver
(c) Pancreas
(d) Salivary glands
(Mains 2010)

48. Seminal plasma in humans is rich in
(a) fructose and calcium but has no enzymes
(b) glucose and certain enzymes but has no calcium
(c) fructose and certain enzymes but poor in calcium
(d) fructose, calcium and certain enzymes.
(2009)

49. Which one of the following is the correct matching of the events occurring during menstrual cycle?
(a) Proliferative phase: Rapid regeneration of myometrium and maturation of Graafian follicle
(b) Secretory phase : Development of increased secretion corpus luteum and of progesterone
(c) Menstruation : Breakdown of myometrium and ovum not fertilised
(d) Ovulation : LH and FSH attain peak level and sharp fall in the secretion of progesterone
(2009)

50. Given below is a diagrammatic sketch of a portion of human male reproductive system. Select the correct set of the names of the parts labelled A, B, C, D.



(a) A-Vas deferens, B-Seminal vesicle, C-Prostate, D-Bulbourethral gland
(b) A-Vas deferens, B-Seminal vesicle, C-Bulbourethral gland, D-Prostate
(c) A-Ureter, B-Seminal vesicle, C-Prostate,D-Bulbourethral gland
(d) A-Ureter, B-Prostate, C-Seminal vesicle, D-Bulbourethral gland
(2009)

51. Foetal ejection reflex in human female is induced by
(a) release of oxytocin from pituitary
(b) fully developed foetus and placenta
(c) differentiation of mammary glands
(d) pressure exerted by amniotic fluid.
(2009)

52. The correct sequence of spermatogenetic stages leading to the formation of sperms in a mature human testis is
(a) spermatogonia - spermatocyte - spermatid - sperms
(b) spermatid - spermatocyte - spermatogonia - sperms
(c) spermatogonia - spermatid - spermatocyte - sperms
(d) spermatocyte - spermatogonia - spermatid - sperms. *(2009)*

53. Which one of the following is the most likely root cause why menstruation is not taking place in regularly cycling human female?
(a) Maintenance of the hypertrophical endometrial lining
(b) Maintenance of high concentration of sex-hormones in the blood stream
(c) Retention of well-developed corpus luteum
(d) Fertilisation of the ovum *(2009)*

54. A change in the amount of yolk and its distribution in the egg will affect
(a) pattern of cleavage
(b) number of blastomeres produced
(c) fertilization
(d) formation of zygote. *(2009)*

55. In humans, at the end of the first meiotic division, the male germ cells differentiate into the
(a) spermatids
(b) spermatogonia
(c) primary spermatocytes
(d) secondary spermatocytes. *(2008)*

56. In human adult females oxytocin
(a) stimulates pituitary to secrete vasopressin
(b) causes strong uterine contractions during parturition
(c) is secreted by anterior pituitary
(d) stimulates growth of mammary glands. *(2008)*

57. Which one of the following statements is incorrect about menstruation?
(a) At menopause in the female, there is especially abrupt increase in gonadotropic hormones.
(b) The beginning of the cycle of menstruation is called menarche.
(c) During normal menstruation about 40 mL blood is lost.
(d) The menstrual fluid can easily clot. *(2008)*

58. Which extraembryonic membrane in humans prevents desiccation of the embryo inside the uterus?
(a) Yolk sac (b) Amnion
(c) Chorion (d) Allantosis *(2008)*

59. Which part of ovary in mammals acts as an endocrine gland after ovulation?
(a) Stroma
(b) Germinal epithelium
(c) Vitelline membrane
(d) Graafian follicle *(2007)*

60. In the human female, menstruation can be deferred by the administration of
(a) combination of FSH and LH
(b) combination of estrogen and progesterone
(c) FSH only (d) LH only. *(2007)*

61. Sertoli cells are regulated by the pituitary hormone known as
(a) LH (b) FSH
(c) GH (d) prolactin. *(2006)*

62. Withdrawal of which of the following hormones is the immediate cause of menstruation?
(a) Progesterone (b) Estrogen
(c) FSH (d) FSH-RH *(2006)*

63. Grey crescent is the area
(a) at the point of entry of sperm into ovum
(b) just opposite to the site of entry of sperm into ovum
(c) at the animal pole
(d) at the vegetal pole. *(2005)*

64. If mammalian ovum fails to get fertilized, which one of the following is unlikely?
(a) Corpus luteum will disintegrate.
(b) Progesterone secretion rapidly declines.
(c) Estrogen secretion further increases.
(d) Primary follicle starts developing. *(2005)*

65. Ovulation in the human female normally takes place during the menstrual cycle
(a) at the mid secretory phase
(b) just before the end of the secretory phase
(c) at the beginning of the proliferative phase
(d) at the end of the proliferative phase. *(2004)*

66. Which of the following hormones is not a secretion product of human placenta?
(a) Human chorionic gonadotropin
(b) Prolactin
(c) Estrogen
(d) Progesterone *(2004)*

67. During embryonic development, the establishment of polarity along anterior/posterior, dorsal/ventral or medial/lateral axis is called
(a) organizer phenomena
(b) axis formation
(c) anamorphosis
(d) pattern formation. *(2003)*

68. What is true for cleavage?
(a) Size of embryo increases.
(b) Size of cells decreases.
(c) Size of cells increases.
(d) Size of embryo decreases. *(2002)*

69. Which set is similar?
(a) Corpus luteum - Graafian follicles
(b) Sebum - Sweat
(c) Bundle of His - Pace maker
(d) Vitamin B_7 - Niacin *(2001)*

70. Blastopore is the pore of
(a) archenteron (b) blastocoel
(c) coelom (d) alimentary canal. *(2000)*

71. The middle piece of the sperm contains
(a) proteins (b) mitochondria
(c) centriole (d) nucleus. *(1999)*

72. After ovulation Graafian follicle regresses into
(a) corpus artesia (b) corpus callosum
(c) corpus luteum (d) corpus albicans.
(1999)

73. Fertilizin is a chemical substance produced from
(a) polar bodies
(b) middle piece of sperm
(c) mature eggs
(d) acrosome. *(1997)*

74. In human beings, the eggs are
(a) mesolecithal (b) alecithal
(c) microlecithal (d) macrolecithal.
(1997)

75. In the fertile human female, approximately on which day of the menstrual cycle does ovulation take place?
(a) Day 14 (b) Day 18
(c) Day 1 (d) Day 8 *(1997)*

76. The mammalian corpus luteum produces
(a) luteotrophic hormone
(b) luteinizing hormone
(c) estrogen
(d) progesterone. *(1995)*

77. In an egg, the type of cleavage is determined by
(a) the amount and distribution of yolk
(b) the number of egg membranes
(c) the shape and size of the sperm
(d) the size and location of the nucleus.
(1995)

78. What is true about cleavage in the fertilized egg in humans?
(a) It starts while the egg is in Fallopian tube.
(b) It starts when the egg reaches uterus.
(c) It is meroblastic.
(d) It is identical to the normal mitosis.
(1994)

79. The extra embryonic membranes of the mammalian embryo are derived from
(a) trophoblast (b) inner cell mass
(c) formative cells (d) follicle cells.
(1994)

80. In the 28 day human ovarian cycle, the ovulation takes place typically on
(a) day 14 of the cycle (b) day 28 of the cycle
(c) day 1 of the cycle (d) day 5 of the cycle.
(1994)

81. Extrusion of second polar body from egg nucleus occurs
(a) after entry of sperm before completion of fertilization
(b) after completion of fertilization
(c) before entry of sperm
(d) without any relation of sperm entry.
(1993)

82. Termination of gastrulation is indicated by
(a) obliteration of blastocoel
(b) obliteration of archenteron
(c) closure of blastopore
(d) closure of neural tube. *(1993)*

83. In telolecithal egg the yolk is found
(a) all over the egg (b) on one side
(c) both the sides (d) centre. *(1993)*

84. Acrosome reaction in sperm is triggered by
(a) capacitation
(b) release of lysin
(c) influx of Na^+
(d) release of fertilizin. *(1993)*

85. Male hormone is produced in the testis by cells of
(a) Sertoli (b) epithelial
(c) spermatocytes (d) Leydig. *(1993)*

86. Meroblastic cleavage is a division which is
(a) horizontal (b) partial/parietal
(c) total (d) spiral. *(1992)*

87. Eye lens is formed from
(a) ectoderm
(b) mesoderm
(c) endoderm
(d) ectoderm and mesoderm. *(1992)*

88. Blastopore is
(a) opening of neural tube
(b) opening of gastrocoel
(c) future anterior end of embryo
(d) found in blastula. *(1992)*

89. Fertilizins are emitted by
(a) immature eggs (b) mature eggs
(c) sperms (d) polar bodies.
(1991)

90. During cleavage, what is true about cells?
(a) Nucleocytoplasmic ratio remains unchanged.
(b) Size does not increase.
(c) There is less consumption of oxygen.
(d) The division is like meiosis. *(1991)*

91. Freshly released human egg has
(a) one Y-chromosome
(b) one X-chromosome
(c) two X-chromosome
(d) one X-chromosome and one Y-chromosome. *(1991)*

92. Location and secretion of Leydig's cells are
(a) liver-cholesterol
(b) ovary-estrogen
(c) testis-testosterone
(d) pancreas-glucagon. *(1991)*

93. Middle piece of mammalian sperm possesses
(a) mitochondria and centriole
(b) mitochondria only
(c) centriole only
(d) nucleus and mitochondria. *(1991)*

94. Gonads develop from embryonic
(a) ectoderm
(b) endoderm
(c) mesoderm
(d) both mesoderm and endoderm. *(1990)*

95. How many sperms are formed from a secondary spermatocyte?
(a) 4 (b) 8
(c) 2 (d) 1 *(1990)*

96. Cells become variable in morphology and function in different regions of the embryo. The process is
(a) differentiation (b) metamorphosis
(c) organisation (d) rearrangement. *(1989)*

97. Human eggs are
(a) alecithal (b) microlecithal
(c) mesolecithal (d) macrolecithal. *(1989)*

98. Egg is liberated from ovary in
(a) secondary oocyte stage
(b) primary oocyte stage
(c) oogonial stage
(d) mature ovum stage. *(1989)*

Answer Key

1.	(c)	**2.**	(a)	**3.**	(b)	**4.**	(b)	**5.**	(c)	**6.**	(d)	**7.**	(a)	**8.**	(d)	**9.**	(d)	**10.**	(b)
11.	(c)	**12.**	(d)	**13.**	(a)	**14.**	(c)	**15.**	(c)	**16.**	(b)	**17.**	(a)	**18.**	(b)	**19.**	(c)	**20.**	(b)
21.	(b)	**22.**	(c)	**23.**	(a)	**24.**	(b)	**25.**	(d)	**26.**	(a)	**27.**	(a)	**28.**	(d)	**29.**	(d)	**30.**	(c)
31.	(c)	**32.**	(a)	**33.**	(a)	**34.**	(b)	**35.**	(a)	**36.**	(a)	**37.**	(c)	**38.**	(b)	**39.**	(a)	**40.**	(b)
41.	(b)	**42.**	(b)	**43.**	(a)	**44.**	(b)	**45.**	(b)	**46.**	(d)	**47.**	(a)	**48.**	(d)	**49.**	(b)	**50.**	(a)
51.	(b)	**52.**	(a)	**53.**	(b)	**54.**	(a)	**55.**	(d)	**56.**	(b)	**57.**	(d)	**58.**	(b)	**59.**	(d)	**60.**	(b)
61.	(b)	**62.**	(a)	**63.**	(b)	**64.**	(c)	**65.**	(d)	**66.**	(b)	**67.**	(a)	**68.**	(b)	**69.**	(a)	**70.**	(a)
71.	(b)	**72.**	(c)	**73.**	(c)	**74.**	(b)	**75.**	(a)	**76.**	(d)	**77.**	(a)	**78.**	(a)	**79.**	(a)	**80.**	(a)
81.	(a)	**82.**	(a)	**83.**	(b)	**84.**	(c)	**85.**	(d)	**86.**	(b)	**87.**	(a)	**88.**	(b)	**89.**	(b)	**90.**	(b)
91.	(b)	**92.**	(c)	**93.**	(a)	**94.**	(c)	**95.**	(c)	**96.**	(a)	**97.**	(a)	**98.**	(a)				

EXPLANATIONS

1. (c) : The sperms in the female's genital tract are made capable of fertilising the egg by secretions of the female genital tract. These secretions remove coating substances deposited on the surface of the sperms particularly those on the acrosome. Thus, the receptor sites on the acrosome are exposed and sperm becomes active to penetrate the egg. This phenomenon of sperm activation in mammals is known as capacitation.

2. (a) **3. (b)**

4. (b) : During pregnancy, placenta acts as an endocrine gland and secretes some hormones such as estrogen, progesterone, human chorionic gonadotropin (hCG), human placental lactogen (hPL), chorionic thyrotropin, chorionic corticotropin and relaxin.

5. (c) : GnRH is secreted by the hypothalamus which stimulates the anterior lobe of pituitary gland to secrete luteinising hormone (LH) and FSH. FSH stimulates the growth of the ovarian follicles and stimulates the formation of estrogens. LH stimulates the corpus luteum to secrete progesterone. Rising levels of progesterone and estrogen inhibits the release of GnRH, which in turn, inhibits the production of FSH and LH.

6. (d) : The fusion of a haploid male gamete (sperm) and a haploid female gamete (ovum) to form a diploid zygote is called fertilisation. In human beings, it takes place in the ampullary isthmic junction of the oviduct (Fallopian tube).

7. (a) : During follicular phase FSH secretion increases. Follicular phase (proliferative phase) usually includes cycle days 6-13 or 14 in a 28 days cycle. The follicle stimulating hormone (FSH) secreted by the anterior lobe of the pituitary gland stimulates the ovarian follicle to secrete estrogens.

8. (d)

9. (d) : In human beings, ovum is released from the ovary in the secondary oocyte stage. The maturation of secondary oocyte is completed in the mother's oviduct (Fallopian tube) usually after the sperm has entered the secondary oocyte for fertilisation. Entry of the sperm restarts the cell cycle breaking down MPF (M-phase promoting factor) and turning on APC (Anaphase promoting complex). Completion of meiosis II converts the secondary oocyte into a fertilised ovum (egg) or zygote (and also a second polar body).

10. (b)

11. (c) : In human females, ovulation is the release of secondary oocyte from the ovary at about 14^{th} day of the menstrual cycle. Both LH and FSH attain a peak level during this period. Rapid secretion of LH induces rupturing of fully developed Graafian follicle and thereby release of ovum. LH surge is actually responsible for ovulation.

12. (d) : Ectopic pregnancy is a complication of pregnancy in which implantation of embryo takes place at site other than uterus. Signs and symptoms include abdominal pain and vaginal bleeding. Most ectopic pregnancies (90%) occur in the Fallopian tube, which are known as tubal pregnancies.

13. (a) : Spermatogonia are diploid cells which mature into primary spermatocytes ($2n$) by growth. They then produce two haploid secondary spermatocytes by meiosis I. Each secondary spermatocyte (n) completes the meiosis II and produces two spermatids (n). Each spermatid (n) develops into a spermatozoan or sperm (n). Similarly, in females, oogonia are the diploid cells from which through meiosis, polar bodies (n) and single ovum (n) are produced.

14. (c) : *Refer to answer 1.*

15. (c) : Hysterectomy is the surgical removal of uterus. It may also involve removal of the cervix, ovaries, Fallopian tubes and other surrounding structures.

16. (b) : Process of parturition is induced by both nervous system and hormones secreted by the endocrine glands of the mother. The signals for child birth (parturition) originate from the fully developed foetus and placenta which induce mild uterine contractions called foetal ejection reflex. This causes quick release of oxytocin from the maternal posterior lobe of pituitary gland which induces labour pains. Prostoglandins, progesterone and estrogen also play a role. Prolactin is the hormone which induces lactation and has no role in parturition.

17. (a) : Urethra is the urinary duct which originates from the neck of urinary bladder and opens to the exterior at the tip of penis in males. It is a common pathway for passage of urine and semen.

18. (b) : Corpus luteum secretes steroid hormones progesterone and estrogen, to make uterus suitable for implantation (in case fertilisation occurs) and it's maintenance (mainly endometrium).

19. (c) : The trophoblastic cells secrete human chorionic gonadotropin hormone which has properties similar to those of lutenizing hormone (LH) of the pituitary gland. It takes over the job of pituitary LH during pregnancy. The hCG maintains the corpus luteum and stimulates it to secrete progesterone. The latter maintains the endometrium of the uterus and causes it to grow throughout pregnancy. This also prevents menstruation. Progesterone also causes increased secretion of mucus in the cervix of the uterus that forms a protective plug during pregnancy.

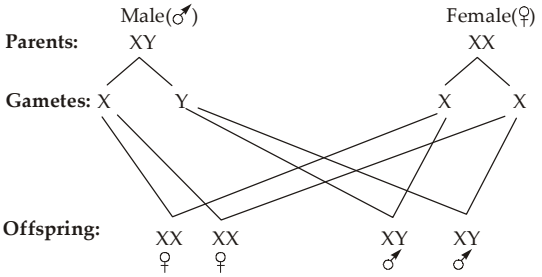
20. (b) : Spermatogenesis is the process of formation of haploid spermatozoa (sperms) from diploid spermatogonia inside the testes of the male. At sexual maturity, the undifferentiated primordial germ cells divide several times by mitosis to produce a large number of spermatogonia or sperm mother cells. Each spermatogonium actively grows to a larger primary spermatocyte by obtaining nourishment from the nursing cells. The phenomenon of formation of primary spermatocytes from spermatogonia, is called spermatocytogenesis. Each primary spermatocyte undergoes two successive divisions, called maturation divisions. The first maturation division is reductional or meiotic. Hence, the primary spermatocyte divides into two haploid daughter cells called secondary spermatocytes. Both secondary spermatocytes now undergo second maturation division which is an ordinary mitotic division to form four haploid spermatids, by each primary spermatocyte. The transformation of spermatids into spermatozoa is called spermiogenesis or spermateleosis or differentiation phase.

21. (b) : Parturition is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from the maternal pituitary. Oxytocin acts on the uterine muscle and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. This lead to expulsion of the baby out of the uterus through the birth canal.

22. (c) : The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium. Such as endometrium is necessary for implantation of the fertilized ovum and other events of pregnancy. In the absence of fertilization, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation. The menstrual flow results due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina.

23. (a) : The zona granulosa and theca cells of Graafian follicle remaining in the ovary after ovulation and some surrounding capillaries and connective tissue evolve into the corpus luteum (a temporary endocrine gland). The corpus luteum produces progesterone and, in the event of fertilization, provides the required progesterone until the placenta is formed. In the absence of fertilization, the life span of the corpus luteum is 14 days. It then degenerates into a corpus albicans, which is mainly a scar tissue.

24. (b) : Establishment of sex through differential development in an individual at an early stage of life is called sex determination. It is determined at the time of fertilization and is also called as syngametic sex determination. The female is homomorphic (isomorphic) possessing two similar sex chromosomes, XX and the male is heteromorphic possessing one X chromosome similar to that of female and one shorter and morphologically different Y chromosome. The female is said to be homogametic (produces similar eggs) and the male heterogametic (produces two types of sperms *i.e.*, X or Y). Sex is determined at the time of fertilization by the kind of sperm (X or Y) that fuses with the ovum (X).



25. (d) : *Refer to answer 21.*

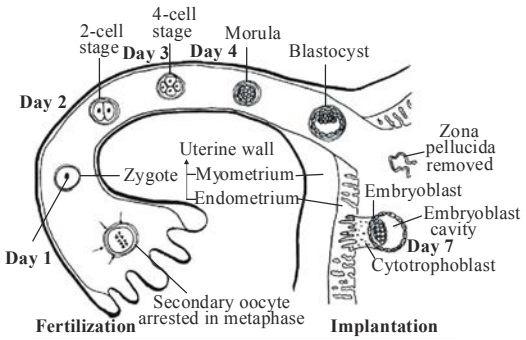
26. (a) : Sperms remain viable for 48 hours to 72 hours.

27. (a) : *Refer to answer 21.*

28. (d) : During pregnancy, placenta also acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental estrogen, progesterone, etc. The hCG stimulates and maintains the corpus luteum to secrete progesterone.

29. (d) : Interstitial cells or Leydig cells are the cells interspersed between the seminiferous tubules of the testis. They secrete androgens (*e.g.*, testosterone) in response to stimulation by luteinizing hormone from the anterior pituitary gland.

30. (c) : After fertilization, zygote undergoes rapid mitotic divisions, called cleavage, which is characterized by absence of growth of daughter cells. This leads to the conversion of single celled zygote into a multicellular structure called blastocyst or blastula. Implantation or embedding of zygote into endometrium of uterus occurs in blastocyst stage. The various stages in the journey of a fertilized egg from fertilization in the Fallopian tube to the implantation site in the uterus is illustrated in the given figure.



Blastocyst comes in contact with the endometrium in the region of embryonal knob or embryonic disc. It adheres to the same. The surface cells of trophoblast secrete lytic enzymes which cause corrosion of endometrial lining. They also give rise to finger-like outgrowths called chorionic villi. Chorionic villi and uterine tissue become interdigitated. Villi not only help in fixation but also absorption of nourishment.

31. (c) : After ovulation which occurs in the middle of menstrual cycle, empty Graafian follicle continues growth under the influence of LH. The follicular cells are converted into lutein cells by deposition of yellowish lipid inclusions. The phenomenon is called luteinization. The ruptured Graafian follicle is now called corpus luteum. It secretes hormones, mainly progesterone and small quantity of estrogen. Both LH and progesterone help in further growth and thickening of endometrium. The major change is that the endometrial glands become secretory. The uterine wall becomes ready for nourishing and anchoring blastocyst if fertilization takes place. Hence, this phase of menstrual cycle is called luteal or secretory phase. The phase lasts for about 13 days *i.e.*, 15-28 days of 28 days menstrual cycle.

32. (a) : The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens. The seminiferous tubules of the testis open into the vasa efferentia through rete testis. The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis. So if vasa efferentia gets blocked, the gametes will not be transported from testes to epididymis.

33. (a) : The testes are situated outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes (2–2.5°C lower than the normal internal body temperature) necessary for spermatogenesis.

34. (b) : The oviducts (Fallopian tubes), uterus and vagina constitute the female accessory ducts. Each Fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus, the part closer to the ovary is the funnel-shaped infundibulum. The edges of the infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation. The uterus is single and it is also called womb, open into vagina through a narrow cervix. So, III is infundibulum, IV is fimbriae and V is cervix.

35. (a) : The process of fusion of a sperm with an ovum is called fertilization. During fertilization, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms. Thus, it ensures that only one sperm can fertilize an ovum. The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. In contact with the surface of egg covering, the acrosome releases its contained hydrolytic enzymes, also called sperm lysins. It is known as acrosomal reaction. Acrosome reaction results in dissolving of corona cells and degeneration of zona pellucida which helps in sperm penetration.

36. (a) : Both LH and FSH attain a peak level in the middle of menstrual cycle (about 14^{th} day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).

37. (c) : Sertoli cells (named after Italian histologist Enrico Sertoli) are found in the walls of the seminiferous tubules of the testis. Compared with the germ cells they appear large and pale. They anchor and probably nourish the developing germ cells, especially the spermatids, which become partly embedded within them.

38. (b) : The seminiferous tubules are closed at one end but on the other side they join to a network the rete testis from where fine ciliated ductules, the vasa efferentia arise. Cilia help in conducting sperms. The rete testis is a network of tubules conducting sperm from the seminiferous tubules of the testis to the vasa efferentia.

39. (a) : Semen or seminal fluid or seminal plasma is the fluid ejaculated from the penis at sexual climax. Each ejaculate may contain 300 – 500 million spermatozoa suspended in a fluid secreted by the prostate gland and seminal vesicles with a small contribution from Cowper's glands. It is rich in fructose, calcium and certain enzymes. It provides a fluid medium for transport of sperms, nourishes and activates sperms, lubricates the reproductive tract of female and neutralizes the acidity of the vagina of female to protect the sperms.

40. (b) : In human beings, after one month of pregnancy, the embryo's heart is formed. By the end of the second month of pregnancy, the foetus develops limbs and digits. By the end of 12 weeks (first trimester), most of the major organ systems are formed. The first movements of the foetus and appearance of hair on the head are usually observed during the fifth month. By the end of 24 weeks (second trimester), the body is covered with fine hair, eye-lids separate, and eyelashes are formed. By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.

41. (b) : Oogenesis starts with division of oogonia (gamete mother cells) giving rise to primary oocyte which enters into prophase I of the meiotic divison and get temporarily arrested at this stage. These primary oocyte gets surrounded by primary, secondary and tertiary follicles respectively. The tertiary follicle grow in size and completes its first meiotic divison to give rise to haploid secondary oocyte. This secondary oocyte forms a new membrane called zona pellucida surrounding it. During fertilisation the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division (2^{nd} divison) of the secondary oocyte. The second meiotic division is also unequal and results in the formation of a second polar body and a haploid ovum (ootid).

42. (b) : Acrosome is the cap-like structure on the front end of a spermatozoan. It breaks down just before fertilisation (the acrosome reaction), releasing a number of hydrolytic enzymes, also called sperm lysins that assist penetration between the follicle cells that still surround the ovum, thus facilitating fertilisation. Failure of the acrosome reaction is a cause of male infertility.

43. (a) : A morula is an embryo at an early stage of embryonic development, consisting of cells (called blastomeres) in a solid ball contained within the zona pellucida. The morula is produced by embryonic cleavage, the rapid division of the zygote. The increase in number of cells does not change the size of the original mass. The divisions are rapid because there is no net growth of the embryo-the cell cycle alternates between DNA replication and mitosis. In the absence of growth, the cell number in the embryo increases while the cell size decreases. Thus, it has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA.

44. (b) : Each Fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus, the part closer to the ovary is the funnel-shaped infundibulum. The edges of the infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation. The infundibulum leads to a wider part of the oviduct called ampulla. The last part of the oviduct, isthmus has a narrow lumen and it joins the uterus.

45. (b) : *Refer to answer 21.*

46. (d) : Implantation in endometrial uterine wall takes place at blastocyst stage of embryonic development. Before implantation, the blastomeres of early blastocyst get arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called inner cell mass. It is the trophoblast layer through which blastocyst gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.

47. (a) : The male accessory glands include paired seminal vesicles, a prostate and paired bulbourethral glands. Secretions of these glands constitute the seminal plasma which is rich in fructose, calcium and certain enzymes. The secretions of bulbourethral glands also helps in the lubrication of the penis.

48. (d) : *Refer to answer 47.*

49. (b) : Secretory phase is also called as luteal phase. The luteinising hormone or LH is secreted by the anterior lobe of pituitary gland. LH causes ovulation. LH stimulates cells of ovarian follicles to develop corpus luteum. Corpus luteum secretes large amount of progesterone.

50. (a)

51. (b) : *Refer to answer 21.*

52. (a) : *Refer to answer 20.*

53. (b) : High concentration of sex steroids (estrogen) exerts negative feedback on anterior pituitary, decreasing LH secretion and release thus, lowering LH level in blood. Due to insufficient LH level no ovulation occurs which causes irregular menstruation.

54. (a) : Cleavage is a series of cell divisions by which a single fertilized egg cell is transformed into a multicellular body, the blastula. Characteristically no growth occurs during cleavage, the shape of the embryo is unchanged except for the formation of central cavity (the blastocoel), and the ratio of nuclear material (DNA) to cytoplasm increases. The mode of cleavage is determined by the amount of yolk and its distribution. On this basis cleavage may be holoblastic and meroblastic.

55. (d) : During embryonic development the primordial germ cells migrate to the testis where they become spermatogonia. At puberty the spermatogonia proliferate rapidly by mitosis. Some undergo growth phase to become primary spermatocytes that further undergo through meiotic division I to become secondary spermatocytes. After completion of meiotic division II the secondary spermatocytes produce spermatids which differentiate to form spermatozoa.

56. (b) : In human adult female oxytocin is a hormone released by the pituitary gland (neurohypophysis), that causes contraction of the uterus during labour and stimulates milk flow from the breasts by causing contraction of muscle fibres in the milk ducts.

57. (d) : Menstruation is a process which involves discharge of blood (45 – 100mL), serous fluid, cell debris and mucosal fragments from cast off endometrial lining due to reduce titre of both estrogen and progesterone hormone. Blood clotting does not occur due to presence of fibrinolysin.

58. (b) : Amnion is a type of extraembryonic membrane formed by the amniogenic cells inside and splanchnopleuric extraembryonic mesoderm outside. Amnion surrounds the embryo creating the amniotic cavity that is filled with amniotic fluid. The amniotic fluid serves as a shock absorber for the foetus, regulates foetal body temperature and prevents desiccation.

59. (d) : The Graafian follicle is fluid-filled capsule that surrounds and protects the developing egg cell inside the ovary during the menstrual cycle. Graafian follicle represents the final stage of follicular development before ovulation. Shortly before ovulation the follicle swells and develops a stigma. At ovulation, the stigma ruptures, releasing the secondary oocyte and corona radiata into the peritoneal cavity to be taken up by the oviduct. The zona granulosa and theca cells remaining in the ovary after ovulation and some surrounding capillaries and connective tissue evolve into the corpus luteum (a temporary endocrine gland) *i.e.,* after the egg cell has been released, the follicle remains and is known as a corpus luteum. The corpus luteum produces progesterone and, in the event of fertilization, provides the required progesterone until the placenta is formed. The corpus luteum also produces some estrogen.

60. (b)

61. (b) : Sertoli cells are present in the germinal epithelium of the seminiferous tubules. These cells nourish the developing sperms. These cells differentiate spermatogonia into sperms. They are under the influence of FSH released by anterior pituitary gland.

62. (a) : The menstrual cycle consists of three phases; proliferative phase, secretory phase and menstrual phase. During menstrual phase the production of LH is considerably reduced. The withdrawal of this hormone causes degeneration of the corpus luteum and, therefore, progesterone production is reduced. The endometrium degenerates and breaks down. Thus menstruation begins.

63. (b) : Grey crescent is the area just opposite to the site of entry of sperm into ovum. It marks the future dorsal side of the embryo.

64. (c) : If the mammalian ovum fails to fertilize choices, (a) and (b) are obvious. Since corpus luteum declines so progesterone also decreases rapidly (progesterone is essential for maintenance of pregnancy). Also estrogen continues to cause growth of the endometrium which ultimately becomes thick enough to breakdown and cause menstruation. Hence choice (c) is incorrect as estrogen secretion does not decrease further. Primary follicles continue developing irrespective of ovulatory condition.

65. (d) : Ovulation (the release of secondary oocyte from the graafian follicle) takes place at the end of proliferative phase of menstrual cycle. During this phase, the follicle stimulating hormone (FSH) secreted by the anterior lobe of the pituitary gland stimulates the ovarian follicle to secrete estrogen. Estrogen stimulates the proliferation of the endometrium of the uterine wall. The endometrium becomes thicker by rapid cell multiplication and this is accompanied by an increase of uterine glands and blood vessels. This phase ends when the ovarian

follicle ruptures and ovulation occurs and at the same time the production of estrogen stops.

66. (b) : Prolactin is secreted by anterior pituitary gland which stimulates mammary gland development during pregnancy and lactation after child birth.

67. (a) : During embryonic development, the establishment of polarity along anterior/posterior, dorsal/ventral or medial/lateral axis is called organizer phenomenon. The organizer is the part of an embryo consisting of undifferentiated cells that follow a specific course of development by identifying the polarity of particular region.

68. (b) : During cleavage, the zygote divides repeatedly to convert the large cytoplasmic mass into a large number of small blastomeres. It involves cell division without growth in size because cells continue to be retained within the zona pellucida. However, cell size decreases during cleavage.

69. (a) : A mature ovarian follicle is called Graafian follicle. It contains follicular cells, an antrum, and an oocyte. After ovulation, the empty Graafian follicle shows deposition of leutin and forms corpus luteum that ultimately degenerates.

70. (a) : Archenteron is known as the primitive gut that forms during gastrulation in the developing blastula. It develops into the digestive tract of an animal. The open end of the archenteron is called blastopore.

71. (b) : The sperm consists of head, neck, middle piece and tail. The middle piece of human sperm contains the mitochondria coiled around the axial filament called mitochondrial spiral. They provide energy for the movement of the sperm.

72. (c) : *Refer to answer 69.*

73. (c) : Mature egg (ovum) secretes a chemical named fertilizin (composed of glycoprotein = monosaccharides + amino acids). Sperm has on its surface a protein substance called antifertilizin (composed of acidic amino acids). The fertilizin of an egg interacts with the antifertilizin of a sperm of the same species. This interaction makes the sperms stick to the egg surface. The adhesion of sperm to the egg of the same species through chemical recognition is known as agglutination.

74. (b) : In human beings, the eggs are alecithal, *i.e.*, they do not contain yolk. Mesolecithal eggs contain moderate amount of yolk *e.g.*, frog. Microlecithal eggs contain a little amount of yolk *e.g., Amphioxus*. Macrolecithal eggs contain large amount of yolk *e.g.*, birds.

75. (a) : Ovulation is the releasing of egg by ruptured graafian follicle. The wall of graafian follicle is ruptured by sudden increase in the level of luteinising hormone. The length of menstruation cycle is 28 days (average) from the start of one menstruation period to the start of the next. At about 14^{th} day of the cycle, the distended follicle ruptures and the ovum is extruded into the Fallopian tube.

76. (d) : Progesterone is secreted by the corpus luteum of the ovary. It stimulates further development of the uterine epithelium and mammary glands. It is also required for the formation of the placenta and for the maintenance of pregnancy. Luteotrophic hormone and luteinizing hormone are secreted by the anterior lobe of pituitary gland. Estrogen is secreted by the cells of the Graafian follicles.

77. (a) : The amount of yolk and how it is distributed determines the type of cleavage. On this basis cleavage is of two types:

(i) Holoblastic (total cleavage) - where the segmentation line passes through the entire egg. It occurs in alecithal (without yolk), microlecithal (with very little amount of yolk) and mesolecithal (little amount of yolk) egg.

(ii) Meroblastic (partial cleavage) - where segmentation line does not pass through the egg and remained confined to a part of the egg. It occurs in megalecithal (large amount of yolk) egg.

78. (a) : Cleavage is a series of rapid mitotic divisions of the zygote which convert the single celled zygote into a multicellular structure called blastula (blastocyst).

About thirty hours after fertilization, the newly formed zygote divides into two cells, the blastomeres, in the upper portion of the Fallopian tube. This is the first cleavage. The next division occurs within forty hours after fertilization. The third division occurs about three days after fertilization. During these early cleavages, the young embryo is slowly moving down the Fallopian tube towards the uterus. At the end of fourth day, the embryo reaches the uterus. It has thirty two cells.

79. (a) : Trophoblast is the layer of cells encircling the blastocoel and the inner cell mass. The latter gives rise to the embryo. The cells of the trophoblast form the placenta and foetal membrane.

80. (a) : *Refer to answer 75.*

81. (a) : The entry of sperm stimulates the secondary oocyte to resume and complete the suspended meiosis II. This produces a haploid mature ovum and a second polar body. The second polar body immediately degenerates and sperm tail as well.

82. (a) : Gastrulation is the process through which the presumptive areas of organ specific rudiments present on the surface of blastula move to their specific positions where these occur in the adult. Gastrulation results in setting apart of the three primary germinal layers *i.e.*, the ectoderm, mesoderm and endoderm from single layer of cells, the blastoderm, and in the formation of primordial gut or archenteron. At the onset of gastrulation, the blastoderm at the vegetal pole becomes flat. It gradually bends inwards till the embryo assumes the appearance of a double-walled cup. The cavity formed by invagination is called archenteron or primitive gut. Its opening is called blastopore and the embryo at this stage is gastrula.

As a result of invagination, the presumptive endoderm, mesoderm and notochord are shifted from the surface to the interior of the embryo. The blastocoel is gradually obliterated till the two layers come in contact. By the completion of gastrulation, the lateral horns of mesodermal crescent converge and come to lie on either side of the presumptive notochord.

83. (b) : Eggs with abundant yolk concentrated in one hemisphere of the egg are termed telolecithal. This occurs in many invertebrates and in all vertebrates lower than marsupial mammals.

84. (c) : The activated spermatozoan on reaching the egg plasma membrane, undergoes a number of changes in its acrosomal region. All these changes are collectively described under acrosome reaction. Acrosome reaction is calcium dependent involving massive uptake of calcium and sodium with an efflux of hydrogen generating high pH and osmotic pressure, producing negative surface charge, and partial or total release of the acrosomal enzymes. Calcium influx may activate phospholipase resulting in accumulation of unsaturated fatty acids and fusiogenic lysophospholipids contributing to acrosome reaction.

85. (d)

86. (b) : *Refer to answer 77.*

87. (a) : Ectoderm, mesoderm and endoderm are the three germ layers that give rise to the specific tissues, organs and organ-systems. Ectoderm gives rise to conjunctiva, cornea, lens of eye, muscles of iris, vitreous humour, retina, lacrimal gland along with other parts of the body.

88. (b) : Blastopore is the opening by which the cavity of the gastrula (gastrocoel), communicates with the exterior. It is formed as a result of invagination of endoderm during embryonic development. During maturation of some animals it evolves into the anus or the mouth; in others it is covered over and contributes to the canal joining the primitive gut with the cavity of the neural tube.

89. (b) : *Refer to answer 73.*

90. (b) : *Refer to answer 68.*

91. (b) : The egg released is haploid (has only one X-chromosome and 22 autosomes) as it is formed due to meiotic division of diploid primary oocyte having XX chromosome and 44 autosomes.

92. (c) : *Refer to answer 29.*

93. (a) : The middle piece of human sperm contains the mitochondria coiled around the axial filament called mitochondrial spiral. They provide energy for the movement of the sperm. At the end of the middle piece there is a ring centriole (annulus) with unknown functions.

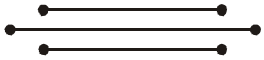
94. (c) : Gonads, muscles, dermis, kidneys, etc., develop from mesoderm. Ectoderm produces epidermis, glands, nervous system, etc. Pancreas, lining of urinary bladder, etc., develop from endoderm.

95. (c) : *Refer to answer 20.*

96. (a) : Differentiation are the changes from simple to more complex forms undergone by developing tissues and organs so that they become specialized for particular functions. Differentiation occurs during embryonic development and regeneration.

97. (a) : *Refer to answer 74.*

98. (a) : In humans, ovum is released from the ovary in the secondary oocyte stage. The wall of the ovary gets ruptured to release the oocyte. In humans ovulation occurs about 14 days before the onset of the next menstruation. Ovulation is induced by LH.



Chapter

26

Reproductive Health

1. Match the following sexually transmitted diseases (column I) with their causative agent (column II) and select the correct option.

	Column I		**Column II**
A.	Gonorrhoea	(i)	HIV
B.	Syphilis	(ii)	*Neisseria*
C.	Genital warts	(iii)	*Treponema*
D.	AIDS	(iv)	Human papilloma virus

	A	**B**	**C**	**D**
(a)	(iii)	(iv)	(i)	(ii)
(b)	(iv)	(ii)	(iii)	(i)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(ii)	(iii)	(iv)	(i)

(NEET 2017)

2. The function of copper ions in copper releasing IUDs is
(a) they inhibit gametogenesis
(b) they make uterus unsuitable for implantation
(c) they inhibit ovulation
(d) they suppress sperm motility and fertilising capacity of sperms. *(NEET 2017)*

3. In case of a couple where the male is having a very low sperm count, which technique will be suitable for fertilisation?
(a) Gamete intracytoplasmic Fallopian transfer
(b) Artificial Insemination
(c) Intracytoplasmic sperm injection
(d) Intrauterine transfer
(NEET 2017)

4. Which of the following is hormone-releasing IUD?
(a) LNG-20 (b) Multiload 375
(c) Lippes loop (d) Cu7
(NEET-II 2016)

5. Which of the following is incorrect regarding vasectomy?
(a) No sperm occurs in seminal fluid
(b) No sperm occurs in epididymis
(c) Vasa deferentia is cut and tied
(d) Irreversible sterility *(NEET-II 2016)*

6. Embryo with more than 16 blastomeres formed due to *in vitro* fertilisation is transferred into
(a) uterus (b) Fallopian tube
(c) fimbriae (d) cervix.
(NEET-II 2016)

7. Which of the following approaches does not give the defined action of contraceptive?

(a)	Hormonal contraceptives	Prevent/retard entry of sperms, prevent ovulation and fertilisation
(b)	Vasectomy	Prevents spermatogenesis
(c)	Barrier methods	Prevent fertilisation
(d)	Intra uterine devices	Increase phagocytosis of sperms, suppress sperm motility and fertilising capacity of sperms

(NEET-I 2016)

8. In context of amniocentesis, which of the following statements is incorrect?
(a) It can be used for detection of Down's syndrome.
(b) It can be used for detection of cleft palate.
(c) It is usually done when a woman is between 14-16 weeks pregnant.
(d) It is used for prenatal sex determination.
(NEET-I 2016)

9. A childless couple can be assisted to have a child through a technique called GIFT. The full form of this technique is
(a) Gamete Internal Fertilisation and Transfer
(b) Germ cell Internal Fallopian Transfer
(c) Gamete Inseminated Fallopian Transfer
(d) Gamete Intra Fallopian Transfer.
(2015)

10. Which of the following is not a sexually transmitted disease?
(a) Trichomoniasis
(b) Encephalitis
(c) Syphilis
(d) Acquired Immuno Deficiency Syndrome (AIDS) *(2015 Cancelled)*

11. Which of the following viruses is not transferred through semen of an infected male?
(a) Chikungunya virus
(b) Ebola virus
(c) Hepatitis B virus
(d) Human immunodeficiency virus *(2015 Cancelled)*

12. Tubectomy is a method of sterilization in which
(a) small part of the Fallopian tube is removed or tied up
(b) ovaries are removed surgically
(c) small part of vas deferens is removed or tied up
(d) uterus is removed surgically. *(2014)*

13. Which of the following is a hormone releasing Intra Uterine Device (IUD)?
(a) Multiload 375 (b) LNG - 20
(c) Cervical cap (d) Vault *(2014)*

14. Assisted reproductive technology, IVF involves transfer of
(a) ovum into the Fallopian tube
(b) zygote into the Fallopian tube
(c) zygote into the uterus
(d) embryo with 16 blastomeres into the Fallopian tube. *(2014)*

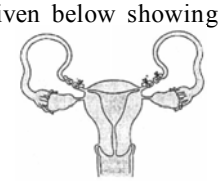
15. Artificial insemination means
(a) artificial introduction of sperms of a healthy donor into the vagina
(b) introduction of sperms of a healthy donor directly into the ovary
(c) transfer of sperms of a healthy donor to a test tube containing ova
(d) transfer of sperms of husband to a test tube containing ova. *(NEET 2013)*

16. One of the legal methods of birth control is
(a) by having coitus at the time of day break
(b) by a premature ejaculation during coitus
(c) abortion by taking an appropriate medicine
(d) by abstaining from coitus from day 10 to 17 of the menstrual cycle. *(NEET 2013)*

17. The stage transferred into the uterus after induced fertilization of ovum in the laboratory is
(a) embryo at 4 blastomeres stage
(b) embryo at 2 blastomeres stage
(c) morula
(d) zygote. *(Karnataka NEET 2013)*

18. One of the following is not a method of contraception. Which one?
(a) Condoms
(b) Pills of a combination of oxytocin and vasopressin
(c) Lippes loop
(d) Tubectomy *(Karnataka NEET 2013)*

19. What is the figure given below showing in particular?



(a) Ovarian cancer
(b) Uterine cancer
(c) Tubectomy
(d) Vasectomy *(2012)*

20. The test-tube baby programme employs which one of the following techniques?
(a) Intra cytoplasmic sperm injection (ICSI)
(b) Intra uterine insemination (IUI)
(c) Gamete intra Fallopian transfer (GIFT)
(d) Zygote intra Fallopian transfer (ZIFT) *(2012)*

21. Which one of the following is the most widely accepted method of contraception in India at present?
(a) Cervical caps
(b) Tubectomy
(c) Diaphragms
(d) IUDs (Intra uterine devices) *(2011)*

22. Medical Termination of Pregnancy (MTP) is considered safe up to how many weeks of pregnancy?
(a) Eight weeks (b) Twelve weeks
(c) Eighteen weeks (d) Six weeks *(2011)*

23. The technique called Gamete Intra Fallopian Transfer (GIFT) is recommended for those females
(a) who cannot produce an ovum
(b) who cannot retain the foetus inside uterus
(c) whose cervical canal is too narrow to allow passage for the sperms
(d) who cannot provide suitable environment for fertilization. *(Mains 2011)*

24. *In vitro* fertilisation is a technique that involves transfer of which one of the following into the Fallopian tube?
(a) Embryo only, upto 8 cell stage
(b) Either zygote or early embryo upto 8 cell stage
(c) Embryo of 32 cell stage
(d) Zygote only *(2010)*

25. The permissible use of the technique amniocentesis is for
(a) detecting sex of the unborn foetus
(b) artificial insemination
(c) transfer of embryo into the uterus of a surrogate mother
(d) detecting any genetic abnormality. *(2010)*

26. Cu ions released from copper-releasing intra uterine devices (IUDs)
(a) make uterus unsuitable for implantation
(b) increase phagocytosis of sperms
(c) suppress sperm motility
(d) prevent ovulation. *(2010)*

27. Consider the statements given below regarding contraception and answer as directed there after
(1) medical termination of pregnancy (MTP) during first trimester is generally safe
(2) generally chances of conception are nil until mother breast-feeds the infant upto two years
(3) intrauterine devices like copper-T are effective contraceptives
(4) contraception pills may be taken upto one week after coitus to prevent conception.
Which two of the above statements are correct?
(a) 1, 3 (b) 1, 2
(c) 2, 3 (d) 3, 4 *(2008)*

28. Given below are four methods (A-D) and their modes of action (i-iv) in achieving contraception. Select their correct matching from the four options that follow

Method	Mode of Action
(A) The pill	(i) Prevents sperms reaching cervix
(B) Condom	(ii) Prevents implantation
(C) Vasectomy	(iii) Prevents ovulation
(D) Copper T	(iv) Semen contains no sperms

(a) A – (iii), B – (iv), C – (i), D – (ii)
(b) A – (ii), B – (iii), C – (i), D – (iv)
(c) A – (iii), B – (i), C – (iv), D – (ii)
(d) A – (iv), B – (i), C – (ii), D – (iii) *(2008)*

29. The formula for exponential population growth is
(a) dN/dt = rN (b) dt/dN = rN
(c) dN/rN = dt (d) rN/dN = dt. *(2006)*

30. Test tube baby means a baby born when
(a) it is developed in a test tube
(b) it is developed through tissue culture method
(c) the ovum is fertilized externally and thereafter implanted in the uterus
(d) it develops from a non-fertilized uterus. *(2003)*

31. Two opposite forces operate in the growth and development of every population. One of them is related to the ability to reproduce at a given rate. The force opposite to it is called
(a) fecundity
(b) environmental resistances
(c) biotic control
(d) mortality. *(2003, 1998)*

32. In a population, unrestricted reproductive capacity is called as
(a) biotic potential (b) fertility rate
(c) carrying capacity (d) birth rate. *(2002)*

33. What is the work of copper-T?
(a) To inhibit ovulation
(b) To inhibit fertilization
(c) To inhibit implantation of blastocyst
(d) To inhibit gametogenesis *(2000)*

34. What is the work of progesterone which is present in oral contraceptive pills?
(a) To inhibit ovulation
(b) To check oogenesis
(c) To check entry of sperms into cervix and to make them inactive
(d) To check sexual behaviour *(2000)*

35. Tablets to prevent male contraception contain
(a) progesterone (b) LH
(c) FSH (d) both (b) and (c). *(1999)*

36. The most important component of the oral contraceptive pills is
(a) thyroxine
(b) luteinizing hormone
(c) progesterone
(d) growth hormone. *(1998)*

37. The present population of the world is about
(a) 15 trillion (b) 6 billion
(c) 500 million (d) 100 million.
(1997)

38. Foetal sex can be determined by examining cells from the amniotic fluid by looking for
(a) chiasmata (b) kinetochore
(c) barr bodies (d) autosomes.
(1997)

39. The test tube baby means
(a) fertilization and development both in uterus
(b) fertilization in *vitro* and then transplantation in uterus
(c) a baby grown in test tube
(d) fertilized and developed embryo in test tube.
(1996)

40. In India, human population is heavily weighed towards the younger age groups as a result of
(a) short life span of many individuals and high birth rate
(b) long life span of many individuals and high birth rate
(c) short life span of many individuals and low birth rate
(d) long life span of many individuals and low birth rate. *(1995)*

41. Which of the following statements is correct with reference to a test tube baby?
(a) Fertilization of the egg is effected outside the body; the fertilized egg is then placed in the womb of the mother where the gestation is completed.
(b) Fertilization of the egg is effected in the female genital tract. It is then taken out and grown in a large test tube.
(c) A prematurely born baby is reared in an incubator.
(d) Fertilization of the egg and growth of the embryo are affected in a large test tube.
(1994)

Answer Key

1.	(d)	**2.**	(d)	**3.**	(b,c)	**4.**	(a)	**5.**	(b)	**6.**	(a)	**7.**	(b)	**8.**	(b)	**9.**	(d)	**10.**	(b)
11.	(a)	**12.**	(a)	**13.**	(b)	**14.**	(b)	**15.**	(a)	**16.**	(c)	**17.**	(c)	**18.**	(b)	**19.**	(c)	**20.**	(d)
21.	(d)	**22.**	(b)	**23.**	(a)	**24.**	(b)	**25.**	(d)	**26.**	(c)	**27.**	(a)	**28.**	(c)	**29.**	(a)	**30.**	(c)
31.	(b)	**32.**	(a)	**33.**	(b,c)	**34.**	(a)	**35.**	(d)	**36.**	(c)	**37.**	(b)	**38.**	(c)	**39.**	(b)	**40.**	(a)
41.	(a)																		

EXPLANATIONS

1. (d)

2. (d) : Copper releasing IUDs (*i.e.,* CuT, LNG-20) are placed in the uterus of the females. They are an efficient birth control methods. Copper ions released by them suppress motility and fertilising capacity of the sperms.

3. (b, c)

4. (a) : LNG-20 is the hormone releasing IUD, multiload 375 and Cu7 are copper releasing IUDs and Lippes loop is a non-medicated IUD.

5. (b) : Vasectomy is a surgical contraception method performed in males. In vasectomy, a small part of the vas deferens is removed or tied up through a small cut on the scrotum. This prevents sperm transport. Vasectomy has a poor reversibility. There is no effect on libido and erectile functioning. Seminal vesicles are one pair of sac like structures which join vasa deferentia to form ejaculatory duct. They secrete seminal fluid which contains fructose, prostaglandins and clotting protein, but no sperms. In a male who has undergone vasectomy, the ejaculatory duct will receive seminal fluid but due to cut in vasa deferentia sperms will not be transported from epididymis hence the semen will lack sperms.

6. (a) : Embryo with more than 16 blastomeres formed due to *in vitro* fertilisation is transferred into uterus (intra-uterine transfer, IUT).

7. (b) : Vasectomy is a sterilisation technique for the males in which a small part of the vas deferens is removed or tied up through a small cut on the scrotum to prevent passage of sperms. Spermatogenesis is the series of cell division in the testis that results in the production of spermatozoa or sperms.

8. (b) : Amniocentesis is fetal sex determination and disorder test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo. It can be used to determine the sex of the infant, to identify some abnormalities in the number of chromosomes and to detect certain biochemicals and enzymatic abnormalities. It is usually done when woman is 14-16 weeks pregnant. Cleft palate can be detected by ultrasound.

9. (d) : Gamete Intra Fallopian Transfer (GIFT) is an assisted reproductive technology in which both the sperm and unfertilised oocytes are transferred into the Fallopian tubes. Fertilisation takes place *in vivo* (inside the body of the female).

10. (b)

11. (a) : Chikungunya virus is transmitted through an *Aedes aegypti* mosquito.

12. (a) : Sterilization provides a permanent and sure birth control. In females, it is called tubectomy. Tubectomy involves the blocking of the Fallopian tubes. A small part of the Fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

13. (b) : Intra uterine devices (IUDs) are plastic or metal objects which are inserted by doctors in the uterus through vagina. These are available as non-medicated IUDs (*i.e*., Lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and hormone releasing IUDs (progestasert, LNG-20). Vault cap is hemispheric dome like rubber or plastic cap with a thick rim which is meant for fitting over the vaginal vault over the cervix.

14. (b) : Assisted reproductive technologies (ART) include a number of special techniques which assist infertile couples to have children. An important technique of ART is test tube baby programme. The baby produced by conceiving in a culture dish and nursing in the uterus is called a test tube baby. This method involves *in vitro* fertilization (IVF), *i.e*., fertilization of male and female gamete outside the body in almost similar conditions as that in the body followed by embryo transfer (ET). Zygote or embryo upto 8 blastomeres is transferred into the Fallopian tube (ZIFT - Zygote Intra Fallopian Transfer) and mature embryo with more than 8 blastomeres is transferred to uterus to complete its further development.

15. (a) : In artificial insemination technique, the semen of a healthy donor male is collected and is introduced artificially through a flexible polyethylene catheter into the vagina or into uterus called intra-uterine insemination (IUI). Best results are obtained when the motile sperm count is more than 10 million. The fertilizing capacity of spermatozoa (sperms) is for 24- 48 hours. The procedure may be repeated 2-3 times over a period of 2 – 3 days.

16. (c) : Intentional or voluntary termination of pregnancy by taking an appropriate medicine before full term is called medical termination of pregnancy (MTP) or induced abortion. Nearly 45 to 50 million MTPs are performed in a year all over the world which

account to 1/5th of the total number of conceived pregnancies in a year. MTP has a significant role in decreasing the population though it is not meant for that purpose. Government of India legalized MTP in 1971 with some strict conditions to avoid its misuse. Such restrictions are all the more important to check indiscriminate and illegal female foeticides.

17. (c) : Cleavage divisions produce a solid ball of cells called morula. It has 8–16 cells, occasionally 32 cells. It is transferred into uterus (IUT-Intra-uterine transfer) for further development.

18. (b) : Oxytocin is a birth hormone and vasopressin (anti-diuretic hormone) reabsorbs water from the renal tubules to conserve water in the body. They have no role in contraception.

19. (c) : Tubectomy involves blocking of the Fallopian tubes. The Fallopian tube are tied twice and cut between the knot. It prevents the sperms from reaching the ovum and thus prevents fertilization. It is a permanent method of sterilization.

20. (d) : In *in vitro* fertilization method, popularly known as test tube baby programme, ova from the wife/donor (female) and sperms from the husband/ donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory. The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the Fallopian tube (ZIFT-zygote intra Fallopian transfer) and embryos with more than 8 blastomeres, into the uterus (IUT-intra uterine transfer), to complete its further development.

21. (d) : At present the most widely accepted method of contraception in India is IUDs. These Intra Uterine Devices (IUDs) are presently available as the non-medicated IUDs (*e.g.*, lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormones releasing IUDs (Progestasert, LNG-20). IUDs increase phagocytosis of sperms within the uterus and the Cu-ions released suppress sperm motility and the fertilizing capacity of sperms. The hormone releasing IUDs make the uterus unsuitable for implantation and cervix hostile to the sperms.

22. (b) : Medical termination of pregnancy (MTP) or abortion is the termination of pregnancy before the foetus becomes viable. MTP is comparatively safe upto 12 weeks (the first trimester) of pregnancy. It becomes more risky after the first trimester period of pregnancy as the foetus becomes intimately associated with the maternal tissues.

23. (a) : Gamete Intra Fallopian Transfer (GIFT) is transfer of an ovum collected from a donor into the Fallopian tube of another female who cannot produce ova but can provide proper environment for fertilization and further development.

24. (b) : *Refer to answer 14.*

25. (d) : Amniocentesis is withdrawal of a sample of the fluid (amniotic fluid) surrounding a foetus in the uterus by piercing the amniotic sac through the abdominal wall, under direct ultrasound guidance. As the amniotic fluid contains cells from the foetus, cell cultures enable chromosome patterns to be studied so that prenatal diagnosis of chromosomal abnormalities can be made. Certain metabolic errors and other abnormalities, such as spina bifida, can also be diagnosed prenatally from analysis of the cells or of the fluid.

As this technique also helps in detection of sex of the unborn foetus, it has been banned in order to legally check increasing female foeticides.

26. (c) : *Refer to answer 2.*

27. (a) : Intrauterine devices like copper T are effective contraceptives for birth control. It suppresses sperm motility and the fertilising capacity of the sperm. Medical termination of pregnancy or induced abortion is voluntary or intentional termination of pregnancy before full term of foetus. It is comparatively safe upto 12 weeks (the first trimester) of pregnancy.

28. (c) : Pills also called contraceptive pills contain small doses of either progestogens or progestogen-oestrogen combinations. They inhibit ovulation and implantation. Condoms are made of thin rubber/latex sheath used to cover the penis in the male or vagina and cervix in the female just before coitus so that the ejaculated semen is not released in the female reproductive tract, thus preventing sperms reaching cervix. In vasectomy, a small part of the vas deferens is removed or tied up through a small cut on the scrotum, thus blocking gamete (sperm) transport. However semen is a collection of secretions from the seminal vesicles, prostate gland, Cowper's gland and sperms from testes. So as the sperm is blocked semen is free of sperms. Copper T is an intrauterine device, which is inserted by doctors in the uterus through vagina. The copper ions released by them suppress sperm motility and also make the uterus unstable for implantation.

29. (a) : Nearly all populations will tend to grow exponentially as long as there are resources available. The formula for exponential population growth is $dN/dt = rN$. In this equation d is the rate of change, N is the number of existing individuals, r is the intrinsic

growth rate, *t* is time, and dN/dt is the rate of change in population size.

30. (c) : By *in vitro* fertilization, the ovum is fertilized with sperm outside the body of a woman, providing the ovum with the same environmental conditions as it would have got inside the uterus. The zygote is grown inside a culture and when embryo is formed, it is then implanted into uterus where it develops into foetus and then into a child. This is called test tube baby.

Methodology involves the following steps :

- Removal of unfertilised ovum from reproductive tract of a female.
- Ovum is kept under aseptic conditions.
- Fusion of sperm and ovum in a culture medium, outside the female body to form the zygote.
- Zygote is stimulated to develop *in vitro* upto 32-celled stage.
- Developing embryo is implanted on the endometrium of the uterus at 32-celled stage. So the pregnancy in the woman starts and further the development of the child continues in the womb till it is born.

31. (b) : The environmental factors which can check the growth of population size constitute the environmental resistance. These include predators, food, water, nesting sites, similar competitors, etc. All living things tend to reproduce until the point at which their environment becomes a limiting factor. No population, human or otherwise, can grow indefinitely; eventually, some biotic or abiotic variable will begin to limit population growth.

32. (a) : Biotic potential is defined as the physiological capacity of organisms to produce their offspring under natural conditions. It is also called reproductive potential. In nature, the biotic potential of organisms is enormous but all the organisms do not survive due to the lack of food and space. There are also a number of diseases and the predatory organisms, that feed upon other organisms. The carrying capacity is the maximum number of individuals which the environment can support or sustain.

33. (b, c) : Copper-T is an intrauterine device (IUD) used by women as a birth control. An IUD is a small device which is placed inside the uterus. The vertical and horizontal arms of the Copper - T contain copper which is slowly released into the uterine cavity. Copper stops sperm from making their way up through the uterus into the tubes, and it reduces the ability of sperm to fertilize the egg. It also prevents a fertilized egg (blastocyst) from successfully implanting in the lining of the uterus if fertilization has occurred.

34. (a) : Pills also called contraceptive pills contain small doses of either progestogens or progestogen-oestrogen combinations. They inhibit ovulation and implantation.

35. (d) : Male contraceptives work by interfering with sperm production or delivery, that means they inhibit the spermatogenesis as well as the function of male sex hormone testosterone.

LH and FSH (both called gonadotropic hormone are secreted from anterior pituitary) have specific functions in the testis. FSH stimulates male germ cells for spermatogenesis and LH stimulates accessory cells, called Leydig cells to produce sex steroids, especially testosterone. Thus, these two hormones (FSH and LH) prevent male contraception.

36. (c) : The most common type of pill is the so called "combined pill". It contains a combination of synthetic progestins (acting like progesterone) and estrogen. Combined pills inhibit ovulation by inhibiting the normal release of FSH and LH from the pituitary. They mimic the hormones produced by the corpus luteum, causing the uterine walls to thicken, as during normal menstrual cycle, and suppressing the release of FSH and LH.

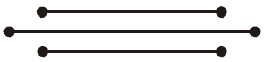
37. (b) : As this question appeared in 1997, so the population of world in mid 1997 was 5, 840, 324, 240 *i.e.*, approximately 6 billion.

38. (c) : Barr body is a structure consisting of a condensed X chromosome that is found in nondividing nuclei of female mammals. Amniotic fluid contains foetal skin cells, that are stained to determine the presence of sex chromatin (barr body). The presence of barr body indicates that the developing foetus is female with two X-chromosome.

39. (b) : *Refer to answer 30.*

40. (a) : A population having mostly younger age group means its birth rate is high. If death rate is increased then the proportion of old age group will be increased. But in this case death rate has increasing trend thence in a human population which is heavily weighted towards the younger age groups, there will be short life span and high birth rate.

41. (a) : *Refer to answer 30.*



Chapter
27

Principles of Inheritance and Variation

1. Thalassemia and sickle cell anaemia are caused due to a problem in globin molecule synthesis. Select the correct statement.
(a) Both are due to a quantitative defect in globin chain synthesis.
(b) Thalassemia is due to less synthesis of globin molecules.
(c) Sickle cell anaemia is due to a quantitative problem of globin molecules.
(d) Both are due to a qualitative defect in globin chain synthesis. *(NEET 2017)*

2. The genotypes of a husband and wife are I^AI^B and I^Ai.
Among the blood types of their children, how many different genotypes and phenotypes are possible?
(a) 3 genotypes; 4 phenotypes
(b) 4 genotypes; 3 phenotypes
(c) 4 genotypes; 4 phenotypes
(d) 3 genotypes; 3 phenotypes *(NEET 2017)*

3. A disease caused by an autosomal primary non disjunction is
(a) Klinefelter's syndrome
(b) Turner's syndrome
(c) sickle cell anaemia
(d) Down's syndrome. *(NEET 2017)*

4. Among the following characters, which one was not considered by Mendel in his experiments on pea?
(a) Trichomes-Glandular or non-glandular
(b) Seed-Green or yellow
(c) Pod-Inflated or constricted
(d) Stem-Tall or dwarf *(NEET 2017)*

5. Which one from those given below is the period for Mendel's hybridisation experiments?
(a) 1840-1850 (b) 1857-1869
(c) 1870-1877 (d) 1856-1863
(NEET 2017)

6. The mechanism that causes a gene to move from one linkage group to another is called
(a) inversion (b) duplication
(c) translocation (d) crossing-over.
(NEET-II 2016)

7. If a colour-blind man marries a woman who is homozygous for normal colour vision, the probability of their son being colour-blind is
(a) 0 (b) 0.5
(c) 0.75 (d) 1. *(NEET-II 2016)*

8. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in
(a) somaclonal variation
(b) polyteny
(c) aneuploidy
(d) polyploidy. *(NEET-I 2016)*

9. Pick out the correct statements.
(1) Haemophilia is a sex-linked recessive disease.
(2) Down's syndrome is due to aneuploidy.
(3) Phenylketonuria is an autosomal recessive gene disorder.
(4) Sickle cell anaemia is an X-linked recessive gene disorder.
(a) (1), (3) and (4) are correct.
(b) (1), (2) and (3) are correct.
(c) (1) and (4) are correct.
(d) (2) and (4) are correct. *(NEET-I 2016)*

10. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed the resulting genotypes were in the ratio of
(a) 3 : 1 : : Tall : Dwarf
(b) 3 : 1 : : Dwarf : Tall
(c) 1 : 2 : 1 : : Tall homozygous : Tall heterozygous : Dwarf
(d) 1 : 2 : 1 : : Tall heterozygous : Tall homozygous : Dwarf. *(NEET-I 2016)*

11. Match the terms in column I with their description in column II and choose the correct option.

	Column I	Column II
A.	Dominance	(i) Many genes govern a single character
B.	Codominance	(ii) In a heterozygous organism only one allele expresses itself
C.	Pleiotropy	(iii) In a heterozygous organism both alleles express themselves fully
D.	Polygenic inheritance	(iv) A single gene influences many characters

	A	B	C	D
(a)	(iv)	(i)	(ii)	(iii)
(b)	(iv)	(iii)	(i)	(ii)
(c)	(ii)	(i)	(iv)	(iii)
(d)	(ii)	(iii)	(iv)	(i)

(NEET-I 2016)

12. In a test cross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. This indicates
(a) the two genes are linked and present on the same chromosome
(b) both of the characters are controlled by more than one gene
(c) the two genes are located on two different chromosomes
(d) chromosomes failed to separate during meiosis. *(NEET-I 2016)*

13. Which of the following most appropriately describes haemophilia?
(a) Chromosomal disorder
(b) Dominant gene disorder
(c) Recessive gene disorder
(d) X-linked recessive gene disorder
(NEET-I 2016)

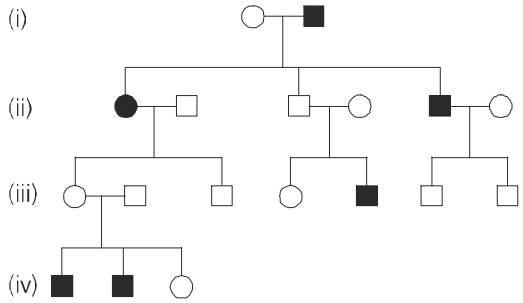
14. A gene showing codominance has
(a) alleles that are recessive to each other
(b) both alleles independently expressed in the heterozygote
(c) one allele dominant on the other
(d) alleles tightly linked on the same chromosome. *(2015)*

15. In his classic experiments on pea plants, Mendel did not use
(a) seed shape (b) flower position
(c) seed colour (d) pod length.
(2015)

16. A colour blind man marries a woman with normal sight who has no history of colour blindness in her family. What is the probability of their grandson being colour blind ?
(a) Nil (b) 0.25
(c) 0.5 (d) 1 *(2015)*

17. A pleiotropic gene
(a) controls a trait only in combination with another gene
(b) controls multiple traits in an individual
(c) is expressed only in primitive plants
(d) is a gene evolved during Pliocene.
(2015)

18. In the following human pedigree, the filled symbols represent the affected individuals. Identify the type of given pedigree.



(a) Autosomal recessive
(b) X-linked dominant
(c) Autosomal dominant
(d) X-linked recessive *(2015)*

19. The term "linkage" was coined by
(a) G. Mendel (b) W. Sutton
(c) T.H. Morgan
(d) T. Boveri. *(2015)*

20. The movement of a gene from one linkage group to another is called
(a) translocation (b) crossing over
(c) inversion (d) duplication.
(2015 Cancelled)

21. Alleles are
(a) different molecular forms of a gene
(b) heterozygotes
(c) different phenotype
(d) true breeding homozygotes.
(2015 Cancelled)

22. Multiple alleles are present
(a) at the same locus of the chromosome
(b) on non-sister chromatids
(c) on different chromosomes
(d) at different loci on the same chromosome.
(2015 Cancelled)

23. A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offsprings?
(a) A, B, AB and O (b) O only
(c) A and B only (d) A, B and AB only
(2015 Cancelled)

24. How many pairs of contrasting characters in pea plants were studied by Mendel in his experiments?
(a) Eight (b) Seven
(c) Five (d) Six
(2015 Cancelled)

25. An abnormal human baby with 'XXX' sex chromosomes was born due to
(a) fusion of two ova and one sperm
(b) fusion of two sperms and one ovum
(c) formation of abnormal sperms in the father
(d) formation of abnormal ova in the mother.
(2015 Cancelled)

26. Fruit colour in squash is an example of
(a) recessive epistasis
(b) dominant epistasis
(c) complementary genes
(d) inhibitory genes. *(2014)*

27. A man whose father was colour blind marries a woman who had a colour blind mother and normal father. What percentage of male children of this couple will be colour blind?
(a) 25% (b) 0%
(c) 50% (d) 75%
(2014)

28. A human female with Turner's syndrome
(a) has 45 chromosomes with XO
(b) has one additional X chromosome
(c) exhibits male characters
(d) is able to produce children with normal husband. *(2014)*

29. Select the incorrect statement with regard to haemophilia.
(a) It is a dominant disease.
(b) A single protein involved in the clotting of blood is affected.
(c) It is a sex-linked disease.
(d) It is a recessive disease. *(NEET 2013)*

30. Which of the following cannot be detected in a developing foetus by amniocentesis?
(a) Down's syndrome (b) Jaundice
(c) Klinefelter's syndrome
(d) Sex of the foetus *(NEET 2013)*

31. If both parents are carriers for thalassaemia, which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child?
(a) 25% (b) 100%
(c) No chance (d) 50%
(NEET 2013)

32. If two persons with 'AB' blood group marry and have sufficiently large number of children, these children could be classified as 'A' blood group: 'AB' blood group : 'B' blood group in 1 : 2 : 1 ratio. Modern technique of protein electrophoresis reveals presence of both 'A' and 'B' type proteins in 'AB' blood group individuals. This in an example of
(a) partial dominance
(b) complete dominance
(c) codominance
(d) incomplete dominance. *(NEET 2013)*

33. Which idea is depicted by a cross in which the F_1 generation resembles both the parents?
(a) Inheritance of one gene
(b) Codominance
(c) Incomplete dominance
(d) Complete dominance *(NEET 2013)*

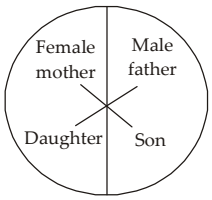
34. Which one is the incorrect statement with regard to the importance of pedigree analysis?
(a) It confirms that DNA is the carrier of genetic information.
(b) It helps to understand whether the trait in question is dominant or recessive.
(c) It confirms that the trait is linked to one of the autosome.
(d) It helps to trace the inheritance of a specific trait. *(Karnataka NEET 2013)*

35. Down's syndrome in humans is due to
(a) three 'X' chromosomes
(b) three copies of chromosome 21
(c) monosomy
(d) two 'Y' chromosomes.
(Karnataka NEET 2013)

36. A normal-visioned man whose father was colour-blind, marries a woman whose father was also colour-blind. They have their first child as a daughter. What are the chances that this child would be colour-blind?
(a) 100% (b) Zero percent
(c) 25% (d) 50% *(2012)*

37. F_2 generation in a Mendelian cross showed that both genotypic and phenotypic ratios are same as 1 : 2 : 1. It represents a case of
(a) co-dominance (b) dihybrid cross
(c) monohybrid cross with complete dominance
(d) monohybrid cross with incomplete dominance. *(2012)*

38. Represented below is the inheritance pattern of a certain type of trait in humans. Which one of the following conditions could be an example of this pattern?



(a) Phenylketonuria
(b) Sickle cell anaemia
(c) Haemophilia (d) Thalassemia
(Mains 2012)

39. A test cross is carried out to
(a) determine the genotype of a plant at F_2
(b) predict whether two traits are linked
(c) assess the number of alleles of a gene
(d) determine whether two species or varieties will breed successfully. *(Mains 2012)*

40. When two unrelated individuals or lines are crossed, the performance of F_1 hybrid is often superior to both its parents. This phenomenon is called
(a) heterosis (b) transformation
(c) splicing
(d) metamorphosis. *(2011)*

41. Which one of the following conditions correctly describes the manner of determining the sex?
(a) Homozygous sex chromosomes (ZZ) determine female sex in birds.
(b) XO type of sex chromosomes determine male sex in grasshopper.
(c) XO condition in humans as found in Turner's syndrome, determines female sex.
(d) Homozygous sex chromosomes (XX) produce male in *Drosophila*. *(2011)*

42. Which one of the following conditions of the zygotic cell would lead to the birth of a normal human female child?
(a) Two X chromosomes
(b) Only one Y chromosome
(c) Only one X chromosome
(d) One X and one Y chromosome
(Mains 2011)

43. Test cross in plants or in *Drosophila* involves crossing
(a) between two genotypes with recessive trait
(b) between two F_1 hybrids
(c) the F_1 hybrid with a double recessive genotype
(d) between two genotypes with dominant trait.
(Mains 2011)

44. Which one of the following symbols and its representation, used in human pedigree analysis is correct?
(a)  =Mating between relatives
(b) ○ = Unaffected male
(c) □ = Unaffected female
(d) ◆ = Male affected *(2010)*

45. ABO blood groups in humans are controlled by the gene *I*. It has three alleles - I^A, I^B and *i*. Since there are three different alleles, six different genotypes are possible. How many phenotypes can occur?
(a) Three (b) One
(c) Four (d) Two
(2010)

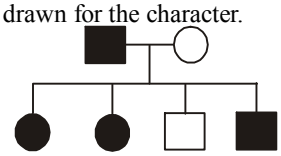
46. Select the correct statement from the ones given below with respect to dihybrid cross.
(a) Tightly linked genes on the same chromosomes show higher recombinations.
(b) Genes far apart on the same chromosome show very few recombinations.
(c) Genes loosely linked on the same chromosome show similar recombinations.
(d) Tightly linked genes on the same chromosome show very few recombinations. *(2010)*

47. The genotype of a plant showing the dominant phenotype can be determined by
(a) test cross (b) dihybrid cross
(c) pedigree analysis (d) back cross. *(2010)*

48. Which one of the following cannot be explained on the basis of Mendel's law of dominance?
(a) The discrete unit controlling a particular character is called a factor.
(b) Out of one pair of factors one is dominant, and the other recessive.
(c) Alleles do not show any blending and both the characters recover as such in F_2 generation.
(d) Factors occur in pairs . *(2010)*

49. ABO blood grouping is controlled by gene *I* which has three alleles and show co-dominance. There are six genotypes. How many phenotypes in all are possible?
(a) Six (b) Three
(c) Four (d) Five *(Mains 2010)*

50. Study the pedigree chart of a certain family given below and select the correct conclusion which can be drawn for the character.



(a) The female parent is heterozygous.
(b) The parents could not have had a normal daughter for this character.
(c) The trait under study could not be colour blindness.
(d) The male parent is homozygous dominant. *(Mains 2010)*

51. A cross in which an organism showing a dominant phenotype is crossed with the recessive parent in order to know its genotype is called
(a) monohybrid cross (b) back cross
(c) test cross (d) dihybrid cross. *(Mains 2010)*

52. In *Antirrhinum* two plants with pink flowers were hybridized. The F_1 plants produced red, pink and white flowers in the proportion of 1 red, 2 pink and 1 white. What could be the genotype of the two plants used for hybridization? Red flower colour is determined by RR, and white by rr genes?
(a) rrrr (b) RR
(c) Rr (d) rr *(Mains 2010)*

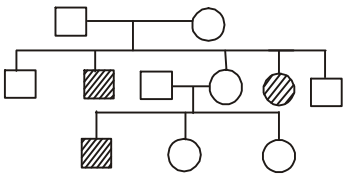
53. Select the incorrect statement from the following.
(a) Galactosemia is an inborn error of metabolism.
(b) Small population size results in random genetic drift in a population.
(c) Baldness is a sex-limited trait.
(d) Linkage is an exception to the principle of independent assortment in heredity. *(2009)*

54. Sickle-cell anaemia is
(a) caused by substitution of valine by glutamic acid in the beta globin chain of haemoglobin
(b) caused by a change in a single base pair of DNA
(c) characterized by elongated sickle like RBCs with a nucleus
(d) an autosomal linked dominant trait. *(2009)*

55. The genetic defect–adenosine deaminase (ADA) deficiency may be cured permanently by
(a) administering adenosine deaminase activators
(b) introducing bone marrow cells producing ADA into cells at early embryonic stages
(c) enzyme replacement therapy
(d) periodic infusion of genetically engineered lymphocytes having functional ADA cDNA. *(2009)*

56. The most popularly known blood grouping is the ABO grouping. It is named ABO and not ABC, because "O" in it refers to having
(a) overdominance of this type on the genes for A and B types
(b) one antibody only - either anti - A or anti - B on the RBCs
(c) no antigens A and B on RBCs
(d) other antigens besides A and B on RBCs. *(2009)*

57. Study the pedigree chart given below. What does it show?



(a) Inheritance of a condition like phenylketonuria as an autosomal recessive trait.
(b) The pedigree chart is wrong as this is not possible.
(c) Inheritance of a recessive sex-linked disease like haemophilia.
(d) Inheritance of a sex-linked inborn error of metabolism like phenylketonuria. *(2009)*

58. Which one of the following conditions in humans is correctly matched with its chromosomal abnormality/linkage?
(a) Erythroblastosis foetalis - X-linked
(b) Down's syndrome - 44 autosomes + XO
(c) Klinefelter's syndrome - 44 autosomes + XXY
(d) Colour blindness - Y-linked *(2008)*

59. A human male produces sperms with the genotypes AB, Ab, aB, and ab pertaining to two diallelic characters in equal proportions. What is the corresponding genotype of this person?
(a) AaBB (b) AABb
(c) AABB (d) AaBb. *(2007)*

60. In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seeded plant is crossed with a green seeded plant, what ratio of yellow and green seeded plants would you expect in F_1 generation?
(a) 9 : 1 (b) 1 : 3
(c) 3 : 1 (d) 50 : 50. *(2007)*

61. Inheritance of skin colour in humans is an example of
(a) point mutation
(b) polygenic inheritance
(c) codominance
(d) chromosomal aberration. *(2007)*

62. In the hexaploid wheat, the haploid (n) and basic (x) numbers of chromosomes are
(a) $n = 21$ and $x = 21$ (b) $n = 21$ and $x = 14$
(c) $n = 21$ and $x = 7$ (d) $n = 7$ and $x = 21$. *(2007)*

63. A common test to find the genotype of a hybrid is by
(a) crossing of one F_2 progeny with female parent
(b) studying the sexual behaviour of F_1 progenies
(c) crossing of one F_1 progeny with male parent
(d) crossing of one F_2 progeny with male parent. *(2007)*

64. Test cross involves
(a) crossing between two genotypes with dominant trait
(b) crossing between two genotypes with recessive trait
(c) crossing between two F_1 hybrids
(d) crossing the F_1 hybrid with a double recessive genotype. *(2006)*

65. Both sickle cell anaemia and Huntington's chorea are
(a) virus-related diseases
(b) bacteria-related diseases
(c) congenital disorders
(d) pollutant-induced disorders. *(2006)*

66. If a colour blind woman marries a normal visioned man, their sons will be
(a) all colour blind
(b) all normal visioned
(c) one-half colour blind and one-half normal
(d) three-fourths colour blind and one-fourth normal. *(2006)*

67. Cri-du-chat syndrome in humans is caused by the
(a) trisomy of 21st chromosome
(b) fertilization of an XX egg by a normal Y-bearing sperm
(c) loss of half of the short arm of chromosome 5
(d) loss of half of the long arm of chromosome 5. *(2006)*

68. Sickle cell anaemia has not been eliminated from the African population because
(a) it is controlled by dominant genes
(b) it is controlled by recessive genes
(c) it is not a fatal disease
(d) it provides immunity against malaria. *(2006)*

69. In Mendel's experiments with garden pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledon (YY) was dominant over green cotyledon (yy). What are the expected phenotypes in the F_2 generation of the cross RRYY × rryy?
(a) Round seeds with yellow cotyledons, and wrinkled seeds with yellow cotyledons
(b) Only round seeds with green cotyledons
(c) Only wrinkled seeds with yellow cotyledons
(d) Only wrinkled seeds with green cotyledons *(2006)*

70. How many different kinds of gametes will be produced by a plant having the genotype AABbCC?
(a) Two (b) Three
(c) Four (d) Nine *(2006)*

71. Phenotype of an organism is the result of
(a) genotype and environment interactions
(b) mutations and linkages
(c) cytoplasmic effects and nutrition
(d) environmental changes and sexual dimorphism. *(2006)*

72. Which one of the following is an example of polygenic inheritance?
(a) Skin colour in humans
(b) Flower colour in *Mirabilis jalapa*
(c) Production of male honey bee
(d) Pod shape in garden pea *(2006)*

73. In order to find out the different types of gametes produced by a pea plant having the genotype AaBb it should be crossed to a plant with the genotype
(a) AABB (b) AaBb
(c) aabb (d) aaBB. *(2005)*

74. G-6-P dehydrogenase deficiency is associated with haemolysis of
(a) leucocytes (b) lymphocytes
(c) platelets (d) RBCs. *(2005)*

75. A man and a woman, who do not show any apparent signs of a certain inherited disease, have seven children (2 daughters and 5 sons). Three of the sons suffer from the given disease but none of the daughters affected. Which of the following mode of inheritance do you suggest for this disease?
(a) Sex-linked dominant
(b) Sex-linked recessive
(c) Sex-limited recessive
(d) Autosomal dominant *(2005)*

76. A woman with 47 chromosomes due to three copies of chromosome 21 is characterized by
(a) superfemaleness (b) triploidy
(c) Turner's syndrome
(d) Down's syndrome. *(2005)*

77. Haemophilia is more commonly seen in human males than in human females because
(a) a greater proportion of girls die in infancy
(b) this disease is due to a Y-linked recessive mutation
(c) this disease is due to an X-linked recessive mutation
(d) this disease is due to an X-linked dominant mutation. *(2005)*

78. Which of the following is not a hereditary disease?
(a) Cystic fibrosis (b) Thalassaemia
(c) Haemophilia (d) Cretinism *(2005)*

79. A woman with normal vision, but whose father was colour blind, marries a colour blind man. Suppose that the fourth child of this couple was a boy. This boy
(a) may be colour blind or may be of normal vision
(b) must be colour blind
(c) must have normal colour vision
(d) will be partially colour blind since he is heterozygous for the colour blind mutant allele. *(2005)*

80. In a plant, red fruit (R) is dominant over yellow fruit (*r*) and tallness (*T*) is dominant over shortness (*t*). If a plant with *RRTt* genotype is crossed with a plant that is *rrtt*,
(a) 25% will be tall with red fruit
(b) 50% will be tall with red fruit
(c) 75% will be tall with red fruit
(d) all the offspring will be tall with red fruit. *(2004)*

81. A male human is heterozygous for autosomal genes A and B and is also hemizygous for haemophilic gene h. What proportion of his sperms will be abh?
(a) 1/8 (b) 1/32
(c) 1/16 (d) 1/4 *(2004)*

82. Lack of independent assortment of two genes A and B in fruit fly *Drosophila* is due to
(a) repulsion (b) recombination
(c) linkage (d) crossing over. *(2004)*

83. One of the parents of a cross has a mutation in its mitochondria. In that cross, that parent is taken as a male. During segregation of F_2 progenies that mutation is found in
(a) one-third of the progenies
(b) none of the progenies
(c) all the progenies
(d) fifty percent of the progenies. *(2004)*

84. A normal woman, whose father was colour-blind is married to a normal man. The sons would be
(a) 75% colour-blind (b) 50% colour-blind
(c) all normal
(d) all colour-blind. *(2004)*

85. The recessive genes located on X-chromosome humans are always
(a) lethal (b) sub-lethal
(c) expressed in males
(d) expressed in females. *(2004)*

86. Which one of the following traits of garden pea studied by Mendel was a recessive feature?
(a) Axial flower position
(b) Green seed colour
(c) Green pod colour
(d) Round seed shape *(2003)*

87. The genes controlling the seven pea characters studied by Mendel are now known to be located on how many different chromosomes?
(a) Seven (b) Six
(c) Five (d) Four *(2003)*

88. Two crosses between the same pair of genotypes or phenotypes in which the sources of the gametes are reversed in one cross, is known as
(a) test cross (b) reciprocal cross
(c) dihybrid cross (d) reverse cross. *(2003)*

89. Pattern baldness, moustaches and beard in human males are examples of
(a) sex linked traits (b) sex limited traits
(c) sex influenced traits
(d) sex determining traits. *(2003)*

90. Which one of the following conditions though harmful in itself, is also potential saviour from a mosquito borne infectious disease ?
(a) Thalassaemia (b) Sickle cell anaemia
(c) Pernicious anaemia
(d) Leukaemia *(2003)*

91. Down's syndrome is caused by an extra copy of chromosome number 21. What percentage of offspring produced by an affected mother and a normal father would be affected by this disorder?
(a) 100 % (b) 75 %
(c) 50 % (d) 25 % *(2003)*

92. In *Drosophila*, the sex is determined by
(a) the ratio of number of X-chromosome to the sets of autosomes
(b) X and Y chromosomes
(c) the ratio of pairs of X-chromosomes to the pairs of autosomes
(d) whether the egg is fertilized or develops parthenogenetically. *(2003)*

93. Which of the following is an example of pleiotropy?
(a) Haemophilia (b) Thalassemia
(c) Sickle cell anaemia (d) Colour blindness *(2002)*

94. There are three genes a, b, c. Percentage of crossing over between a and b is 20%, b and c is 28% and a and c is 8%. What is the sequence of genes on chromosome?
(a) *b, a, c* (b) *a, b, c*
(c) *a, c, b* (d) None of these *(2002)*

95. On selfing a plant of F_1-generation with genotype "AABbCC", the genotypic ratio in F_2-generation will be
(a) 3 : 1 (b) 1 : 1
(c) 9 : 3 : 3 : 1
(d) 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1. *(2002)*

96. A gene is said to be dominant if
(a) it expresses it's effect only in homozygous state
(b) it expresses it's effect only in heterozygous condition
(c) it expresses it's effect both in homozygous and heterozygous condition.
(d) it never expresses it's effect in any condition. *(2002)*

97. A diseased man marries a normal woman. They get three daughters and five sons. All the daughters were diseased and sons were normal. The gene of this disease is
(a) sex linked dominant
(b) sex linked recessive
(c) sex limited character
(d) autosomal dominant. *(2002)*

98. Which of the following is a correct match?
(a) Down's syndrome - 21st chromosome
(b) Sickle cell anaemia - X-chromosome
(c) Haemophilia - Y-chromosome
(d) Parkinson's disease - X and Y chromosome. *(2002)*

99. Two nonallelic genes produces the new phenotype when present together but fail to do so independently then it is called
(a) epistasis (b) polygene
(c) non complementary gene
(d) complementary gene. *(2001)*

100. A and B genes are linked. What shall be genotype of progeny in a cross between AB/ab and ab/ab?
(a) AAbb and aabb (b) AaBb and aabb
(c) AABB and aabb (d) None of the above *(2001)*

101. When dominant and recessive alleles express itself together it is called
(a) co-dominance (b) dominance
(c) amphidominance
(d) pseudo dominance. *(2001)*

102. Ratio of complementary genes is
(a) 9 : 3 : 4 (b) 12 : 3 : 1
(c) 9 : 3 : 3 : 4 (d) 9 : 7. *(2001)*

103. Independent assortment of genes does not takes place when
(a) genes are located on homologous chromosomes
(b) genes are linked and located on same chromosome
(c) genes are located on non-homogenous chromosome
(d) all of these. *(2001)*

104. Sickle cell anaemia induce to
(a) change of amino acid in a-chain of haemoglobin
(b) change of amino acid in b-chain of haemoglobin
(c) change of amino acid in both a and b chains of haemoglobin
(d) change of amino acid either a or b chains of haemoglobin. *(2001)*

105. Number of Barr bodies in XXXX female is
(a) 1 (b) 2
(c) 3 (d) 4. *(2001)*

106. Male XX and female XY sometime occur due to
(a) deletion
(b) transfer of segments in X and Y chromosome
(c) aneuploidy
(d) hormonal imbalance. *(2001)*

107. Probability of four sons to a couple is
(a) 1/4 (b) 1/8
(c) 1/16 (d) 1/32. *(2001)*

108. Due to the cross between TTRr × ttrr the resultant progenies show what percent of tall, red flowered plants
(a) 50% (b) 75%
(c) 25% (d) 100%. *(2000)*

109. According to Mendelism, which character shows dominance?
(a) Terminal position of flower
(b) Green colour in seed coat
(c) Wrinkled seeds
(d) Green pod colour *(2000)*

110. Mongolian Idiocy due to trisomy in 21st chromsome is called
(a) Down's syndrome
(b) Turner's syndrome
(c) Klinefelter's syndrome
(d) Triple X syndrome. *(2000)*

111. Erythroblastosis foetalis is caused when fertilization takes place between gametes of
(a) Rh^- female and Rh^+ male
(b) Rh^+ female and Rh^- male
(c) Rh^+ female and Rh^+ male
(d) Rh^- female and Rh^- male. *(2000)*

112. In *Drosophila* the XXY condition leads to femaleness whereas in human beings the same condition leads to Klienfelter's syndrome in male. It proves
(a) in human beings Y chromosme is active in sex determination
(b) Y chromosome is active in sex determination in both human beings and *Drosophila*
(c) in *Drosophila* Y chromosome decides femaleness
(d) Y chromosome of man have genes for syndrome. *(2000)*

113. A gene pair hides the effect of another gene. The phenomenon is called
(a) dominance (b) segregation
(c) epistasis (d) mutation. *(1999)*

114. In hybridization, Tt × tt gives rise to the progeny of ratio
(a) 2 : 1 (b) 1 : 2 : 1
(c) 1 : 1 (d) 1 : 2. *(1999)*

115. A marriage between normal visioned man and colour blind woman will produce offspring
(a) colour blind sons and 50% carrier daughter
(b) 50% colourblind sons and 50% carrier daughter
(c) normal males and carrier daughters
(d) colour blind sons and carrier daughters. *(1999)*

116. The problem, due to Rh^- factor arises when the blood of two (Rh^+ and Rh^-) mix up
(a) during pregnancy
(b) in a test tube
(c) through transfusion
(d) both (a) and (c). *(1999)*

117. Haemophilic man marries a normal woman. Their offsprings will be
(a) all haemophilic
(b) all boys haemophilic
(c) all girls haemophilic
(d) all normal. *(1999)*

118. In human beings, multiple genes are involved in the inheritance of
(a) sickle-cell anaemia (b) skin colour
(c) colour blindness (d) phenylketonuria. *(1999)*

119. When a single gene influences more than one trait it is called
(a) pseudodominance
(b) pleiotropy (c) epistasis
(d) none of these. *(1998)*

120. If Mendel had studied the seven traits using a plant with 12 chromosomes instead of 14, in what way would his interpretation have been different?
(a) He would not have discovered the law of independent assortment.
(b) He would have discovered sex linkage.
(c) He could have mapped the chromosome.
(d) He would have discovered blending or incomplete dominance. *(1998)*

121. Crossing over in diploid organism is responsible for
(a) segregation of alleles
(b) recombination of linked alleles
(c) dominance of genes
(d) linkage between genes. *(1998)*

122. How many different types of genetically different gametes will be produced by a heterozygous plant having the genotype AABbCc?
(a) Six (b) Nine
(c) Two (d) Four *(1998)*

123. A woman with two genes for haemophilia and one gene for colour blindness on one of the 'X' chromosomes marries a normal man. How will the progeny be?
(a) 50% haemophilic colour-blind sons and 50% normal sons
(b) 50% haemophilic daughters (carrier) and 50% colour blind daughters (carrier)
(c) All sons and daughters haemophilic and colour-blind
(d) Haemophilic and colour-blind daughters *(1998)*

124. Mental retardation in man, associated with sex chromosomal abnormality is usually due to
(a) moderate increase in Y complement
(b) large increase in Y complement
(c) reduction in X complement
(d) increase in X complement. *(1998)*

125. Albinism is known to be due to an autosomal recessive mutation. The first child of a couple with normal skin pigmentation was an albino. What is the probability that their second child will also be an albino?
(a) 50% (b) 75%
(c) 100% (d) 25% *(1998)*

126. A fruit fly is heterozygous for sex-linked genes, when mated with normal female fruit fly, the males specific chromosome will enter egg cell in the proportion
(a) 3 : 1 (b) 7 : 1
(c) 1 : 1 (d) 2 : 1. *(1997)*

127. A person with the sex chromosomes XXY suffers from
(a) gynandromorphism
(b) Klinefelter's syndrome
(c) Down's syndrome
(d) Turner's syndrome. *(1997)*

128. Genetic identity of a human male is determined by
(a) sex-chromosome (b) cell organelles
(c) autosome (d) nucleolus. *(1997)*

129. The polygenic genes show
(a) different karyotypes
(b) different genotypes
(c) different phenotypes
(d) none of these. *(1996)*

130. When two dominant independently assorting genes react with each other, they are called
(a) collaborative genes
(b) complementary genes
(c) duplicate genes
(d) supplementary genes. *(1996)*

131. In which of the following diseases, the man has an extra X-chromosome?
(a) Turner's syndrome
(b) Klinefelter's syndrome
(c) Down's syndrome
(d) Haemophilia *(1996)*

132. A person whose father is colour blind marries a lady whose mother is daughter of a colour blind man. Their children will be
(a) all sons colour blind
(b) some sons normal and some colour blind
(c) all colour blind
(d) all daughters normal. *(1996)*

133. A genetically diseased father (male) marries with a normal female and gives birth to 3 carrier girls and 5 normal sons. It may be which type of genetic disease?
(a) Sex-influenced disease
(b) Blood group inheritance disease
(c) Sex-linked disease
(d) Sex-recessive disease *(1996)*

134. When two genetic loci produce identical phenotypes in *cis* and *trans* position, they are considered to be
(a) multiple alleles
(b) the parts of same gene
(c) pseudoalleles
(d) different genes. *(1995)*

135. The phenomenon, in which an allele of one gene suppresses the activity of an allele of another gene, is known as
(a) epistasis (b) dominance
(c) suppression (d) inactivation. *(1995)*

136. The most striking example of point mutation is found in a disease called
(a) Down's syndrome (b) sickle cell anaemia
(c) thalassaemia
(d) night blindness. *(1995)*

137. An abnormal human male phenotype involving an extra X-chromosome (XXY) is a case of
(a) Edward's syndrome
(b) Klinefelter's syndrome
(c) intersex
(d) Down's syndrome. *(1995)*

138. The genes, which remain confined to differential region of Y-chromosome, are
(a) autosomal genes (b) holandric genes
(c) completely sex-linked genes
(d) mutant genes. *(1994)*

139. A child's blood group is 'O'. The parent's blood groups cannot be
(a) A and B (b) A and A
(c) AB and O (d) B and O. *(1994)*

140. Albinism is a congenital disorder resulting from the lack of which enzyme?
(a) Tyrosinase (b) Xanthine oxidase
(c) Catalase (d) Fructokinase *(1994)*

141. The colour blindness is more likely to occur in males than in females because
(a) the Y-chromosome of males have the genes for distinguishing colours
(b) genes for characters are located on the sex-chromosomes
(c) the trait is dominant in males and recessive in females
(d) none of the above. *(1994)*

142. Of both normal parents, the chance of a male child becoming colour blind are
(a) no
(b) possible only when all the four grand parents had normal vision
(c) possible only when father's mother was colour blind
(d) possible only when mother's father was colour blind. *(1993)*

143. Mr. Kapoor has Bb autosomal gene pair and d allele sex-linked. What shall be proportion of Bd in sperms?
(a) Zero (b) 1/2
(c) 1/4 (d) 1/8 *(1993)*

144. Which of the following is suitable for experiment on linkage?
(a) aaBB × aaBB (b) AABB × aabb
(c) AaBb × AaBb (d) AAbb × AaBB *(1993)*

145. Of a normal couple, half the sons are haemophiliac while half the daughters are carriers. The gene is located on
(a) X-chromosome of father
(b) Y-chromosome of father
(c) one X-chromosome of mother
(d) both the X-chromosomes of mother. *(1993)*

146. Two dominant nonallelic genes are 50 map units apart. The linkage is
(a) cis type (b) trans type
(c) complete (d) absent/incomplete. *(1993)*

147. A polygenic inheritance in human beings is
(a) skin colour (b) phenylketonuria
(c) colour blindness
(d) sickle cell anaemia. *(1993)*

148. Mendel studied inheritance of seven pairs of traits in Pea which can have 21 possible combinations. If you are told that in one of these combinations, independent assortment is not observed in later studies, your reaction will be
(a) independent assortment principle may be wrong
(b) Mendel might not have studied all the combinations
(c) it is impossible
(d) later studies may be wrong. *(1993)*

149. Sex is determined in human beings
(a) by ovum
(b) at time of fertilization
(c) 40 days after fertilization
(d) seventh to eight week when genitals differentiate in foetus. *(1993)*

150. A child of O-group has B-group father. The genotype of father will be
(a) I^OI^O (b) I^BI^B
(c) I^AI^B (d) I^BI^O. *(1992)*

151. An allele is dominant if it is expressed in
(a) both homozygous and heterozygous states
(b) second generation
(c) heterozygous combination
(d) homozygous combination. *(1992)*

152. In a cross between AABB × aabb, the ratio of F_2 genotypes between AABB, AaBB, Aabb and aabb would be
(a) 9 : 3 : 3 : 1 (b) 2 : 1 : 1 : 2
(c) 1 : 2 : 2 : 1 (d) 7 : 5 : 3 : 1. *(1992)*

153. Segregation of Mendelian factors (no linkage, no crossing over) occurs during
(a) anaphase I (b) anaphase II
(c) diplotene (d) metaphase I. *(1992)*

154. An organism with two identical alleles is
(a) dominant (b) hybrid
(c) heterozygous (d) homozygous. *(1992)*

155. A colour blind mother and normal father would have
(a) colour blind sons and normal/carrier daughters

(b) colour blind sons and daughters
(c) all colour blind
(d) all normal. *(1992)*

156. Down's syndrome is due to
(a) crossing over (b) linkage
(c) sex-linked inheritance
(d) nondisjunction of chromosomes. *(1992)*

157. In human beings 45 chromosomes/ single X/XO abnormality causes
(a) Down's syndrome
(b) Kinefelter's syndrome
(c) Turner's syndrome
(d) Edward's syndrome. *(1992)*

158. A man of A-blood group marries a women of AB blood group. Which type of progeny would indicate that man is heterozygous A?
(a) AB (b) A
(c) O (d) B *(1991)*

159. Multiple alleles control inheritance of
(a) phenylketonuria (b) colour blindness
(c) sickle cell anaemia
(d) blood groups. *(1991)*

160. The contrasting pairs of factors in Mendelian crosses are called
(a) multiple alleles (b) allelomorphs
(c) alloloci (d) paramorphs. *(1991)*

161. First geneticist/father of genetics was
(a) De Vries (b) Mendel
(c) Darwin (d) Morgan. *(1991)*

162. Mendel's last law is
(a) segregation (b) dominance
(c) independent assortment
(d) polygenic inheritance. *(1991)*

163. Blue eye colour is recessive to brown eye colour. A brown eyed man whose mother was blue eyed marries a blue-eyed women. The children will be
(a) both blue eyed and brown eyed 1 : 1
(b) all brown eyed
(c) all blue eyed
(d) blue eyed and brown eyed 3 : 1. *(1991)*

164. The allele which is unable to express its effect in the presence of another is called
(a) codominant (b) supplementary
(c) complementary (d) recessive. *(1991)*

165. RR (Red) *Antirrhinum* is crossed with white (WW) one. Offspring RW are pink. This is an example of
(a) dominant-recessive
(b) incomplete dominance
(c) hybrid
(d) supplementary genes. *(1991)*

166. A colour blind girl is rare because she will be born only when
(a) her mother and maternal grand father were colour blind
(b) her father and maternal grand father were colour blind
(c) her mother is colour blind and father has normal vision
(d) parents have normal vision but grand parents were colour blind. *(1991)*

167. Cross between AaBB and aaBB will form
(a) 1AaBB : 1aaBB
(b) all AaBB
(c) 3AaBB : 1aaBB
(d) 1AaBB : 3aaBB. *(1990)*

168. In a genetic cross having recessive epistasis, F_2 phenotypic ratio would be
(a) 9 : 6 : 1 (b) 15 : 1
(c) 9 : 3 : 4 (d) 12 : 3 : 1. *(1990)*

169. ABO blood group system is due to
(a) multifactor inheritance
(b) incomplete dominance
(c) multiple allelism
(d) epistasis. *(1990)*

170. tt mates with Tt. What will be characteristic of offspring?
(a) 75% recessive (b) 50% recessive
(c) 25% recessive
(d) All dominant *(1990)*

171. In Down's syndrome of a male child, the sex complement is
(a) XO (b) XY
(c) XX (d) XXY. *(1990)*

172. Haemophilia is more common in males because it is a
(a) recessive character carried by Y-chromosome
(b) dominant character carried by Y-chromosome
(c) dominant trait carried by X-chromosome
(d) recessive trait carried by X-chromosome. *(1990)*

173. Which one is a hereditary disease?
(a) Cataract (b) Leprosy
(c) Blindness (d) Phenylketonuria *(1990)*

174. Both husband and wife have normal vision though their fathers were colour blind. The probability of their daughter becoming colour blind is
(a) 0% (b) 25%
(c) 50% (d) 75%. *(1990)*

175. Bateson used the terms coupling and repulsion for linkage and crossing over. Name the correct parental of coupling type alongwith its cross over or repulsion.
(a) Coupling AABB, aabb; Repulsion AABB, aabb
(b) Coupling AAbb, aaBB; Repulsion AaBb, aabb
(c) Coupling aaBB, aabb; Repulsion AABB, aabb
(d) coupling AABB, aabb : Repulsion AAbb, aaBB *(1990)*

176. A normal green male maize is crossed with albino female. The progeny is albino because
(a) trait for a albinism is dominant
(b) the albinos have biochemical to destroy plastids derived from green male
(c) plastids are inherited from female parent
(d) green plastids of male must have mutated. *(1989)*

177. Two linked genes a and b show 20% recombination. the individuals of a dihybrid cross between ++/++ × ab/ab shall show gametes
(a) ++ : 80 : : ab : 20
(b) ++ : 50 : : ab : 50
(c) ++ : 40 : : ab : 40 : : + a : 10 : : + b : 10
(d) ++ : 30 : : ab : 30 : : + a : 20 : : + b : 20. *(1989)*

178. Which contribute to the success of Mendel?
(a) Qualitative analysis of data
(b) Observation of distinct inherited traits
(c) His knowledge of biology
(d) Consideration of one character at one time *(1988)*

179. A family of five daughter only is expecting sixth issue. The chance of its beings a son is
(a) zero (b) 25%
(c) 50% (d) 100%. *(1988)*

180. Haploids are able to express both recessive and dominant alleles/mutations because there are
(a) many alleles for each gene
(b) two alleles for each gene
(c) only one allele for each gene in the individual
(d) only one allele in a gene. *(1988)*

Answer Key

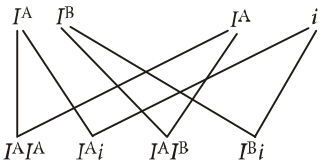
1.	(b)	**2.**	(b)	**3.**	(d)	**4.**	(a)	**5.**	(d)	**6.**	(c)	**7.**	(a)	**8.**	(d)	**9.**	(b)	**10.**	(c)
11.	(d)	**12.**	(a)	**13.**	(d)	**14.**	(b)	**15.**	(d)	**16.**	(b)	**17.**	(b)	**18.**	(a)	**19.**	(c)	**20.**	(a)
21.	(a)	**22.**	(a)	**23.**	(a)	**24.**	(b)	**25.**	(d)	**26.**	(b)	**27.**	(c)	**28.**	(a)	**29.**	(a)	**30.**	(b)
31.	(a)	**32.**	(c)	**33.**	(b)	**34.**	(a)	**35.**	(b)	**36.**	(b)	**37.**	(d)	**38.**	(c)	**39.**	(a)	**40.**	(a)
41.	(b)	**42.**	(a)	**43.**	(c)	**44.**	(a)	**45.**	(c)	**46.**	(d)	**47.**	(a)	**48.**	(c)	**49.**	(c)	**50.**	(a)
51.	(c)	**52.**	(c)	**53.**	(c)	**54.**	(b)	**55.**	(b)	**56.**	(c)	**57.**	(a)	**58.**	(c)	**59.**	(d)	**60.**	(d)
61.	(b)	**62.**	(c)	**63.**	(c)	**64.**	(d)	**65.**	(c)	**66.**	(a)	**67.**	(c)	**68.**	(d)	**69.**	(a)	**70.**	(a)
71.	(a)	**72.**	(a)	**73.**	(c)	**74.**	(d)	**75.**	(b)	**76.**	(d)	**77.**	(c)	**78.**	(d)	**79.**	(a)	**80.**	(b)
81.	(a)	**82.**	(c)	**83.**	(b)	**84.**	(b)	**85.**	(c)	**86.**	(b)	**87.**	(d)	**88.**	(b)	**89.**	(c)	**90.**	(b)
91.	(c)	**92.**	(c)	**93.**	(c)	**94.**	(a)	**95.**	(a)	**96.**	(c)	**97.**	(a)	**98.**	(a)	**99.**	(a)	**100.**	(b)
101.	(a)	**102.**	(d)	**103.**	(b)	**104.**	(b)	**105.**	(c)	**106.**	(b)	**107.**	(c)	**108.**	(a)	**109.**	(d)	**110.**	(a)
111.	(a)	**112.**	(a)	**113.**	(c)	**114.**	(c)	**115.**	(d)	**116.**	(d)	**117.**	(d)	**118.**	(b)	**119.**	(b)	**120.**	(a)
121.	(b)	**122.**	(d)	**123.**	(b)	**124.**	(d)	**125.**	(d)	**126.**	(c)	**127.**	(b)	**128.**	(a)	**129.**	(c)	**130.**	(b)
131.	(b)	**132.**	(d)	**133.**	(c)	**134.**	(c)	**135.**	(a)	**136.**	(b)	**137.**	(b)	**138.**	(b)	**139.**	(c)	**140.**	(a)
141.	(b)	**142.**	(d)	**143.**	(c)	**144.**	(b)	**145.**	(c)	**146.**	(d)	**147.**	(a)	**148.**	(b)	**149.**	(b)	**150.**	(d)
151.	(a)	**152.**	(c)	**153.**	(a)	**154.**	(d)	**155.**	(a)	**156.**	(d)	**157.**	(c)	**158.**	(d)	**159.**	(d)	**160.**	(b)
161.	(b)	**162.**	(c)	**163.**	(a)	**164.**	(d)	**165.**	(b)	**166.**	(b)	**167.**	(a)	**168.**	(c)	**169.**	(c)	**170.**	(b)
171.	(d)	**172.**	(d)	**173.**	(d)	**174.**	(a)	**175.**	(d)	**176.**	(c)	**177.**	(c)	**178.**	(d)	**179.**	(c)	**180.**	(c)

EXPLANATIONS

1. (b): Sickle cell anaemia is caused due to point mutation in which at the 6th position of beta globin chain, glutamic acid is replaced by valine. Thus, it is a qualitative defect in functioning of globin molecules.

Thalassemia is caused due to either mutation or deletion which ultimately results in reduced rate of synthesis of one of the globin chains that make up haemoglobin. Hence, it is a quantitative defect in functioning of globin molecules.

2. (b): If the genotypes of husband and wife are I^AI^B and I^Ai respectively, then the probabilities of genotypes and phenotypes among their children can be worked out as:



Genotype: I^AI^A I^Ai I^AI^B I^Bi

Phenotype: A A AB B

Thus, there are four possible genotypes, *viz*., I^AI^A, I^Ai, I^AI^B and I^Bi and three possible phenotypes, *viz*., A, AB and B among the children.

3. (d): Down's syndrome is an autosomal aneuploidy, caused by the presence of an extra-chromosome number 21. Both the chromosomes of the pair 21 pass into a single egg due to non disjunction during oogenesis.

4. (a): Mendel considered the following characters of pea in his experiments:

	Character	Dominant	Recessive
1.	Seed shape	Round (R)	Wrinkled (r)
2.	Seed cotyledon colour	Yellow (Y)	Green (y)
3.	Flower colour	Violet (V)	White (v)
4.	Pod shape	Inflated (I)	Constricted (i)
5.	Pod colour	Green (G)	Yellow (g)
6.	Flower position	Axial (A)	Terminal (a)
7.	Stem height	Tall (T)	Dwarf (t)

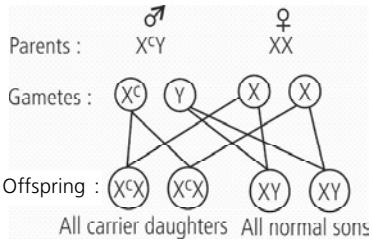
5. (d): Mendel carried out hybridisation experiments on garden pea for 7 years from 1856-1863.

6. (c): Translocation is a chromosomal abnormality caused by rearrangement of parts between non-homologous chromosomes. It may cause a gene to move from one linkage group to another.

7. (a): Genotype of colour blind man – X^cY

Genotype of women homozygous – XX

for normal woman



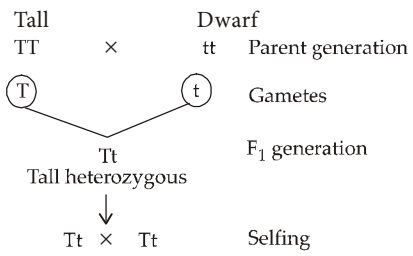
Hence, there is zero (0) probability of their son to be colour-blind.

8. (d): Polyploidy is the phenomenon of occurrence of more than two sets of chromosomes in the nucleus of a cell. Polyploidy is more common in plants. Polyploidy arises as a result of total non-disjunction of chromosomes during mitosis or meiosis.

9. (b): Sickle-cell anaemia is an autosomal recessive genetic disorder. It can be transmitted from parents to the offspring when b oth the partners are carriers of the gene (or heterozygous).

10. (c): When a tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant and the F_1 plants were selfed the resulting genotypes were in the ratio of 1 : 2 : 1 *i.e.,* Tall homozygous : Tall heterozygous : Dwarf

It can be illustrated as given below:



♂ / ♀	T	t
T	TT Tall	Tt Tall
t	Tt Tall	Tt Dwarf

F_2 generation

Phenotypic ratio : 3 : 1 : : Tall : Dwarf

Genotypic ratio - 1 : 2 : 1 : : TT : Tt : tt

11. (d)

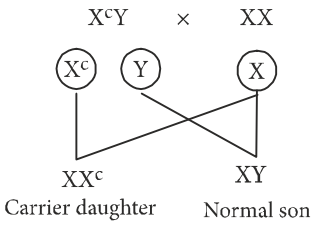
12. (a): If in a dihybrid test cross more parental combinations appear as compared to the recombinants in F_2 generation, then it is indicative of involvement of linkage. Linkage is the tendency of two different genes on the same chromosome to remain together during the separation of homologous chromosomes at meiosis. During complete linkage no recombinants are formed whereas in incomplete linkage few recombinants are produced along with parental combinations.

13. (d): Haemophilia is a sex-linked disease. It occurs due to the presence of a recessive sex linked gene *h*, which is carried by X-chromosome.

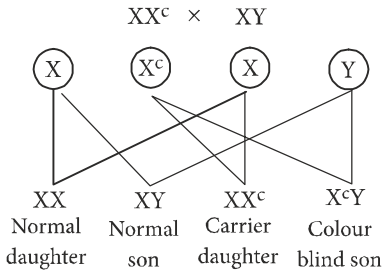
14. (b) : The phenomenon of expression of both the alleles in a heterozygote is called codominance. The alleles which do not show dominance-recessive relationship and are able to express themselves independently when present together are called codominant alleles. As a result the heterozygous condition has a phenotype different from either of homozygous genotypes, *e.g.*, alleles for blood group A (I^A) and for blood group B (I^B) are codominant so that when they come together in an individual, they produce blood group AB.

15. (d) : *Refer to answer 4.*

16. (b) : When a colour blind man (X^cY) marries a normal woman (XX), all of their daughters are carriers and all of their sons are normal, as shown in following figure:



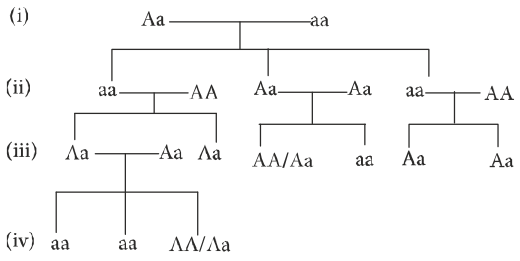
When the carrier daughter (XX^c) is married to a normal man, the probability of their son being colour blind is 0.25, as shown in following figure:



From above crosses, it is clear that the probability of occurrence of colour blindness in the grandson of a colour blind man and a normal woman is 0.25.

17. (b) : The ability of a gene to have multiple phenotypic effects because it influences a number of characters simultaneously is known as pleiotropy. The gene having a multiple phenotypic effect because of its ability to control expression of two or more characters is called pleiotropic gene. In human beings pleiotropy is exhibited by syndromes called sickle cell anaemia and phenylketonuria.

18. (a) : Autosomal recessive traits are the traits which are caused by recessive autosomal genes when present in homozygous condition. The given pedigree can be explained as:



As the trait appears only in homozygous recessive individuals (aa), therefore it is an autosomal recessive trait.

19. (c) : Linkage is the phenomenon of certain genes staying together during inheritance through generations without any change or separation due to their being present on the same chromosome. Linkage was first suggested by Sutton and Boveri (1902-1903) when they propounded the famous "chromosomal theory of inheritance." Bateson and Punnett (1906) while working on sweet pea found that the factors for certain characters do not show independent assortment.

However, it was Morgan (1910) who clearly proved and defined linkage on the basis of his breeding experiments in fruit fly (*Drosophila melanogaster*).

20. (a): *Refer to answer 6.*

21. (a): Genes are the units of inheritance and contain the information that is required to express a particular trait in an organism. Alternating forms of a single gene which code for a pair of contrasting traits are known as alleles. For example, two alleles determine the height of pea plant (tall and dwarf).

22. (a)

23. (a): The man has blood group A, thus its genotype can either be I^AI^A or I^AI^O. Similarly, woman can either have I^BI^B, or I^BI^O genotype. Thus, their offspring can have any of the blood groups A (I^AI^A or I^AI^O), B (I^BI^B or I^BI^O), AB (I^AI^B) or O (I^OI^O).

24. (b): *Refer to answer 4.*

25. (d): The abnormal baby has an extra X chromosome, thus it must have been produced by fusion of abnormal XX ovum with a normal X sperm. Abnormal XX sperm is not possible because, males have XY genotype, and if produce abnormal sperms, then XY sperms and O sperms will be produced. If fusion of multiple gametes have occurred (either two ova with one sperm or two sperms with one ovum), then the human baby will have triploid genotype not the trisomy of sex chromosomes.

26. (b): A dominant epistatic allele suppresses the expression of a non-allelic gene whether the latter is dominant or recessive. The gene which suppresses the expression of a non-allelic gene is known as epistatic gene. The gene or locus which is suppressed by the presence of non-allelic gene is termed as hypostatic gene. In summer squash or *Cucurbita pepo*, there are three types of fruit colour— yellow, green and white. White colour is dominant over other colours while yellow is dominant over green. Yellow colour is formed only when the dominant epistatic gene is represented by its recessive allele (w). When the hypostatic gene is also recessive (y), the colour of the fruit is green, *i.e.*,

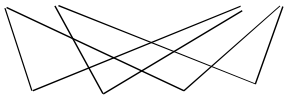
W – Yy, W – yy → White
wwY → Yellow
wwyy → Green

27. (c): It is given that the man had colour blind father, *i.e.*, man's genotype would be XY.

Now, the woman had a colourblind mother and normal father, thus her genotype would be X^cX. A cross between them can be represented as below.

Parents: X^cX × XY

Gametes : X^c X X Y



Progeny : X^cX XX X^cY XY

Carrier female | Normal female | Colour blind male | Normal male

Therefore, 50% of male children of this couple will be colour blind.

28. (a): A human female with Turner's syndrome has single sex chromosome *i.e.*, 44 + X0 (45). Such females are called sterile females with rudimentary ovaries. Other associated phenotypes of this condition are short stature, webbed-neck, broad chest, lack of secondary sexual characteristics and sterility. Thus, any imbalance in the copies of the sex chromosomes may disrupt the genetic information necessary for normal sexual development.

29. (a): Haemophilia is sex-linked disease which is also known as bleeder's disease as the patient will continue to bleed even from a minor cut since he or she does not possess the natural phenomenon of blood clotting due to absence of antihaemophiliac globulin or factor VIII (haemophilia – A) and plasma thromboplastin factor IX (haemophilia–B, Christmas disease) essential for it. As a result of continuous bleeding the patient may die of blood loss. It is genetically due to the presence of a recessive sex linked gene *h*, carried by X-chromosome. A female becomes haemophiliac only when both of her X-chromosomes carry the gene (X^hX^h). However, such females generally die before birth because the combination of these two recessive alleles is lethal. A female having only one allele for haemophilia (XX^h) appears normal because the allele for normal blood clotting present on the other X-chromosome is dominant. Such females are known as carriers. In case of males, a single gene for the defect is able to express itself as the Y-chromosome is devoid of any corresponding allele (X^hY).

30. (b): Amniocentesis is a foetal sex determination test in which amniotic fluid containing foetal cells

which surrounds the developing embryo is extracted and cells are tested for chromosomal pattern to identify genetic disorders, if any. Jaundice is not a chromosomal disorder thus cannot be tested by amniocentesis.

31. (a): Thalassaemia is an autosomal recessive blood disorder. In the given case, both the partners are unaffected carriers for the gene *i.e.*, have heterozygous genotype Tt. Persons homozygous for the autosomal recessive gene of β-thalassaemia suffer from severe haemolytic anaemia. Heterozygous persons are also not normal, but show the defect in a less severe form (thalassaemia minor).

Parents genotype: Tt × Tt

↓

Offspring genotype: TT : Tt : tt

1 : 2 : 1

Normal Carriers Affected

25% 50% 25%

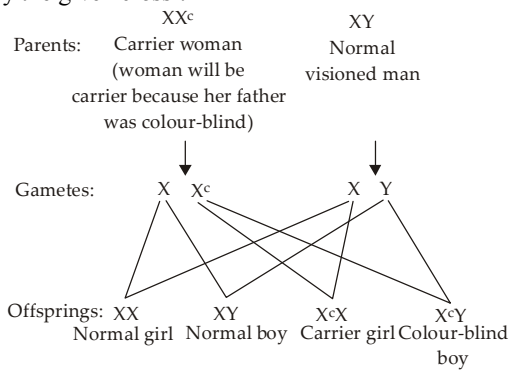
32. (c): *Refer to answer 14.*

33. (b): In codominance, both the alleles are able to express themselves independently when present together resulting in a phenotype that is intermediate between both the parental homozygous phenotypes, thereby resembling both of them. *E.g.*, roan coat colour in cattle is a result of co-dominance of alleles for white and red coat colour.

34. (a): Pedigree analysis is a system of analysis by following the movement and distribution of certain genetic traits in many generations of a family. Pedigree analysis cannot confirm that DNA is the carrier of genetic information because it is an analysis system. For DNA based experiments, molecular biology techniques are used.

35. (b): Down's syndrome is the trisomy of 21st chromosome in man. Down's syndrome is characterized by short stature, warty skin, protruding tongue, slanting eyes, with folded eyelids. The affected person's face presents a typical mongoloid look. Hence it is also called as mongoloid idiocy. It occurs due to the phenomenon of non-disjunction. Non-disjunction occurs when a pair of homologous chromosomes do not separate in meiosis but migrate to the same pole of the cell resulting in an uneven number of chromosomes in the daughter cells (45 in one and 47 in other) This numerical abnormality results in trisomy (2n + 1) and monosomy (2n – 1). Non-disjunction is more common in sex chromosomes.

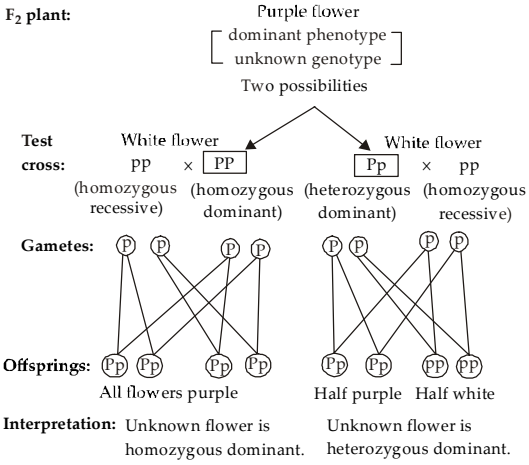
36. (b): In the given condition the chances of child to be colour-blind is zero percent. It can be understood by the given cross :



37. (d): The inheritance of flower colour in the dog flower (snapdragon or *Antirrhinum sp.*) is a good example which shows incomplete dominance. In a cross between true-breeding red-flowered (RR) and true-breeding white-flowered plants (rr), the F_1 (Rr) was pink. When the F_1 was self-pollinated the F_2 resulted in the following ratio, 1 (RR) Red : 2 (Rr) Pink : 1 (rr) White. Here the genotype ratios were 1 : 2 : 1 as in any Mendelian monohybrid cross, but the phenotype ratios had changed from the 3 : 1 dominant : recessive ratio to 1 : 2 : 1.

38. (c)

39. (a): Test cross is performed to determine the genotype of F_2 plant. In a typical test cross an organism showing dominant phenotype and whose genotype is to be determined is crossed with one that is homozygous recessive for the allele being investigated, instead of self-crossing. The progenies of such a cross can easily be analysed to predict the genotype of the test organism. Given ahead is an illustration of test cross:



40. (a): The increased vigour displayed by the offspring from a cross between genetically different parents is called heterosis. Hybrids from crosses between different crop varieties (F_1 hybrids) are often stronger and produce better yields than the original varieties.

41. (b): XO type of sex chromosomes determine male sex in grasshoppers. This type of sex-determination comes under XX-XO type. Its common examples are cockroaches, grasshoppers and bugs. The female has two homomorphic sex chromosomes XX and is homogametic. It produces similar eggs, each with X-chromosome. The male has one chromosome only and is heterogametic. It produces 2 types of sperms : gynosperms with X and androsperms without X. Fertilisation of an egg by X-bearing sperm yields female offspring and by no X sperm yields male offspring.

Parents	Phenotypes / Genotypes	Male	Female
		AA + XO	AA + XX
Gametes		A + X, A + O	A + X, A + X

F_1 Generation

♂ \ ♀ : A + X | A + X

A + X	AA + XX	AA + XX	Females
A + O	AA + XO	AA + XO	Males
	Genotypes		Phenotypes

Fig. XX–XO type of sex determination.

42. (a): In humans, the female has a pair of X chromosome (homogametic composition) and the male has XY chromosomes (heterogametic composition). Therefore, two normal X chromosomes in zygotic cell lead to the birth of a normal human female child.

43. (c): *Refer to answer 39.*

44. (a): A record of inheritance of certain genetic traits for two or more generations presented in the form of a diagram or family tree is called pedigree. In a pedigree a square represents the male, a circle the female, solid (blackened) symbol shows the trait under study or affected individual; unaffected or normal individual by an open or clear symbol and a cross or shade (of any type) in the symbol signifies the carrier of a recessive allele. Words can also be used in place of symbols. Parents are shown by horizontal line while their offsprings are connected to it by a vertical line. The offsprings are then shown in the form of a horizontal line below the parents and numbered with arabic numerals.

45. (c): The three alleles I^A, I^B and i of gene I in ABO blood group system can produce six different genotypes and four different phenotypes as shown below :

Genotypes	Phenotypes
I^AI^B, I^Ai	Blood group A
I^BI^B, I^Bi	Blood group B
I^AI^B –	Blood group AB
$i\,i$ –	Blood group O

46. (d): Linkage is the phenomenon of certain genes staying together during inheritance through generations without any change or separation due to their being present on the same chromosome. Linked genes occur in the same chromosome. Strength of the linkage between two genes is inversely proportional to the distance between the two *i.e.*, two linked genes show higher frequency of crossing over (recombination) if the distance between them is higher and lower frequency if the distance is small.

47. (a): *Refer to answer 39.*

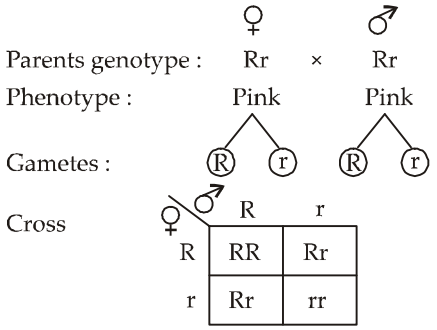
48. (c): According to Mendel's law of dominance, in heterozygous individuals a character is represented by two contrasting factors called alleles or allelomorphs which occur in pairs. Out of the two contrasting alleles, only one is able to express its effect in the individual. It is called dominant factor or dominant allele. The other allele which does not show its effect in the heterozygous individual is called recessive factor or recessive allele. The option (c) in the given question cannot be explained on the basis of law of dominance. It can only be explained on the basis of Mendel's law of independent assortment, according to which in a dihybrid cross, the two alleles of each character assort independently (do not show any blending) of the alleles of other character and separate at the time of gamete formation. Both the characters are recovered as such in F_2 generation producing both parental and new combinations of traits.

49. (c) : *Refer to answer 45.*

50. (a)

51. (c) : *Refer to answer 39.*

52. (c) : The given situation is an example of incomplete dominance where phenotype found in F_1 generation do not resemble either of the two parents. The genotype of the two plants used for cross will be



Genotypic ratio : RR : Rr : rr
1 : 2 : 1

Phenotype : Red : Pink : White

The incomplete dominance of dominant allele (here 'R') over recessive allele (here 'r') could be due to mutations (insertion, deletion, substitution or inversion of nucleotides). The mutant allele generally produces a faulty or no product. This modification in the product may lead to incomplete dominance of the (unmodified) wild type dominant allele.

53. (c) : Baldness is a sex influenced trait. The dominance of alleles may differ in heterozygotes of the two sexes. This phenomenon is called "sex influenced dominance". Gene products of heterozygotes in the two sexes may be influenced differentially by sex hormones.

54. (b) : Sickle-cell anaemia is an autosomal hereditary disorder in which erythrocytes become sickle shaped. It is caused by the formation of abnormal haemoglobin called haemoglobin-S. Haemoglobin-S is formed when 6th amino acid of β-chain, *i.e.*, glutamic acid is replaced by valine due to substitution. It occurs due to a single nucleotide change (A → T) in the β-globin gene of coding strand. In the normal β-globin gene the DNA sequence is CCTGAGGAG, while in sickle-cell anaemia, the sequence is CCTGTGGAG.

55. (b) : ADA deficiency can be permanently cured if the isolated gene from bone marrow cells producing ADA is introduced into cells at early embryonic stages.

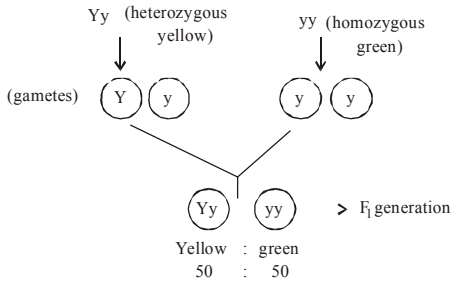
56. (c) : In ABO blood group O refers to O blood group. It has no antigen (A and B) on RBCs.

57. (a) : This chart shows inheritance of an autosomal recessive trait like phenylketonuria. An autosomal recessive trait may skip a generation. It appears in case of marriage between two heterozygous individuals (Aa × Aa = 3 Aa + 1 aa), a recessive individual with hybrid (Aa × aa = 2 Aa + 2 aa) and two recessive (aa × aa = all aa). Phenylketonuria is an inborn, autosomal, recessive metabolic disorder in which homozygous recessive individual lacks the enzyme phenylalanine hydroxylase. The heterozygous individuals are normal but carriers.

58. (c) : Klinefelter's syndrome is a genetic disorder in which there are three sex chromosomes, XXY, rather than the normal XX or XY. The number of autosomes are normal *i.e.*, 44. Affected individuals are apparently male but are tall and thin, with small testes, failure of normal sperm production (azoospermia), enlargement of the breasts (gynaecomastia) and absence of facial and body hairs.

59. (d) : As sperms produced are with genotypes AB, Ab, aB, ab (two diallelic character) the person must be heterozygous for both genes. So his genotype will be AaBb.

60. (d) : Yellow (Y) seeds are dominant to green (y). So a heterozygous yellow seeded plant will have the genotype of (Yy) and a green seeded plant will have genotype of (yy). When these two plants are crossed, the F_1 generation will have the ratio of yellow : green as 50 : 50. It is shown as



61. (b) : Polygenic (or Quantitative) inheritance is that type of inheritance in which the complete expression of a trait is controlled by two or more genes in which a dominant allele of each gene contributes only a unit fraction of the trait and total phenotypic expression is the sum total of a additive or cumulative effect of all the dominant alleles of genes/polygenes. Human skin colour is an example of such polygenic inheritance which is controlled by three pairs of polygenes A, B and C. Negro/black colour is due to presence of all the six dominant contributing alleles AABBCC. Very light colour or white colour is due to presence of all six recessive non-contributing alleles aabbcc.

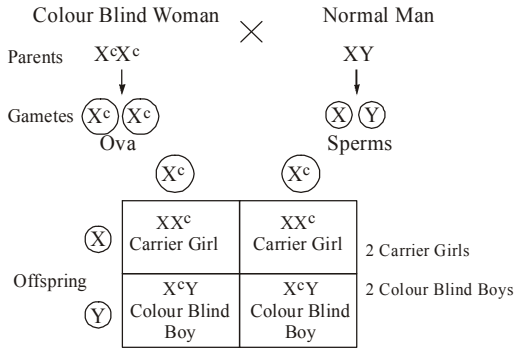
62. (c) : Hexaploid wheat is a result of allopolyploidy induced by doubling the chromosome number of the hybrid produced by crossing two different plants. In hexaploid wheat *Triticale* $2n = 6x = 42$. So x stands for basic chromosome number and n for haploid chromosome number. So, $n = 21$ and $x = 7$ for hexaploid wheat.

63. (c) : A common test to find the genotypes of a hybrid is by crossing of one F_1 progeny with male parent.

64. (d) : *Refer to answers 39.*

65. (c) : A congenital disorder is a medical condition that is present at birth. Congenital disorders can be a result of genetic abnormalities, the intrauterine environment, or unknown factors. Sickle cell disease [a group of genetic disorders caused by sickle haemoglobin (Hb^S). Hb^S molecules tend to clump together, making red blood cells sticky, stiff and more fragile and causing them to form into a curved, sickle shape] and Huntington's chorea (an inherited disorder characterised by degenerative changes in the basal ganglia structures, which ultimately result in a severely shrunken brain and enlarged ventricles, abnormal body movements called chorea and loss of memory) are congenital disorders.

66. (a) : Colour blindness is a recessive sex-linked trait.



All sons will be colour blind and all daughters will be carriers.

67. (c) : Cri-du-chat syndrome, also called deletion 5p syndrome, (or 5p minus), is a rare genetic disorder. Cri-du-chat syndrome is due to a partial deletion of the short arm of chromosome number 5. The name of this syndrome is French for "cry of the cat," referring to the distinctive cry of children with this disorder. The cry is caused by abnormal larynx development, which becomes normal within a few weeks of birth. Infants with cri-du-chat have low birth weight and may have respiratory problems. Some people with this disorder have a shortened lifespan, but most have a normal life expectancy.

68. (d) : Sickle cell anaemia is an autosomal hereditary disorder in which the erythrocytes become sickle shaped. The disorder or disease is caused by the formation of an abnormal haemoglobin called haemoglobin-S. As found out by Ingram (1958), haemoglobin-S differs from normal haemoglobin-A in only one amino acid - 6th amino acid of β-chain, glutamic acid, is replaced by valine. This is the major effect of the allele. During conditions of oxygen deficiency 6-valine forms hydrophobic bonds with complementary sites of other globin molecules. It distorts their configuration. As a result, erythrocytes having haemoglobin-S become sickle-shaped. Carriers of the sickle cell anaemia gene are protected against malaria because of their particular haemoglobin mutation; this explains why sickle cell anaemia is particularly common among people of African origin. The malarial parasite has a complex life cycle and spends part of it in red blood cells and feeds on haemoglobin. Both sickle-cell anaemia and thalassemia are more common in malaria areas, because these mutations convey some protection against the parasite. In a carrier, the presence of the malaria parasite causes the red blood cell to rupture, making the *Plasmodium* unable to reproduce. Further, the polymerisation of Hb affects the ability of the parasite to digest Hb in the first place. Therefore, in areas where malaria is a problem, people's chances of survival actually increase if they carry sickle cell anaemia. Thus, sickle-cell anaemia is a potential saviour from malaria.

69. (a) : Since round seed shape is dominant over wrinkled seed shape and yellow cotyledon is dominant over green cotyledon so RRYY individuals is round yellow and rryy is wrinkled green.

Round yellow seeds × Wrinkled green seeds
RRYY rryy
↓
F_1 generation RrYy
F_2 generation is obtained by selfing F_1.

♀ \ ♂	RY	Ry	rY	ry
RY	RRYY	RRYy	RrYY	RrYy
Ry	RRYy	RRyy	RrYy	Rryy
rY	RrYY	RrYy	rrYY	rrYy
ry	RrYy	Rryy	rrYy	rryy

Expected phenotypes in F_2 generation

Round yellow seed 9	Wrinkled yellow seed 3
Round green seed 3	Wrinkled green seed 1

70. (a) : The plant having genotype AABbCC is heterozygous for only one character B. Number of gametes = 2^n, where n is the heterozygosity.
Since $n = 1$ so 2 gametes will be formed. Those are ABC and AbC.

Factor 1	Factor 2	Factor 3	Genotype of gametes
A	B	C	ABC
		C	ABC
		C	AbC
	b	C	AbC
A	B	C	ABC
		C	ABC
	b	C	AbC
		C	AbC

So, the two types of gametes will be ABC and AbC.

71. (a) : The external manifestation, morphological or physiological expression of an individual with regard to one or more characters is called phenotype. For recessive genes, phenotype and genotype are similar. For dominant genes, the phenotype is same for both homozygous states. Phenotype is influenced by environment as well as age. A child definitely differs from adolescent, the latter from adult and an adult from aged one. Many phenotypes are determined by multiple genes. Thus, the identity of phenotype is determined by genotype and environment.

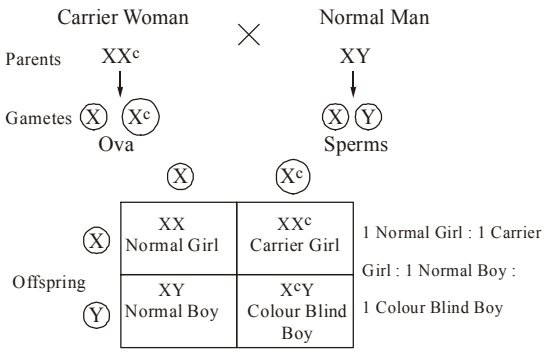
72. (a) : *Refer to answer 61.*

73. (c) : A test cross involving the crossing of F_1 individual with the homozygous recessive parent. It is done to find out homozygous and heterozygous individuals. So AaBb, should be crossed with aabb.

74. (d) : Glucose-6-phosphate dehydrogenase (G-6-PD) deficiency is a group of hereditary abnormalities (X linked disorder) in which the activity of the erythrocyte enzyme G-6-PD is markedly diminished leading to haemolysis.

75. (b) : Traits governed by sex-linked recessive genes are : (a) produce disorders in males more often than in females, (b) express themselves in males even when represented by a single allele because Y-chromosome does not carry any corresponding alleles, (c) seldom appear in both father and son, (d) fail to appear in females unless their father also possesses the same and the mother is a carrier, (e) female heterozygous for the trait function as carrier and (f) female homozygous for the recessive trait transfer the trait to all the sons.

Take the example of colour blindness which is a recessive sex-linked trait. In the question, as man and woman do not show any signs of disease, so man must be normal and woman must be carrier.



76. (d) : Down's syndrome is caused by the presence of an extra chromosome number 21. Both the chromosomes of the pair 21 pass into a single egg. Thus, the egg possesses 24 chromosomes instead of 23 and offspring has 47 chromosomes (45 + XY in males, 45 + XX in males) instead of 46. Turner's syndrome is formed by the union of an abnormal 0 egg and a normal X sperm or a normal egg and an abnormal 0 sperm. The individual has 45 chromosomes (44 + X) instead of 46. Female with more than two X chromosomes is called superfemale. Triploidy is a condition in which an organism has three times (3n) the haploid number (n) of chromosomes.

77. (c) : *Refer to answer 29.*

78. (d) : Cretinism occurs due to hyposecretion of thyroid hormones. Haemophilia is a sex linked recessive trait. Cystic fibrosis is also a recessive autosomal disorder resulting in mucus clogging in lungs. Thalassemia involves a gene mutation in the polypeptide chains of haemoglobin.

79. (a) : Colour blindness is a recessive sex-linked trait. Since the woman's father was colour blind. She should be carrier of the colour blind gene (X^cX). When she marries to colour blind man their progeny could be

Parent	X^cX	×	X^cY		
	Carrier woman		Colourblind man		
Progeny	X^cX^c	X^cX	X^cY	XY	
	Colour blind girl	Carrier girl	Colour blind son	Normal son	

80. (b) : Since red fruit colour is dominant over yellow fruit colour and tallness is dominant over shortness.

RRTt × rrtt .... Parents
Red Tall Yellow Short
RT Rt rt .... Gametes
RrTt Rrtt .... F_1
Red Tall Red Short

These are produced in 1 : 1 ratio.

81. (a) : The male human is heterozygous for autosomal gene A and B and also hemizygous for haemophilic gene *h,* then his genotype will be $AaBbX^hY$ because haemophilia is a sex linked trait that is present on X-chromosome. So, the total number of gametes will be abX^h, abY, ABX^h, ABY, AbX^h, AbY, aBX^h, aBY. So the proportion of abX^h sperm will be 1/8.

82. (c) : Mendel's law of independent assortment states that when the parent differs from each other in two or more pairs of contrasting characters, the inheritance of one pair of factor is independent of the other. For the character to assort independently they should be located on separate non-homologous chromosomes. Genes present on the same chromosome show linkage. It means that these characters remain together and thus low numbers of combinations are formed. This phenomenon is called linkage and such genes are called linked genes. So, A and B are linked genes.

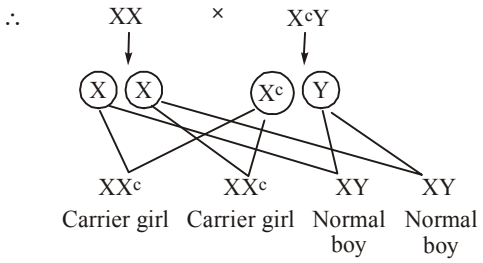
83. (b) : Mutation is a sudden alteration of the chemical structure of a gene or the alteration of its position on the ch romosome by breaking and rejoining of the chromosome. It has occured in male parent. But organelles like mitochondria, chloroplast etc. are a part of cytoplasmic inheritance.

Cytoplasmic inheritance is the passage of traits from parents to offspring through structures present inside the cytoplasm of contributing gametes. Plasma genes occur in plastids, mitochondria, plasmids and some special particles like kappa particles, sigma particles, etc. In higher organisms cytoplasmic inheritance is called maternal inheritance because the zygote receives most of its cytoplasm from the ovum. Therefore, cytoplasmic inheritance is usually unparental.So none of the progeny will show mutation.

84. (b) : In question, where the genotype of the other parent is not mentioned then that should be considered normal. Colour blindness is a recessive sex- linked trait

(i) To find out the genotype of a woman.

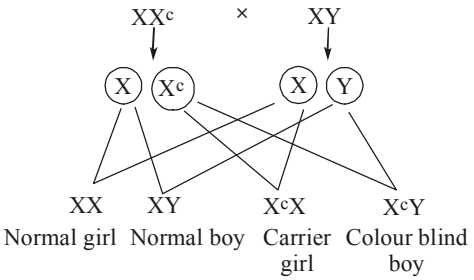
Her father is colour-blind \ his genotype is X^cY and her mother is normal so her genotype is XX.



So, woman is carrier.

(ii) When this woman marries normal man

∴ 50% of the sons would be colour blind.



85. (c) : The recessive genes located on X-chromosome of humans are always expressed in males *e.g.*, colour blindness is a recessive sex-linked trait in which the eye fails to distinguish red and green colours. The gene for the normal vision is dominant. The normal gene and its recessive allele are carried by X-chromosomes. In females colour blindness appears only when both the sex chromosomes carry the recessive gene (X^cX^c). The females have normal vision but function as carrier if a single recessive gene for colour blindness is present (XX^c). However, in human males the defect appears in the presence of a single recessive gene (X^cY) because Y-chromosome of male does not carry any gene for colour vision.

86. (b) : *Refer to answer 4.*

87. (d) : Mendel worked on seven characters. These characters showed complete independent assortment despite the seven characters chosen by him were present on four chromosomes –1, 4, 5 and 7.

88. (b) : A reciprocal cross means that the same two parent are used in two experiments in such a way that if in one experiment A is used as the female parent and B is used as the male parent then in the other experiment A will be used as the male parent and B as the female parent. Thus the sources of gametes are reversed. When the F_1 individuals obtained in a cross is crossed with the recessive parent, it is called a test cross. When inheritance of two pairs of contrasting character is studied simultaneously it is called dihybrid cross.

89. (c) : Sex influenced traits are autosomal traits that are influenced by sex. If a male has one recessive allele, he will show that trait, but it will take two recessive alleles for the female to show that same trait *e.g.* pattern baldness, moustaches and beard in males. Sex linked traits are those traits determining genes of which are found on the sex chromosomes. Sex limited traits are the traits which are expressed in a particular sex though their genes also occur in the other sex *e.g.*, milk secretion in mammalian females.

90. (b) : *Refer to answer 68.*

91. (c) : Down's syndrome is the example of autosomal aneuploidy. Here, an extra copy of chromosome 21 occurs. As it is an autosomal disease, the offsprings produced from affected mother and normal father should be 50 %.

92. (c) : According to genic balance theory of sex determination the ratio between the number of X-chromosomes and number of complete sets of autosomes will determine the sex. The X-chromosome is believed to carry female tendency genes, while autosomes carry male tendency genes. Both these sets of genes start functioning and there has to be a balance between them for an individual to become male or female. If the ratio between X and A is 1.0 it will be a female individual and when it is 0.5, it would be male.

93. (c) : Pleiotropic gene is such a gene which has a wider effect on phenotype *i.e.*, it controls several phenotypic traits. Sickle cell anaemia is considered to be caused by one such pleiotropic gene. It is caused due to mutation in β-globin gene of haemoglobin.

94. (a) : Linkage/ Cross over/ Chromosome maps is a graphic representation of relative positions/ order and relative distances of genes in a chromosome in the form of line like a linear road map depicting different places and their relative distances without giving exact mileage. It is based on Morgan's hypothesis (1911) that frequency of crossing over/recombination between two linked genes is directly proportional to the physical distance between the two. 1 map unit or centrimorgan is equivalent to 1% recombination between two genes. Percentage of crossing over between *a* and *b* is 20% so they are 20 map distance apart and *b* and *c* are 28 map distance apart. So, that correct sequence of genes on chromosomes will be as

$$b \xrightarrow{20} a \xrightarrow{8} c$$

95. (a) : Selfing is the process of fertilisation with polar or male gametes of the same individual. AABbCC will produce two type of gametes ABC and AbC. Thus, in F_2 generation three genotypes will be obtained. These are AABBCC, AABbCC and AAbbCC in the ratio of 1 : 2 : 1. Phenotypically AABBCC and AABbCC are same. So the phenotypic ratio in F_2 generation will be 3 : 1.

96. (c) : Dominant factor is an allele or Mendelian factor which expressess itself in the hybrid (heterozygous) as well as in homozygous state. It is denoted by capital letter.

97. (a) : In the inheritance pattern of sex chromosomes X-chromosome of father always passes to daughter and X-chromosome of mother passes to son. As the father is diseased and all the girls inherit it, it is obvious the disease is sex-linked. The mother is not a carrier (as evident from the fact that no son is diseased). Thus, the gene is dominant and expresses even in heterozygous condition.

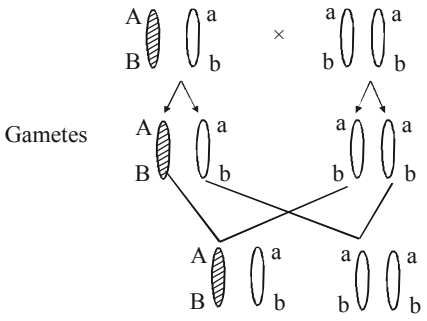
98. (a) : Down's syndrome (Mongolian Idiocy, Mongolism) is caused by the presence of an extra chromosome number 21. Sickle cell anaemia is not a sex linked (*i.e.*, X linked) disease but an autosomally inherited recessive trait.

Haemophilia is X-linked but not holandric/Y-linked.

Parkinson's disease is a degenerative disease. It is not at all hereditary.

99. (a) : Epistasis is the phenomenon of suppression of phenotypic expression of gene by a non-allelic gene which shows its own effect. The gene which masks the effect of another is called epistatic gene while the one which is suppressed is termed hypostatic gene. Epistasis is of three types - dominant, recessive and dominant-recessive.

100. (b) : The tendency of potential combinations to remain together, which is expressed in terms of low frequency of recombinations (new combinations) is called linkage. Genes present on same chromosomes show linkage. These genes are called linked genes. Since A and B genes are linked they will be passed on together in the progeny.



101. (a) : *Refer to answer 33.*

102. (d) : If two genes present on different loci produce the same effect when present alone but interact to form a new trait when present together, they are called complementary genes. The F_2 ratio is modified to 9 : 7 instead of 9 : 3 : 3 : 1.

103. (b) : According to law of independent assortment, the two factors of each trait assort at random and independent of the factors of other traits at the time of meiosis and get randomly as well as independently rearranged in the offspring. Principle of law of

independent assortment is applicable to only those factors or genes which are present on different chromosomes.

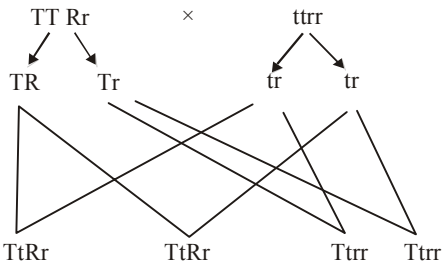
104. (b) : *Refer to answer 68.*

105. (c) : Barr body is a mass of condensed sex chromatin in the nuclei of normal female somatic cells due to inactive X chromosome. Whenever the number of X-chromosomes is two or more than two, the number of barr bodies is one less than the number of X-chromosomes. Therefore, the number of barr bodies in XXXX female is three.

106. (b) : Male XX and female XY sometimes occur due to transfer of segments in X and Y chromosomes. Deletion is the loss of an intercalary segment of a chromosome which is produced by a double break in the chromosomes followed by the union of remaining parts. Aneuploidy is a condition of having fewer or extra chromosomes than the normal genome number of the species.

107. (c)

108. (a) : The cross can be represented as :



Tall Red TtRr - 50%
Tall White Ttrr - 50%

109. (d) : *Refer to answer 4.*

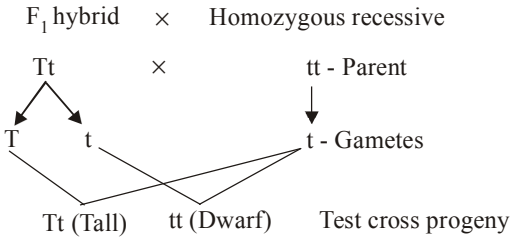
110. (a)

111. (a): If fertilization takes place between gametes of Rh^- female and Rh^+ male then the resulting foetus' blood is Rh^+. The Rh^+ blood of the foetus stimulates the formation of anti Rh factors in the mother's blood. In second pregnancy (with Rh^+ foetus), the anti Rh factors of the mother's blood destroy the foetal red blood corpuscles. This is called erythroblastosis foetalis. New born may survive but it is often anaemic. The Rh^- child does not suffer.

112. (a) : Y-chromosome does not play any role in determination of sex in *Drosophila*. In human being, XXY is phenotypically male with underdeveloped testes, gynecomastia and often mental retardation. It is caused by the union of a non-disjunct XX egg and sperm and a normal X egg and abnormal XY sperm. This indicates that in human being Y chromosome is active in sex determination.

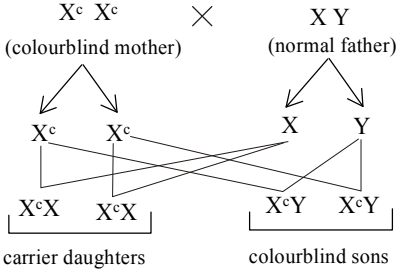
113. (c) : *Refer to answer 99.*

114. (c) : Crossing of individuals having dominant phenotype with its homozygous recessive is a test cross, which can be represented as:



Thus, ratio of progeny is = $\boxed{1:1}$.

115. (d) : Colour blindness is produced by a recessive gene which lies on X chromosome. A marriage between normal visioned man (XY) and colour blind women (X^cX^c), results in colour blind sons (X^cY^c) and carrier daughters (XX^c).

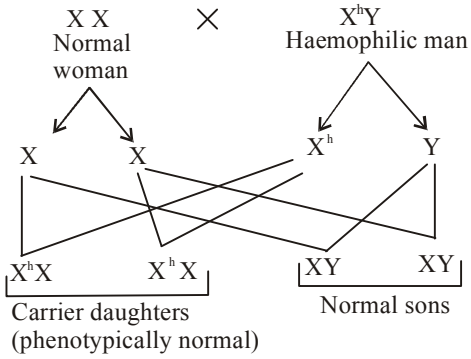


116. (d) : A protein named as rhesus antigen, is present on the surface of red blood corpuscles. Persons having this rhesus antigen (Rh factor) are called Rh positive (Rh^+). Others who do not have this factor are known as Rh negative (Rh^-). Both Rh^+ and Rh^- individuals are phenotypically normal. The problem arises during blood transfusion and pregnancy.

The first blood transfusion of Rh^+ blood to the person with Rh^- blood causes no harm because the Rh^- person develops anti Rh factors or antibodies in his/her blood. In second blood transfusion of Rh^+ blood to the Rh^- person, the latter's anti Rh factors attack and destroy the red blood corpuscles of the donor. If father's blood is Rh^+, mother's blood is Rh^- and foetus' blood is Rh^+. Then in second pregnancy (with Rh^+ foetus), the anti Rh factors of the mother's blood destroy the fetal red blood corpuscles.

117. (d) : Haemophilia is caused by a recessive gene located in the X-chromosome. When a haemophilic man (X^hY) marries a normal woman (XX), produces

carrier girls (XX^h) and normal boys (XY), *i.e.* all their offsprings will be normal.



118. (b) : *Refer to answer 61.*

119. (b) : The ability of a gene to have multiple phenotypic effect because it influences a number of characters simultaneously is known as pleiotropy.

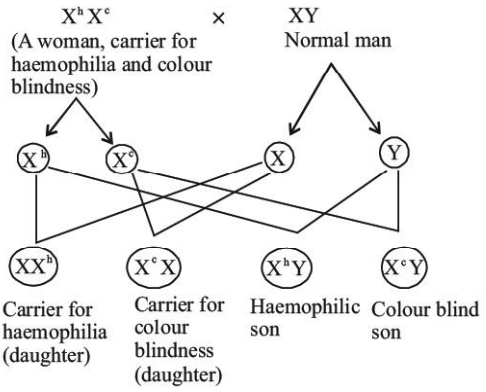
120. (a) : According to principle of independent assortment, the two factors of each trait assort at random and independent of the factors of other traits at the time of meiosis and get randomly as well as independently rearranged in the offspring. Priniciple of independent assortment is applicable to only those factors or genes which are present on different chromosomes. Chromosome have hundreds of genes which show linked inheritance or linkage. Linkage is the phenomenon of certain genes (present on the same chromosome) to remain together and get inherited through generations. The seven characters that Mendel choose were present on 14 chromosomes and so they did not show linkage but if present on 12 chromosomes they would have shown linkage and the principle of independent assortment would not have been discovered.

121. (b) : Crossing over is the reciprocal exchange of segments between non-sister chromatids of a pair of homologous chromosomes. It results in recombination of genes.

122. (d) : Number of gametes = $2^n = 2^2 = 4$.

where *n* is the number of gene in heterozygous form. The four gametes formed will be →ABc, AbC, Abc and ABC.

123. (b) : Both diseases are produced by a recessive gene which lies on the X-chromosomes. A woman having both gene for haemophilia on one X-chromosome and gene for colour blindness on another X-chromosome will have genotype X^hX^c.



Thus, progeny includes 50% haemophilic daughters (carrier) and 50% colour blind daughters (carrier).

124. (d) : In humans, sex chromosomal abnormality is due to gene carried on X-chromosome. Increase in X-complement leads to Klinefelter's syndrome. Klinefelter's syndrome, 47, XXY or XXY syndrome is a condition caused by a chromosome aneuploidy. Affected males have an extra X sex chromosome. It is formed by the union of an XX egg and normal Y sperm or normal X egg and abnormal XY sperm. Affected males are almost always effectively sterile, although advanced reproductive assistance is sometimes possible and some degree of language learning impairment and mental retardation may be present. In adults, possible characteristics vary widely and include little to no signs of affectedness, a lanky, youthful build and facial appearance, or a rounded body type with some degree of gynecomastia (increased breast tissue).

125. (d) : Albinism is caused by the absence of the enzyme tyrosinase which is essential for the synthesis of the pigment from dihydroxy-phenyl-alanine. The gene for albinism (a) does not produce the enzyme tyrosinase but its normal allele (A) does. Thus, only homozygous individual (aa) is affected by this disease. Albinos (individuals with albinism) lack dark pigment melanin in the skin, hair and iris. Although albinos have poor vision yet they lead normal life. On the basis of principles of simple recessive inheritance, the probability of albinic child from a normally pigmented parents, will be 1/4 or 25%.

126. (c) : The female *Drosophila* possesses two homomorphic sex chromosomes (XX) and the male *Drosophila* contains two heteromorphic sex chromosomes (XY). The differential or non-homologous region of Y-chromosome is mostly heterochromatic. The female parent produces only one type of eggs (22 + X). The male parent produces two types of gametes (22 + Y) and (22 + X). They are

produced in equal proportions. As the two types of sperms are produced in equal proportions, there are equal chances of getting a male or female fly in a particular mating.

127. (b) : *Refer to answer 124.*

128. (a) : Sex chromosomes are those chromosomes whose presence, absence or particular form determines the sex of the individual in unisexual or dioecious organisms, *e.g.*, XX - XY. XY method (XX - XY).

Despite differences in morphology, XY chromosomes synapse during zygotene. They have two parts, homologous and differential. Homologous regions of the two take part in synapsis.

129. (c) : *Refer to answer 61.*

130. (b) : Complementary genes are those non-allelic genes which independently show a similar effect but produce a new trait when present together in the dominant form. Supplementary genes are a pair of non-allelic genes, one of which produces its effect independently in the dominant state while the dominant allele of the second gene is without any independent effect but is able to modify the effect of the former to produce a new trait. Duplicate genes are independent genes producing the same or similar effect.

131. (b) : *Refer to answer 124.*

132. (d) : In question where the genotype of the other parent is not mentioned then that should be considered as normal.

(i) To find out the genotype of person.

His father is colour blind.

$\therefore$ genotype = X^cY ... (i)

His mother is normal XX ... (ii)

$X^cY \times XX$

Offsprings X^cX, X^cX, XY, XY

As all sons will be normal therefore the genotype of the person will be XY. ...(iii)

(ii) To find out the genotype of lady

Father's genotype - XY ... (iv)

Her mother is a daughter of colourblind father and normal mother.

$X^cY \times XX$

X^cX, X^cX, XY, XY

So the mother of lady would be carrier having genotype X^cX ... (v)

Performing cross between (iv) and (v) to find out lady's genotype.

$XY \times X^cX$

X^cX, XX, X^cY, XY

As 50% daughter are carrier and 50% daughter are normal. So the lady can be normal or carrier having genotype XX, X^cX respectively. ... (vi)

Now considering both the genotype of the lady and the genotype of the person, the result would be as follows.

$XY \times X^cX$ $\quad\quad$ $XY \times XX$

X^cX, XY, XX, X^cY $\quad\quad$ XX, XX, XY, XY

About cases show that if mother (lady) is carrier then options (a) and (c) are not true. Option (b) is true and option (d) all daughters normal (though phenotypically) is also true. If mother is normal then options (a), (b) and (c) are not true and option (d) is true so from the cases, it is concluded that option (d) is true.

133. (c)

134. (c) : E.B. Lewis in 1951 reported from a cross of apricot eyed and white eyed flies in *Drosophila*, he obtained F_1 having intermediate eye colour. In F_2, he had expected segregation only for apricot and white, but he recovered very low frequency of wild type. Since those alleles behaved as non-alleles, Lewis preferred to call them pseudoalleles and the phenomenon as pseudoallelism. In pseudoallelism, in *cis* position both the mutant alleles are on one chromosome. So the other chromosome will be normal and will be able to produce the end result. But in *trans* position the sequence of steps involved in synthesis will be interrupted due to mutations on either of the two homologous chromosomes thus leading to a mutant phenotype.

135. (a) : *Refer to answer 99.*

136. (b) : Point mutation involves only the replacement of one nucleotide with another. One type of point mutation is missense mutation. These are base changes that alter the codon for an amino acid resulting in its substitution with a different amino acid. For example,

mutation of the codon CTT to ATT would result in the replacement of the hydrophobic amino acid leucine with isoleucine, another hydrophobic amino acid. Many other missense mutations have been described which do affect the encoded protein and result in genetic diseases. These include an A to T mutation in the gene for β-globin, one of the polypeptides of haemoglobin. This mutation changes codon six of the gene from GAG which encodes glutamic acid to GTG which encodes valine. The mutation results in a condition called sickle cell anaemia.

137. (b) : *Refer to answer 124*.

138. (b) : Despite differences in morphology, the XY chromosomes are homologous and synapse during zygotene. It is because they have two parts, homologous and differential. Homologous regions of the two help in pairing. They carry same genes which may have different alleles. The differential region of Y-chromosome carries only Y-linked or holandric genes, *e.g*, testis determining factor (TDF). It is perhaps the smallest gene occupying only 14 base pairs. Other holandric genes are hypertrichosis (excessive hairiness) on pinna, porcupine skin, keratoderma dissipatum (thickened skin of hands and feet) and webbed toes. Holandric genes are directly inherited by a son from his father. Chromosomes which control most of the morpho-physiological characters other than sex, are called autosomes. Sex linked genes are those which are found on the sex chromosomes. Mutant genes are formed by a change in the nucleotide type and sequence of a DNA segment representing a gene or a cistron.

139. (c) : O blood group of a child cannot be obtained from the parents having blood group O × AB. The parents blood groups may be A × O, A × B, B × O, B × A, O × A and O × B.

140. (a) : *Refer to answer 125*.

141. (b) : *Refer to answer 115*.

142. (d) : The chance of a male child becoming colour blind are possible only when mother's father was colour blind. It is an example of criss cross inheritance. If a cross is made between two sexes differing in certain characters, in such a way that character of one sex remains hidden in the opposite sex of F_1 generation, but it is passed on to the same sex in the F_2 generation, it is said to exhibit criss cross inheritance.

143. (c) : Genotype of Mr. Kapoor will be Bbd hence one fourth of the sperms will have Bd.

144. (b) : AABB × aabb is suitable for experiment on linkage. Linkage is the tendency for certain genes tend to be inherited together, because they are on the same chromosome. Thus, parental combinations of characters are found more frequently in offspring than non-parental.

145. (c) : The gene is located on one X-chromosomes of mother. Cross between a haemophilic carrier female X^hX and normal male would yield 50% of the sons being haemophilic and 50% of the daughter are carriers.

146. (d) : Two dominant non-allelic genes are 50 map units apart. The linkage is absent/incomplete. Chromosome mapping is based on the fact that genes are linearly arranged in the chromosome and frequency of crossing over is directly proportional to the distance between two genes. Dominant genes show *cis* arrangement. At 50 map units *cis* is changed to *trans* and *vice-versa* hence no fixed linkage is present.

147. (a) : *Refer to answer 61*.

148. (b) : Law of independent assortment states that when two individuals differ from each other in two or more pairs of factors, the inheritance of one pair is quite independent of the inheritance of other. Law of independent assortment is applicable to only those factors or genes which are located on different chromosomes.

149. (b) : Sex is determined in human beings at the time of fertilisation. Sex of the baby depends upon the sperm which fertilises the ovum.

150. (d) : The genotype of the child would be I^OI^O (recessive). Hence, the genotype of the father can only be I^BI^O.

151. (a)

152. (c) : In a cross between AABB × aabb, the ratio of F_2 genotypes between AABB, AaBB, Aabb and aabb would be 1 : 2 : 2 : 1.

153. (a) : Segregation of Mendelian factors (no linkage, no crossing over) occurs during anaphase I.

At anaphase I, actual segregation occurs, but two similar alleles occurs in the dyad chromosome which separate at anaphase II.

154. (d) : An organism with two identical alleles is homozygous. Homozygous have identical genes at the same locus on each member of a pair of homologous/ chromosomes.

155. (a) : *Refer to answer 66.*

156. (d) : *Refer to answer 35.*

157. (c) : In human beings, 45 chromosomes/single X/XO abnormality causes Turner's syndrome. Individuals having a single X chromosome 2A + XO (45) have female sexual differentiation but ovaries are rudimentary. Other associated phenotypes of this condition are short stature, webbed neck, broad chest, lack of secondary sexual characteristics and sterility. Thus, any unbalance in the copies of the sex chromosomes may disrupt the genetic information necessary for normal sexual development.

158. (d) : $I^AI^O \times I^AI^B$ gives us the following genotypes I^AI^A, I^OI^B, I^AI^B. Hence, when a man of blood group A marries a women of AB blood group, B progeny would indicate that man is heterozygous A.

159. (d) : ABO blood group system is due to multiple allelism. A gene can have more than two alleles or allelomorphs, which can be expressed by mutation in wild form in more than one ways. These alleles or allelomorphs make a series of multiple alleles. The mode of inheritance in case of multiple alleles is called multiple allelism. A well known and simplest example of multiple allelism is the inheritance of ABO blood groups in human beings. In human population, 3 different alleles for this character are found - I^A I^B and I^O. A person is having only two of these three alleles and blood type can be determined.

160. (b) : The contrasting pairs of factors in Mendelian crosses are called allelomorphs. Alleles or allelomorphs are the different forms of a gene, having the same locus on homologous chromosomes and are subject to Mendelian (alternative) inheritance.

161. (b) : An Austrian Monk, Gregor Mendel, developed his theory of inheritance. He formulated the Law of Heredity. Therefore, he is called the 'father of genetics'.

162. (c) : Mendel's last law is independent assortment. The principle of independent assortment states that when two individuals differ from each other in two or more pairs of factors, the inheritance of one pair is quite independent of the inheritance of other.

163. (a) : The brown eyed man will have the genotype Bb and his wife bb. Hence, Bb × bb = Bb : bb. Therefore, the children shall be both blue eyed and brown eyed the ratio is 1 : 1.

164. (d) : The allele which is unable to express its effect in the presence of another is called recessive. A member of a pair of alleles that does not show its effect in the phenotype in the presence of any other allele. It is denoted by small letter.

165. (b) : *Refer to answer 37.*

166. (b) : A colour blind girl is rare because she will be born only when her father and maternal grand-father were colour blind. The genotype of the mother was to be either X^CX^C or X^CX and that of father X^CY so that the daughter becomes colour blind.

167. (a) : Cross between AaBB and aaBB will form 1AaBB : 1 aaBB. On crossing, AaBB × aaBB gives 50% individuals having genotype AaBB and 50% individuals having genotype aaBB.

168. (c) : In a genetic cross having recessive epistasis, F_2 phenotypic ratio would be 9 : 3 : 4. The recessive epistasis is illustrated by coat colour in mouse, the coat colour is determined by A/a pair, recessive allele b is epistatic over A/a. Thus, in the presence of bb, both A and aa give the same phenotype (albino). The F_2 ratio is generally 9 : 3 : 4.

169. (c) : *Refer to answer 159.*

170. (b) : *Refer to answer 114.*

171. (b) : In Down's syndrome of a male child, the sex complement is XY. Down syndrome is an autosomal birth defect caused by the presence of an extra chromosome number 21 (three instead of two number 21 chromosomes or trisomy 21).

172. (d) : Haemophilia is more common in males because it is a recessive trait carried by X-chromosome. Haemophilia A is the most common X-linked genetic disease that prevents normal blood clotting when blood vessels are ruptured.

173. (d) : Phenylketonuria is a hereditary disease. Phenylketonuria is an inherited error of metabolism caused by a deficiency in the enzyme phenylalanine hydroxylase. It results in mental retardation and is inherited as an autosomal recessive trait. It is a hereditary human condition resulting from the inability to convert phenylalanine into tyrosine. This change can be traced to a tiny mutation in a single gene on chromosome 12.

174. (a) : Both husband and wife have normal vision through their fathers were colour blind, the probability of their daughter becoming colour blind is 0%. The chances of daughter becoming colour blind arises only when the father is also colour blind.

175. (d) : Bateson and Punnet explained that when two dominants enter from the same parent-they try to remain together, called coupling. When two dominants enter from different parents they try to remain seperate called repulsion. Bateson and Punnett (1906) used the term coupling and repulsion in sweet pea (*Lathyrus odoratus*) for linkage and crossing over. The correct parental of coupling type along with its cross over or repulsion is coupling AABB, aabb : Repulsion AAbb; aaBB.

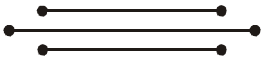
176. (c) : A normal green male maize is crossed with albino female. The progeny is albino because, plastids are inherited from female parents.

177. (c) : Two linked genes a and b show 20% recombination. The individuals of a dihybrid cross between + +/+ + × ab/ab shall show gametes + + : 40 : : ab : 40 : : + a : 10 : : + b : 10.

178. (d) : Consideration of one character at one time contribute to the success of Mendel. Mendel's contribution was unique because of his methodological approach to a definite problem, use of clear cut variables and application of mathematics (statistics) to the problem. Using pea plants and statistical methods, Mendel was able to demonstrate that traits were passed from each parent inheritance of genes.

179. (c) : A family of five daughter only is expecting sixth issue. The chance of its beings a son is 50%. Human have 22 pairs chromosomes which are XX in females and XY in males. So if we cross the parents there is 1 : 1 chance for boy and girl.

180. (c) : Haploids are able to express both recessive and dominant alleles/ mutations because there are only one allele for each gene in the individual. Diploid is an organism containing two different alleles or individual containing both dominant and recessive genes of an allelic pairs.



Chapter
28

Molecular Basis of Inheritance

1. The final proof for DNA as the genetic material came from the experiments of
(a) Hershey and Chase
(b) Avery, MacLeod and McCarty
(c) Hargobind Khorana
(d) Griffith. *(NEET 2017)*

2. If there are 999 bases in an RNA that code for a protein with 333 amino acids, and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered?
(a) 11 (b) 33
(c) 333 (d) 1
(NEET 2017)

3. During DNA replication, Okazaki fragments are used to elongate
(a) the lagging strand towards replication fork
(b) the leading strand away from replication fork
(c) the lagging strand away from the replication fork
(d) the leading strand towards replication fork.
(NEET 2017)

4. Which of the following RNAs should be most abundant in animal cell?
(a) *t*RNA (b) *m*RNA
(c) miRNA (d) *r*RNA
(NEET 2017)

5. Spliceosomes are not found in cells of
(a) fungi (b) animals
(c) bacteria (d) plants.
(NEET 2017)

6. The association of histone H_1 with a nucleosome indicates that
(a) DNA replication is occurring
(b) the DNA is condensed into a chromatin fibre
(c) the DNA double helix is exposed
(d) transcription is occurring. *(NEET 2017)*

7. Taylor conducted the experiments to prove semi-conservative mode of chromosome replication on
(a) *Vinca rosea*
(b) *Vicia faba*
(c) *Drosophila melanogaster*
(d) *E. coli.* *(NEET-II 2016)*

8. The equivalent of a structural gene is
(a) muton (b) cistron
(c) operon (d) recon.
(NEET-II 2016)

9. Which of the following *r*RNAs acts as structural RNA as well as ribozyme in bacteria?
(a) 5S *r*RNA (b) 18S *r*RNA
(c) 23S *r*RNA (d) 5.8S *r*RNA
(NEET-II 2016)

10. A molecule that can act as a genetic material must fulfill the traits given below, except
(a) it should be able to express itself in the form of 'Mendelian characters'
(b) it should be able to generate its replica
(c) it should be unstable structurally and chemically
(d) it should provide the scope for slow changes that are required for evolution.
(NEET-II 2016)

11. DNA-dependent RNA polymerase catalyses transcription on one strand of the DNA which is called the
(a) template strand (b) coding strand
(c) alpha strand (d) antistrand.
(NEET-II 2016)

12. Which one of the following is the starter codon?
(a) UAA (b) UAG
(c) AUG (d) UGA
(NEET-I 2016)

13. Which of the following is required as inducer (s) for the expression of *Lac* operon?
(a) Lactose
(b) Lactose and Galactose
(c) Glucose
(d) Galactose
(NEET-I 2016)

14. A complex of ribosomes attached to a single strand of RNA is known as
(a) polypeptide (b) Okazaki fragment
(c) polysome (d) polymer.
(NEET-I 2016)

15. Which one of the following is not applicable to RNA?
(a) Heterocyclic nitrogenous bases
(b) Chargaff's rule
(c) Complementary base pairing
(d) 5' phosphoryl and 3' hydroxyl ends
(2015)

16. Balbiani rings are sites of
(a) polysaccharide synthesis
(b) RNA and protein synthesis
(c) lipid synthesis
(d) nucleotide synthesis. *(2015)*

17. Identify the correct order of organisation of genetic material from largest to smallest.
(a) Genome, chromosome, gene, nucleotide
(b) Chromosome, genome, nucleotide, gene
(c) Chromosome, gene, genome, nucleotide
(d) Genome, chromosome, nucleotide, gene
(2015)

18. Satellite DNA is important because it
(a) does not code for proteins and is same in all members of the population
(b) codes for enzymes needed for DNA replication
(c) codes for proteins needed in cell cycle
(d) shows high degree of polymorphism in population and also the same degree of polymorphism in an individual, which is heritable from parents to children.
(2015)

19. Gene regulation governing lactose operon of *E.coli* that involves the *lac* I gene product is
(a) negative and repressible because repressor protein prevents transcription
(b) feedback inhibition because excess of β-galactosidase can switch off transcription
(c) positive and inducible because it can be induced by lactose
(d) negative and inducible because repressor protein prevents transcription.
(2015 Cancelled)

20. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are
(a) G 17%, A 33%, T 33%
(b) G 8.5%, A 50%, T 24.5%
(c) G 34%, A 24.5%, T 24.5%
(d) G 17%, A 16.5%, T 32.5%.
(2015 Cancelled)

21. Which one of the following is wrongly matched?
(a) Transcription - Writing information from DNA to *t*RNA.
(b) Translation - Using information in *m*RNA to make protein.
(c) Repressor protein - Binds to operator to stop enzyme synthesis.
(d) Operon - Structural genes, operator and promoter.
(2014)

22. Transformation was discovered by
(a) Meselson and Stahl
(b) Hershey and Chase
(c) Griffith
(d) Watson and Crick. *(2014)*

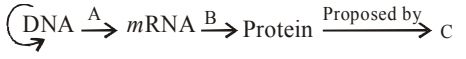
23. Select the correct option.

	Direction of RNA synthesis	Direction of reading of the template DNA strand
(a)	5′ – 3′	3′ – 5′
(b)	3′ – 5′	5′ – 3′
(c)	5′ – 3′	5′ – 3′
(d)	3′ – 5′	3′ – 5′

(2014)

24. Which of the following statements is not true of two genes that show 50% recombination frequency?
(a) The gene show independent assortment.
(b) If the genes are present on the same chromosome, they undergo more than one crossovers in every meiosis.
(c) The genes may be on different chromosomes.
(d) The genes are tightly linked.
(NEET 2013)

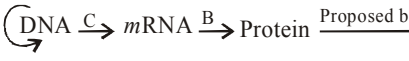
25. The diagram shows an important concept in the genetic implication of DNA. Fill in the blanks A to C.



(a) A - Transcription, B -Translation, C - Francis Crick
(b) A - Translation, B - Extension, C - Rosalind Franklin

(c) A - Transcription, B - Replication, C - James Watson
(d) A - Translation, B - Transcription, C - Ervin Chargaff *(NEET 2013)*

26. Which enzyme will be produced in a cell if there is a nonsense mutation in the *lac* Y gene?
(a) Transacetylase
(b) Lactose permease and transacetylase
(c) β-galactosidase
(d) Lactose permease *(NEET 2013)*

27. 

The figure gives an important concept in the genetic implication of DNA. Fill the blanks A, B and C.
(a) A-Maurice Wilkins, B-Transcription, C-Translation
(b) A-James Watson, B-Replication, C-Extension
(c) A-Erwin Chargaff, B-Translation, C-Replication
(d) A-Francis Crick, B-Translation, C-Transcription
(Karnataka NEET 2013)

28. Satellite RNAs are present in some
(a) viroids (b) prions
(c) bacteriophages (d) plant viruses.
(Karnataka NEET 2013)

29. Which of the following is not a property of the genetic code?
(a) Non-overlapping (b) Ambiguous
(c) Degeneracy (d) Universal
(Karnataka NEET 2013)

30. Genes of interest can be selected from a genomic library by using
(a) cloning vectors
(b) DNA probes
(c) gene targets
(d) restriction enzymes.
(Karnataka NEET 2013)

31. In an inducible operon, the genes are
(a) usually not expressed unless a signal turns them"on".
(b) usually expressed unless a signal turns them "off".
(c) never expressed
(d) always expresser.
(Karnataka NEET 2013)

32. One of the most frequently used techniques in DNA fingerprinting is
(a) VNTR (b) SSCP
(c) SCAR (d) AFLP.
(Karnataka NEET 2013)

33. Removal of introns and joining of exons in a defined order during transcription is called
(a) looping (b) inducing
(c) slicing (d) splicing. *(2012)*

34. If one strand of DNA has the nitrogenous base sequence as ATCTG, what would be the complementary RNA strand sequence?
(a) TTAGU (b) UAGAC
(c) AACTG (d) ATCGU *(2012)*

35. Ribosomal RNA is actively synthesized in
(a) lysosomes (b) nucleolus
(c) nucleoplasm (d) ribosomes.
(2012)

36. Which one of the following is not a part of a transcription unit in DNA?
(a) The inducer (b) A terminator
(c) A promoter (d) The structural gene
(2012)

37. Removal of RNA polymerase III from nucleoplasm will affect the synthesis of
(a) *t*RNA (b) hnRNA
(c) *m*RNA (d) *r*RNA. *(2012)*

38. What are the structures called that give an appearance as 'beads-on-string' in the chromosomes when viewed under electron microscope?
(a) Genes (b) Nucleotides
(c) Nucleosomes (d) Base pairs *(2011)*

39. The unequivocal proof of DNA as the genetic material came from the studies on a
(a) bacterium (b) fungus
(c) viroid (d) bacterial virus.
(Main 2011)

40. Which one of the following does not follow the central dogma of molecular biology?
(a) Pea (b) *Mucor*
(c) *Chlamydomonas* (d) HIV *(2010)*

41. Which one of the following palindromic base sequences in DNA can be easily cut at about the middle by some particular restriction enzyme?
(a) 5′ ——— CGTTCG ——— 3′
3′ ——— ATGGTA ——— 5′
(b) 5′ ——— GATATG ——— 3′
3′ ——— CTACTA ——— 5′

(c) 5′ ——— GAATTC ——— 3′
3′ ——— CTTAAG ——— 5′

(d) 5′ ——— CACGTA ——— 3′
3′ ——— CTCAGT ——— 5′ *(2010)*

42. The one aspect which is not a silent feature of genetic code, is its being
(a) degenerate (b) ambiguous
(c) universal (d) specific. *(2010)*

43. Select the two correct statements out of the four (i –iv) statements given below about lac operon.
(i) Glucose or galactose may bind with the repressor and inactivate it.
(ii) In the absence of lactose the repressor binds with the operator region.
(iii) The *z*-gene codes for permease.
(iv) This was elucidated by Francois Jacob and Jacques Monod.
The correct statements are
(a) (ii) and (iii) (b) (i) and (iii)
(c) (ii) and (iv) (d) (i) and (ii). *(2010)*

44. The 3′ - 5′ phosphodiester linkages inside a polynucleotide chain serve to join
(a) one DNA strand with the other DNA strand
(b) one nucleoside with another nucleoside
(c) one nucleotide with another nucleotide
(d) one nitrogenous base with pentose sugar. *(Main 2010)*

45. The *lac* operon consists of
(a) four regulatory genes only
(b) one regulatory gene and three structural genes
(c) two regulatory genes and two structural genes
(d) three regulatory genes and three structural genes. *(Main 2010)*

46. In eukaryotic cell transcription, RNA splicing and RNA capping take place inside the
(a) ribosomes (b) nucleus
(c) dictyosomes (d) ER. *(Main 2010)*

47. Which one of the following statements about the particular entity is true ?
(a) Centromere is found in animal cells, which produces aster during cell division.
(b) The gene for producing insulin is present in every body cell.
(c) Nucleosome is formed of nucleotides.
(d) DNA consists of core of eight histones. *(Main 2010)*

48. Whose experiments cracked the DNA and discovered unequivocally that a genetic code is a "triplet"?
(a) Hershey and Chase
(b) Morgan and Sturtevant
(c) Beadle and Tatum
(d) Nirenberg and Mathaei *(2009)*

49. Semi-conservative replication of DNA was first demonstrated in
(a) *Escherichia coli*
(b) *Streptococcus pneumoniae*
(c) *Salmonella typhimurium*
(d) *Drosophila melanogaster.* *(2009)*

50. Removal of introns and joining the exons in a defined order in a transcription unit is called
(a) tailing (b) transformation
(c) capping (d) splicing. *(2009)*

51. What is not true for genetic code?
(a) It is nearly universal.
(b) It is degenerate.
(c) It is unambiguous.
(d) A codon in *m*RNA is read in a non-contiguous fashion. *(2009)*

52. In the DNA molecule,
(a) the proportion of adenine in relation to thymine varies with the organism
(b) there are two strands which run antiparallel-one in 5′ → 3′ direction and other in 3′ → 5′
(c) the total amount of purine nucleotides and pyrimidine nucleotides is not always equal
(d) there are two strands which run parallel in the 5′ → 3′ direction. *(2008)*

53. Which one of the following pairs of nitrogenous bases of nucleic acids, is wrongly matched with the category mentioned against it?
(a) Guanine, Adenine - Purines
(b) Adenine, Thymine - Purines
(c) Thymine, Uracil - Pyrimdines
(d) Uracil, Cytosine - Pyrimidines *(2008)*

54. Polysome is formed by
(a) a ribosome with several subunits
(b) ribosomes attached to each other in a linear arrangement
(c) several ribosomes attached to a single *m*RNA
(d) many ribosomes attached to a strand of endoplasmic reticulum. *(2008)*

55. Which one of the following pairs of codons is correctly matched with their function or the signal for the particular amino acid?
(a) AUG, ACG - Start/methionine
(b) UUA, UCA - Leucine
(c) GUU, GCU - Alanine
(d) UAG, UGA - Stop *(2008)*

56. One turn of the helix in a B-form DNA is approximately
(a) 2 nm (b) 20 nm
(c) 0.34 nm (d) 3.4 nm. *(2006)*

57. One gene-one enzyme hypothesis was postulated by
(a) Beadle and Tatum
(b) R. Franklin
(c) Hershey and Chase
(d) A. Garrod. *(2006)*

58. Antiparallel strands of a DNA molecule means that
(a) one strand turns clockwise
(b) one strand turns anti-clockwise
(c) the phosphate groups of two DNA strands, at their ends, share the same position
(d) the phosphate groups at the start of two DNA strands are in opposite position (pole). *(2006)*

59. Which antibiotic inhibits interaction between *t*RNA and *m*RNA during bacterial protein synthesis?
(a) Tetracycline (b) Erythromycin
(c) Neomycin (d) Streptomycin *(2006)*

60. Amino acid sequence, in protein synthesis is decided by the sequence of
(a) *r*RNA (b) *t*RNA
(c) *m*RNA (d) *c*DNA. *(2006)*

61. *E.coli* cells with a mustard *z* gene of the *lac* operon cannot grow in medium containing only lactose as the source of energy because
(a) the *lac* operon is constitutively active in these cells
(b) they cannot synthesize functional beta galactosidase
(c) in the presence of glucose, *E.coli* cells do not utilize lactose
(d) they cannot transport lactose from the medium into the cell. *(2005)*

62. Telomerase is an enzyme which is a
(a) simple protein (b) RNA
(c) ribonucleoprotein (d) repetitive DNA. *(2005)*

63. Using imprints from a plate with complete medium and carrying bacterial colonies, you can select streptomycin resistant mutants and prove that such mutations do not originate as adaptation. These imprints need to be used
(a) on plates with and without streptomycin
(b) on plates with minimal medium
(c) only on plates with streptomycin
(d) only on plates without streptomycin. *(2005)*

64. Protein synthesis in an animal cell occurs
(a) only on the ribosomes present in cytosol
(b) only on ribosome attached to the nuclear envelope and endoplasmic reticulum
(c) on ribosome present in the nucleolus as well as in cytoplasm
(d) on ribosomes present in cytoplasm as well as in mitochondria. *(2005)*

65. Which one of the following makes use of RNA template to synthesize DNA?
(a) DNA polymerase
(b) RNA polymerase
(c) Reverse transcriptase
(d) DNA dependant RNA polymerase *(2005)*

66. Which one of the following hydrolyses internal phosphodiester bonds in a polynucleotide chain?
(a) Lipase (b) Protease
(c) Endonuclease (d) Exonuclease *(2005)*

67. During transcription holoenzyme RNA polymerase binds to a DNA sequence and the DNA assumes a saddle like structure at that point. What is that sequence called?
(a) AAAT box (b) TATA box
(c) GGTT box (d) CAAT box *(2005)*

68. After a mutation at a genetic locus the character of an organism changes due to change in
(a) protein structure
(b) DNA replication
(c) protein synthesis pattern
(d) RNA transcription pattern. *(2004)*

69. Which form of RNA has a structure resembling clover leaf?
(a) *r*RNA (b) hnRNA
(c) *m*RNA (d) *t*RNA *(2004)*

70. During transcription, if the nucleotide sequence of the DNA strand that is being coded is ATACG then the nucleotide sequence in the *m*RNA would be
(a) TATGC (b) TCTGG
(c) UAUGC (d) UATGC. *(2004)*

71. In mutational event, when adenine is replaced by guanine, it is a case of
(a) frame shift mutation
(b) transcription
(c) transition
(d) transversion. *(2004)*

72. The following ratio is generally constant for a given species:
(a) A + G / C + T (b) T + C / G + A
(c) G + C / A + T (d) A + C / T + G.
(2004)

73. What would happen if in a gene encoding a polypeptide of 50 amino acids, 25th codon (UAU) is mutated to UAA ?
(a) A polypeptide of 24 amino acids will be formed.
(b) Two polypeptides of 24 and 25 amino acids will be formed.
(c) A polypeptide of 49 amino acids will be formed.
(d) A polypeptide of 25 amino acids will be formed. *(2003)*

74. What does "*lac*" refer to in what we call the lac operon ?
(a) Lactose
(b) Lactase
(c) Lac insect
(d) The number 1,00,000 *(2003)*

75. During translation initiation in prokaryotes, a GTP molecule is needed in
(a) formation of formyl-met-*t*RNA
(b) binding of 30S subunit of ribosome with *m*RNA
(c) association of 30S *m*RNA with formyl-met-*t*RNA
(d) association of 50S subunit of ribosome with initiation complex.
(2003)

76. Which one of the following triplet codes, is correctly matched with its specificity for an amino acid in protein synthesis or as 'start' or 'stop' codon ?
(a) UCG – start (b) UUU – stop
(c) UGU – leucine (d) UAC – tyrosine
(2003)

77. During transcription, the DNA site at which RNA polymerase binds is called
(a) promoter (b) regulator
(c) receptor (d) enhancer.
(2003)

78. Degeneration of a genetic code is attributed to the
(a) first member of a codon
(b) second member of codon
(c) entire codon
(d) third member of a codon. *(2003)*

79. In the genetic code dictionary, how many codons are used to code for all the 20 essential amino acids ?
(a) 20 (b) 64
(c) 61 (d) 60 *(2003)*

80. In a DNA percentage of thymine is 20% then what will be percentage of guanine?
(a) 20% (b) 40%
(c) 30% (d) 60% *(2002)*

81. Transformation experiment was first performed on which bacteria?
(a) *E. coli*
(b) *Diplococcus pneumoniae*
(c) *Salmonella*
(d) *Pasteurella pestis* *(2002)*

82. Jacob and Monod studied lactose metabolism in *E. coli* and proposed operon concept. Operon concept is applicable for:
(a) all prokaryotes
(b) all prokaryotes and some eukaryotes
(c) all prokaryotes and all eukaryotes
(d) all prokaryotes and some protozoans.
(2002)

83. In *E. coli*, during lactose metabolism repressor binds to:
(a) regulator gene (b) operator gene
(c) structural gene (d) promoter gene.
(2002)

84. Out of 64 codons, 61 codons code for 20 types of amino acid. It is called
(a) degeneracy of genetic code
(b) overlapping of gene
(c) wobbling of codon
(d) universility of codons. *(2002)*

85. Which of the following reunites the exon segments after RNA splicing?
(a) RNA polymerase (b) RNA primase
(c) RNA ligase (d) RNA proteoses
(2002)

86. Which of the following enzymes are used to join bits of DNA?
(a) Ligase (b) Primase
(c) DNA polymerase (d) Endonuclease
(2002)

87. Exon part of *m*RNAs have code for
(a) protein (b) lipid
(c) carbohydrate (d) phospholipid.
(2002)

88. Change in sequence of nucleotide in DNA is called as
(a) mutagen (b) mutation
(c) recombination (d) translation.
(2002)

89. *m*RNA is synthesised on DNA template in which direction
(a) $5' \rightarrow 3'$ (b) $3' \rightarrow 5'$
(c) both (a) and (b) (d) any. *(2001)*

90. In negative operon,
(a) co-repressor binds with repressor
(b) co-repressor does not bind with repressor
(c) co-repressor binds with inducer
(d) camp have negative effect on *lac* operon.
(2001)

91. Gene and cistron words are sometimes used synonymously because
(a) one cistron contains many genes
(b) one gene contains many cistrons
(c) one gene contains one cistron
(d) one gene contains no cistron. *(2001)*

92. Types of RNA polymerase required in nucleus of eukaryotes for RNA synthesis
(a) 1 (b) 2
(c) 3 (d) 4. *(2001)*

93. Method of DNA replication in which two strands of DNA separate and synthesize new strands
(a) dispersive (b) conservative
(c) semi-conservative (d) non conservative.
(2000)

94. Which of the following is initiation codon?
(a) UAG (b) AUC
(c) AUG (d) CCU *(2000)*

95. Anticodon occurs in
(a) *t*RNA (b) *m*RNA
(c) *r*RNA (d) DNA. *(2000)*

96. Length of one loop of B-DNA
(a) 3.4 nm (b) 0.34 nm
(c) 20 nm (d) 10 nm. *(2000)*

97. In three dimensional view the molecule of *t*RNA is
(a) L-shaped (b) S-shaped
(c) Y-shaped (d) E-shaped. *(2000)*

98. Similarity in DNA and RNA is that
(a) both are polymer of nucleotides
(b) both have similar pyrimidine
(c) both have similar sugar
(d) both are genetic material. *(2000)*

99. The *Pneumococcus* experiment proves that
(a) bacteria do not reproduce sexually
(b) RNA sometime controls the production of DNA and proteins
(c) DNA is the genetic material
(d) bacteria undergo binary fission. *(1999)*

100. In operon concept, regulator gene functions as
(a) inhibitor (b) repressor
(c) regulator (d) all of these.
(1999)

101. Initiation codon in eukaryotes is
(a) GAU (b) AGU
(c) AUG (d) UAG. *(1999, 1994)*

102. DNA is mainly found in
(a) nucleolus (b) nucleus only
(c) cytoplasm only (d) none of these.
(1999)

103. In prokaryotes, the genetic material is
(a) linear DNA without histones
(b) circular DNA without histones
(c) linear DNA with histones
(d) circular DNA with histones. *(1999)*

104. In DNA, when AGCT occurs, their association is as per which of the following pair?
(a) AT-GC (b) AG-CT
(c) AC-GT (d) All of these
(1999)

105. The eukaryotic genome differs from the prokaryotic genome because
(a) the DNA is complexed with histone in prokaryotes
(b) the DNA is circular and single stranded in prokaryotes
(c) repetitive sequences are present in eukaryotes
(d) genes in the former case are organized into operons. *(1999)*

106. What base is responsible for hot spots for spontaneous point mutations?
(a) 5-bromouracil (b) 5-methylcytosine
(c) Guanine (d) Adenine *(1998)*

107. Genes that are involved in turning on or off the transcription of a set of structural genes are called
(a) redundant genes
(b) regulatory genes
(c) polymorphic genes
(d) operator genes. *(1998)*

108. DNA elements, which can switch their position, are called
(a) cistrons (b) transposons
(c) exons (d) introns. *(1998)*

109. The codons causing chain termination are
(a) AGT, TAG, UGA
(b) UAG, UGA, UAA
(c) TAG, TAA, TGA
(d) GAT, AAT, AGT. *(1997)*

110. DNA synthesis can be specifically measured by estimating the incorporation of radio-labelled
(a) thymidine (b) deoxyribose sugar
(c) uracil (d) adenine. *(1997)*

111. The RNA that pick up specific amino acid from amino acid pool in the cytoplasm to ribosome during protein synthesis is called
(a) *r*RNA (b) RNA
(c) *m*RNA (d) *t*RNA. *(1997)*

112. Which of the following step of translation does not consume a high energy phosphate bond?
(a) Peptidyl transferase reaction
(b) Aminoacyl *t*RNA binding to A-site
(c) Translocation
(d) Amino acid activation *(1997)*

113. Which of the following serves as a terminal codon?
(a) UAG (b) AGA
(c) AUG (d) GCG *(1996)*

114. The maximum formation of *m*RNA occurs in
(a) ribosome (b) nucleoplasm
(c) cytoplasm (d) nucleolus. *(1996)*

115. Radio-tracer technique shows that DNA is in
(a) multi-helix stage (b) single-helix stage
(c) double-helix stage (d) none of these. *(1996)*

116. The wild type *E.coli* cells are growing in normal medium with glucose. They are transferred to a medium containing only lactose as sugar. Which of the following changes take place?
(a) The *lac* operon is induced.
(b) *E.coli* cells stop dividing.
(c) The *lac* operon is repressed.
(d) All operons are induced. *(1995)*

117. The *lac* operon is an example of
(a) repressible operon
(b) overlapping genes
(c) arabinose operon
(d) inducible operon. *(1995)*

118. An environmental agent, which triggers transcription from an operon, is a
(a) depressor
(b) controlling element
(c) regulator
(d) inducer. *(1995)*

119. If the sequence of bases in DNA is ATTCGATG, then the sequence of bases in its transcript will be
(a) GUAGCUUA (b) AUUCGAUG
(c) CAUCGAAU (d) UAAGCUAC. *(1995)*

120. If the DNA codons are ATG ATG ATG and a cytosine base is inserted at the beginning, then which of the following will result?
(a) CAT GAT GATG
(b) A non-sense mutation
(c) C ATG ATG ATG
(d) CA TGA TGA TG *(1995)*

121. In split genes, the coding sequences are called
(a) exons (b) cistrons
(c) introns (d) operons. *(1995)*

122. Anticodon is an unpaired triplet of bases in an exposed position of
(a) *t*RNA (b) *m*RNA
(c) *r*RNA (d) both (b) and (c). *(1995)*

123. '*Lac* operon' in *E. coli*, is induced by
(a) 'I' gene (b) promoter gene
(c) β-galactosidase (d) lactose. *(1994)*

124. Initiation codon in eukaryotes is
(a) GAU (b) AGU
(c) AUG (d) UAG. *(1994)*

125. There are special proteins that help to open up DNA double helix in front of the replication fork. These proteins are
(a) DNA ligase
(b) DNA topoisomerase I
(c) DNA gyrase
(d) DNA polymerase I. *(1994)*

126. In protein synthesis, the polymerization of amino acids involves three steps. Which one of the following is not involved in the polymerisation of protein ?
(a) Termination (b) Initiation
(c) Elongation (d) Transcription
(1994)

127. Nucleosome core is made of
(a) H_1, H_2A, H_2B and H_3
(b) H_1, H_2A, H_2B, H_4
(c) H_1, H_2A, H_2B, H_3 and H_4
(d) H_2A, H_2B, H_3 and H_4. *(1993)*

128. Initiation codon of protein synthesis (in eukaryotes) is
(a) GUA (b) GCA
(c) CCA (d) AUG. *(1993)*

129. The transforming principle of *Pneumococcus* as found out by Avery, MacLeod and McCarty was
(a) *m*RNA (b) DNA
(c) protein (d) polysaccharide.
(1993)

130. Who proved that DNA is basic genetic material?
(a) Griffith (b) Watson
(c) Boveri and Sutton
(d) Hershey and Chase *(1993)*

131. Because most of the amino acids are represented by more than one codon, the genetic code is
(a) overlapping (b) wobbling
(c) degenerate (d) generate. *(1993)*

132. During DNA replication, the strands separate by
(a) DNA polymerase
(b) topoisomerase
(c) unwindase/helicase
(d) gyrase. *(1993)*

133. The process of translation is
(a) ribosome synthesis
(b) protein synthesis
(c) DNA synthesis
(d) RNA synthesis. *(1993)*

134. A DNA with unequal nitrogen bases would most probably be
(a) single stranded (b) double stranded
(c) triple stranded (d) four stranded.
(1993)

135. Nucleotide arrangement in DNA can be seen by
(a) X-ray crystallography
(b) electron microscope
(c) ultracentrifuge
(d) light microscope. *(1993)*

136. Experimental material in the study of DNA replication has been
(a) *Escherichia coli*
(b) *Neurospora crassa*
(c) *Pneumococcus*
(d) *Drosophila melanogaster*. *(1992)*

137. Khorana first deciphered the triplet codons of
(a) serine and isoleucine
(b) cysteine and valine
(c) tyrosine and tryptophan
(d) phenylalanine and methinonine. *(1992)*

138. *Escherichia coli* fully labelled with ^{15}N is allowed to grow in ^{14}N medium. The two strands of DNA molecule of the first generation bacteria have
(a) different density and do not resemble parent DNA
(b) different density but resemble parent DNA
(c) same density and resemble parent DNA
(d) same density but do not resemble parent DNA. *(1992)*

139. The process of transfer of genetic information from DNA to RNA/formation of RNA from DNA
(a) transversion (b) transcription
(c) translation (d) translocation.
(1991)

140. An octamer of 4 histones complexed with DNA forms
(a) endosome
(b) nucleosome
(c) mesosome
(d) centromere. *(1990)*

141. In the genetic dictionary, there are 64 codons as
(a) 64 amino acids are to be coded
(b) 64 types of *t*RNAs are present
(c) there are 44 nonsense codons and 20 sense codons
(d) genetic code is triplet. *(1990)*

142. DNA replication is
(a) conservative and discontinuous
(b) semi-conservative and semi-discontinuous
(c) semi-conservative and discontinuous
(d) conservative. *(1989)*

143. Genetic code consists of
(a) adenine and guanine
(b) cytosine and uracil
(c) cytosine and guanine
(d) all the above. *(1988)*

Answer Key

1.	(a)	**2.**	(b)	**3.**	(c)	**4.**	(d)	**5.**	(c)	**6.**	(b)	**7.**	(b)	**8.**	(b)	**9.**	(c)	**10.**	(c)
11.	(a)	**12.**	(c)	**13.**	(a)	**14.**	(c)	**15.**	(b)	**16.**	(b)	**17.**	(a)	**18.**	(d)	**19.**	(d)	**20.**	(a)
21.	(a,d)	**22.**	(c)	**23.**	(a)	**24.**	(d)	**25.**	(a)	**26.**	(c)	**27.**	(d)	**28.**	(d)	**29.**	(b)	**30.**	(b)
31.	(a)	**32.**	(a)	**33.**	(d)	**34.**	(b)	**35.**	(b)	**36.**	(a)	**37.**	(a)	**38.**	(c)	**39.**	(d)	**40.**	(d)
41.	(c)	**42.**	(b)	**43.**	(c)	**44.**	(c)	**45.**	(b)	**46.**	(b)	**47.**	(b)	**48.**	(d)	**49.**	(a)	**50.**	(d)
51.	(d)	**52.**	(b)	**53.**	(b)	**54.**	(c)	**55.**	(d)	**56.**	(d)	**57.**	(a)	**58.**	(d)	**59.**	(c)	**60.**	(c)
61.	(b)	**62.**	(c)	**63.**	(c)	**64.**	(d)	**65.**	(c)	**66.**	(c)	**67.**	(b)	**68.**	(a)	**69.**	(d)	**70.**	(c)
71.	(c)	**72.**	(c)	**73.**	(a)	**74.**	(a)	**75.**	(c)	**76.**	(d)	**77.**	(a)	**78.**	(d)	**79.**	(b)	**80.**	(c)
81.	(b)	**82.**	(c)	**83.**	(b)	**84.**	(a)	**85.**	(c)	**86.**	(a)	**87.**	(a)	**88.**	(b)	**89.**	(a)	**90.**	(a)
91.	(c)	**92.**	(c)	**93.**	(c)	**94.**	(c)	**95.**	(a)	**96.**	(a)	**97.**	(a)	**98.**	(a)	**99.**	(c)	**100.**	(b)
101.	(c)	**102.**	(b)	**103.**	(b)	**104.**	(a)	**105.**	(b)	**106.**	(c)	**107.**	(d)	**108.**	(b)	**109.**	(b)	**110.**	(a)
111.	(d)	**112.**	(a)	**113.**	(a)	**114.**	(d)	**115.**	(c)	**116.**	(a)	**117.**	(d)	**118.**	(d)	**119.**	(d)	**120.**	(a)
121.	(a)	**122.**	(a)	**123.**	(c)	**124.**	(c)	**125.**	(b)	**126.**	(d)	**127.**	(d)	**128.**	(d)	**129.**	(b)	**130.**	(d)
131.	(c)	**132.**	(c)	**133.**	(b)	**134.**	(a)	**135.**	(a)	**136.**	(a)	**137.**	(b)	**138.**	(a)	**139.**	(b)	**140.**	(b)
141.	(d)	**142.**	(b)	**143.**	(d)														

EXPLANATIONS

1. (a)

2. (b) : 1 codon consists of 3 bases. Therefore, a deletion on 901 position will affect 33 codons.

3. (c) : Lagging strand is a replicated strand of DNA which is formed in short segments called Okazaki fragments. Its growth is discontinuous. The direction of growth of the lagging strand is 3' → 5' though in each Okazaki fragment it is 5' → 3'.

4. (d) : *r*RNA (ribosomal RNA) is the most abundant of all types of RNA (70-88%). Hence, it will be present in highest amount. Percentage of *t*RNA and *m*RNA is 15% and 2-5% respectively. miRNA (micro RNA) are 21-22 bp long RNA that bring degeneration of *m*RNA.

5. (c) : Spliceosomes helps in removal of introns. They will not occur in prokaryotes because prokaryotes do not have introns and thus, processing does not require splicing of *m*RNA.

6. (b) : Histones help in packaging of DNA. In eukaryotes, DNA packaging is carried out with the help of positively charged basic proteins called histones. Histones are of five types – H_1, H_2A, H_2B, H_3 and H_4. H_1 is attached over the linker DNA. Histone contains a large proportion of the positively charged (basic) amino acids, lysine and arginine in their structure. DNA is negatively charged due to the phosphate groups on its backbone. The result of these opposite charges is strong attraction and therefore, high binding affinity between histones and DNA.

7. (b) : Taylor *et al* (1957) conducted experiment on *Vicia faba* (broad bean) to prove semi-conservative replication of DNA. He fed dividing cells of root tips of *Vicia faba* with radioactive ^3H containing thymine instead of normal thymine and found that all the chromosomes became radioactive. Labelled thymine was then replaced with normal one. Next generation came to have radioactivity in one of the two chromatids of each chromosome while in subsequent generation radioactivity was present in 50% of the chromosomes. This is possible only if out of the two strands of a chromosome, one is formed a fresh while the other is conserved at each replication.

8. (b) : Cistron (or gene) is a length of DNA that contains the information for coding a specific polypeptide chain or a functional RNA molecule (*i.e.*, transfer RNA or ribosomal RNA). Hence, cistron is a unit of function. Currently such a gene is called structural gene.

9. (c) : 23S *r*RNA acts as structural RNA as well as ribozyme in bacteria.

10. (c) : Genetic material should be structurally and chemically stable otherwise its expression will change and leading to loss of several metabolic functions, etc.

11. (a) : The strand of DNA on which RNA polymerase binds to catalyse transcription is called template strand. It is also known as master or antisense strand. It has the polarity of 3′ → 5′.

12. (c) : Polypeptide synthesis is signalled by two initiator codons or start codons *i.e.*, AUG (methionine codon) and rarely by GUG (valine codon).

13. (a) : In *Lac* operon, lactose is an inducer. It binds with suppressor and inactivates it. It allows RNA polymers access to the promoter and transcription proceeds.

14. (c)

15. (b) : Chargaff's rules are applicable only for double stranded DNA molecule. These are not applicable for single stranded DNA or RNA molecules. Chargaff's rules state that DNA helices contain equal molar ratios of A and T, G and C. This is because in a ds DNA molecule, complementary base pairing occurs between A and T, and C and G base pairs. This complementary base pairing is not possible in case of single stranded RNA molecule. Thus, Chargaff's rules are not applicable to RNA.

16. (b) : In certain development stages the polytene chromosomes bear conspicuous swellings called chromosome puffs. The larger swellings are called Balbiani rings. In the region of a puff or Balbiani ring, the DNA strands uncoil, become active and produce number of copies of *m*RNA. The *m*RNAs may remain temporarily stored in the puff and they may undergo transcription to form proteins. Thus, Balbiani rings are the sites of RNA and protein synthesis.

17. (a) : In genome all the genes are contained in a single set of chromosomes. The instructions in our genome are present in the form of DNA. DNA has a complicated structure in the form of a double helix. Single strands of DNA are coiled up into structures called chromosomes. Within the chromosomes, segments of DNA are "read" together to form genes. Thus, a gene is a segment of DNA or chromosome situated at a specific locus (gene locus) which carries coded information associated with a specific function

and can undergo crossing over as well as mutation. A nucleotide is the basic unit of DNA made up of a pentose sugar, phosphoric acid and a nitrogenous base.

18. (d) : Satellite DNA is that part of repetitive DNA which has long repetitive nucleotide sequences in tandem that forms a separate fraction on density ultracentrifugation. DNA fingerprinting involves identifying differences in some specific regions in DNA sequence called as repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times. These repetitive DNA sequences are separated from bulk genomic DNA as different peaks during density gradient centrifugation. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA. Depending on base composition (A:T rich or G:C rich), length of segment, and number of repetitive units, the satellite DNA is classified into many categories, such as micro-satellites, mini-satellites etc. These sequences normally do not code for any proteins, but they form a large portion of human genome. These sequences show high degree of polymorphism and form the basis of DNA fingerprinting. Since DNA from every tissue (such as blood, hair-follicle, skin, bone, saliva, sperm etc.) from an individual show the same degree of polymorphism, they become very useful identification tool in forensic applications.

19. (d) : The control of expression of *lac* operon is negative (as it is turned off normally) and inducible. Inducible operon is an operon which remains switched off normally but becomes operational in the presence of an inducer (lactose, actually allolactose a metabolite of lactose, in case of *lac* operon). The inducible operon generally functions in catabolic pathways. In the presence of an inducer, the repressor has a higher affinity for the inducer than for the operator gene. When lactose is added, a few lactose molecules are carried into the cell by the enzyme lactose permease as small amount of this enzyme is present in the cell even when the operon is not working. These few lactose molecules are converted into allolactose molecules which act as an inducer and bind to the repressor (a product of regulator gene). The repressor-inducer complex fails to join with the operator gene, thus it is turned on.

20. (a) : According to Chargaff's rule, the amount of adenine is always equal to that of thymine and the amount of guanine is always equal to that of cytosine, *i.e.*, A = T and G = C. Also, the purines and pyrimidines are always in equal amounts, *i.e.*, A + G = T + C. Now, given dsDNA has 17% cytosine and hence guanine will be also 17%. So, A + T must be 66%, therefore, percentage of adenine or thymine would be 66/2 = 33%.

21. (a, d) : Transcription is the process in living cells in which the genetic information of DNA is transferred to *m*RNA as first step of gene expression. An operon consists of structural genes, promoter, operator and regulator gene.

22. (c) : Transformation was first studied by S.F. Griffith in 1928 while studying *Streptococcus pneumoniae*. He found that R-Type non virulent bacteria pick up virulence from heat killed virulent S-type bacteria and transform into virulent forms. It was this experiment which indicated presence of a 'transforming principle' which was later found out to be DNA, by Avery *et al.*

23. (a) : RNA polymerase initiates and extends the RNA (chain elongation) and functions always in 5′ to 3′ direction. The structural component of DNA has 3′ to 5′ polarity. It is also called template DNA strand or antisense (–) strand.

24. (d)

25. (a) : The expression of the genetic material occurs normally through the production of proteins. This involves two consecutive steps. These are transcription and translation. The DNA codes for the production of messenger RNA (*m*RNA) during transcription. Messenger RNA carries coded information to ribosomes. The ribosomes read this information and use it for protein synthesis. This process is called translation. F.H.C. Crick described this undirectional flow of information in 1958 as the 'central dogma of molecular biology'.

26. (c) : A nonsense mutation is the one which stops polypeptide synthesis due to the formation of termination or non-sense codon. In *lac* operon, sequence of structural genes is Z, Y, and A, which respectively code for β-galactosidase, lactose permease and transacetylase. If the gene Y has nonsense mutation, gene expression will stop at it, resulting in non-expression of both gene Y and successive gene A. Thus, only β-galactosidase enzyme will be produced.

27. (d) : *Refer to answer 25.*

28. (d) : Plant viruses often contain parasites of their own, referred to as satellites. Satellite RNAs are highly dependent on their helper virus for both replication and encapsidation. Their size vary from 194 to 1500 nucleotides (approx.) The larger satellites

contain open reading frame and express proteins, whereas smaller satellites do not produce functional proteins.

29. (b) : Genetic code is non-ambiguous. Non-ambiguous code means that there is no ambiguity about a particular code. One codon specifies only one amino acid and not any other. There are 64 codons. Out of 64, 3 are stop codons or nonsense codons, *i.e.*, these do not code for any amino acid and rest 61 code for one of the 20 amino acids. Neither of them code for more than one amino acids except GUG which normally code for valine but in certain conditions it also codes for N-formyl methionine as initiation codon.

30. (b) : Gene bank or genomic library is a complete collection of cloned DNA fragments which comprises the entire genome of an organism. Molecular probes are small DNA segments that are used to detect the presence of complementary sequences in nucleic acid samples in genomic library. These are usually formed of 200-500 nucleotide sequences. These segments or probes are labelled either with radioactive or with nonradioactive compound. Probes with DNA sequence complementary to the gene to be isolated are used. They bind with the desired gene, making it visible and help in isolating it from the library.

31. (a) : *Refer to answer 19.*

32. (a)

33. (d) : Introns, which occur principally in eukaryotes, are transcribed into messenger RNA (*m*RNA) but are subsequently removed from the transcription before translation. In certain cases, removal of the introns is an autocatalytic process (self-splicing) whereby the RNA itself has the properties of an enzyme.

34. (b) : In RNA, thymine is substituted with uracil thus, the RNA strand complementary to DNA strand ATCTG will be UAGAC.

35. (b) : Nucleolus is the centre for synthesis of ribosomal RNA (*r*RNA) that form ribosomal subunits. Ribosomal proteins migrate to the nucleolus from their assembly sites in the cytoplasm and are packaged into ribonucleoproteins. These return to the cytoplasm where they become mature ribosome particles.

36. (a) : A transcription unit is a part of DNA that is able to transcribe a complete RNA. It consists of a promoter region (where RNA polymerase binds to start transcription), the structural gene (coding region) and the terminator region (that signals release of RNA polymerase and newly formed RNA strand).

37. (a) : In eukaryotes, RNA polymerase enzymes (Type I, II, III) catalyze the synthesis of RNA using as a template either an existing DNA strand or an RNA strand. Type I is responsible for synthesis of *r*RNA, type II for *m*RNA and type III for *t*RNA synthesis.

38. (c) : Nucleosomes appear as 'beads-on-string' in the chromosome when viewed under electron microscope. The beads in 'beads-on-string' arrangement are complexes of histones and DNA. The bead plus the connecting DNA that leads to the next bead from the nucleosome. Nucleosome is the fundamental unit of organization on which the higher-order packaging of chromatin is built. The bead of each nucleosome contains eight histone molecules in which two copies each of H_2A, H_2B, H_3 and H_4 are found.

39. (d) : The unequivocal proof that DNA is the genetic material came from the experiments of Alfred Hershey and Martha Chase (1952). They worked with viruses that infect bacteria called bacteriophages.

40. (d) :

$$\text{DNA} \xrightarrow{\text{Transcription}} m\text{RNA} \xrightarrow{\text{Translation}} \text{Protein}$$

This one-way flow of information from DNA to *m*RNA and then to protein is called the central dogma of molecular biology by F.H.C. Crick (1958). But later on two American workers H. Temin and D. Baltimore reported that DNA is also formed from RNA in retroviruses, *e.g.*, HIV. This is called reverse transcription or Teminism, *i.e.*,

$$\text{DNA} \underset{\text{Reverse transcription}}{\overset{\text{Transcription}}{\rightleftharpoons}} m\text{RNA} \xrightarrow{\text{Translation}} \text{Protein}$$

This reverse transcription occurs under the influence of reverse transcriptase enzyme. So, HIV viruses does not follow central dogma.

41. (c) : Palindromic nucleotide sequences in the DNA molecule are groups of bases that form the same sequence when read in both forward and backward direction. In the given question, only option (c) represents a palindromic sequence, that can be easily cut at about the middle by some particular restriction enzyme.

42. (b) : *Refer to answer 29.*

43. (c) : The two French scientists, Jacob and Monod proposed the *lac* operon of *E. coli*. The *lac* operon (an inducible operon) contains a promoter, an operator, a regulator gene and three structural genes *z*, *y*, and *a*, coding for the enzyme β-galactosidase, β-galactoside permease, and β-galactoside

transacetylase, respectively. β-galactoside permease "pumps" lactose into the cell, where β-galactosidase cleaves it into glucose and galactose. The function of the transacetylase is still not clear. The *lac* regulator gene, designated the *i* gene, codes for a repressor. In the absence of the inducer (*i.e.*, lactose, actually allolactose), the repressor binds to the *lac* operator sequence, preventing RNA polymerase from binding to the promoter and transcribing the structural genes. The inducer of the operon, allolactose, is derived from lactose in a reaction that is catalyzed by β-galactosidase. Once formed, allolactose binds to the repressor, causing it to be released from the operator; in doing so, it induces transcription of the *z*, *y* and *a* structural genes. CAP is activator called catabolic activator protein. It exerts a positive control in *lac* operon because in its absence RNA polymerase is unable to recognise promotor gene. CAP activates *lac* genes only when glucose is absent. Such enzymes whose synthesis can be induced by adding the substrate are known as inducible enzymes and the genetic systems responsile for the synthesis of such an enzyme are known as inducible operons.

44. (c) : The phosphodiester bonds is formed between the phosphate group, which is connected to carbon 5′ of the sugar residue of one nucleotide, and carbon 3′ of the sugar residue of the next nucleotide.

45. (b) : *Refer to answer 43.*

46. (b) : Unlike in prokaryotes where transcription and translation take place in the same compartment, in eukaryotes primary transcript is first processed in the nucleus and then transported outside of the nucleus. Since the primary transcripts of the eukaryotes contains both the expressing genes (exons) and non-expressing genes (introns), it undergoes splicing of introns and later capping and tailing at 5′-end and 3′-end respectively.

47. (b) : Insulin gene is found in every body cell but is not expressed in all cells. It is nucleosome which consists of a core of eight histones. DNA is composed of nucleotides. Centriole is found in animal cells, which produces aster during cell division.

48. (d) : Genetic code was deciphered in 1960's by Crick, Ochoa, Nirenberg, Mathaei and Khorana.

49. (a) : Mathew Meselson and Franklin Stahl (1958) conducted various experiments using isotopically labelled DNA of *Escherichia coli* to provide evidence in favour of semi-conservative mode of DNA replication.

50. (d) : *m*RNA is not made directly in a eukaryotic cell. It is transcribed as heterogeneous nuclear RNA (hnRNA) in the nucleus. hnRNA contains introns and exons. The introns are removed by RNA splicing leaving behind the exons,which contain the information. The exonic regions of RNA are joined together to produce a single chain RNA required for functioning as translational template.

51. (d) : The relationship between the sequence of amino acids in a polypeptide and nucleotide sequence of DNA or *m*RNA is called genetic code**.** The genetic code is continuous and does not possess pause after the triplets. So a codon in *m*RNA is a non-contiguous fashion. If a nucleotide is deleted or added, the whole genetic code will read differently.

52. (b) : A DNA molecule has two unbranched complementary strands which are spirally coiled. The two chains are antiparallel *i.e.*, they run parallel but in opposite direction. One chain has the polarity 5′ → 3′ whereas, other has 3′ → 5′. Both are held together by hydrogen bonds between their bases *i.e.*, A = T and G ≡ C and the amount of adenine is equal to thymine and guanine equals to cytosine. The base ratio A + T / G + C may vary from one species to another but is constant for a given species. The purine and pyrimidines are always in equal amount (A + G = T + C) but A + T is not necessarily equal to G + C.

53. (b) : The two DNA chains are held together by hydrogen bonds between their nitrogenous bases. Adenine (A), a purine of one chain lies exactly opposite thymine (T), a pyrimidine of the other chain. Similarly, cytosine (C), a pyrimidine lies opposite guanine (G), a purine. Three hydrogen bonds occur between cytosine and guanine (C ≡ G) at positions 1′, 2′, and 6′ and two hydrogen bonds between adenine and thymine (A = T) at positions 1′ and 6′.

54. (c) : Ribosomes may occur in rosettes or helical groups called polyribosomes or polysomes (Gk. *Poly* – many, *soma* – body). The different ribosomes of a polyribosome are connected with a 10 – 20 Å thick strand of messenger or *m*RNA and its maintenance requires energy. Polyribosomes are formed during periods of active protein synthesis when a number of copies of the same polypeptide are required.

55. (d) : AUG codes for methionine and is initiation or start codon which starts the synthesis of polypeptide. UAA (ochre), UAG (amber) and UGA (opal) do not specify any amino acid so they are called termination codons. CUU, CUC, CUA and CUG codes for leucine whereas GCU, GCC, GCA and GCG codes for alanine.

56. (d) : DNA or deoxyribose nucleic acid is the largest macromolecule made of the helically twisted two antiparallel polydeoxyribonucleotide strands held together by hydrogen bonds. The two strands of DNA are together called DNA duplex. It has a diameter of 20Å. One turn spiral has a distance of 34 Å. It contains 10 deoxyribonucleotides in each strand so that the distance between two adjacent nucleotides is 3.4 Å.

57. (a) : In 1948, Beadle and Tatum proposed one-gene one-enzyme hypothesis which states that a gene controls metabolic machinery of the organism through synthesis of an enzyme. This laid the foundation of biochemical genetics. Beadle and Tatum were awarded Nobel Prize in 1958. This one gene one enzyme theory has been changed to one gene one polypeptide hypothesis proposed by Yanofsky. *i.e.*, one gene synthesizes one polypeptide and many polypeptides form one enzyme.

58. (d) : DNA is a type of nucleic acid that forms genetic material in many organisms. It consists of a long polymer of nucleotides which transcribes the coded information in the form of a triplet code of nucleotides in *m*RNA. It is a double helical molecule. The two strands of DNA run in opposite directions to one another with the hydrogen bonds between them. One strand of DNA has 5′-3′ direction and the other strand has 3′-5′ direction. So they are antiparallel. This direction is determined by the presence of a free phosphate or OH group at the end of the strand. If the strand has phosphate group at the the 5′ end and with a free OH group at the 3′ end.

59. (c) : Neomycin is a broad spectrum antibiotic which was first isolated from a strain of *Streptomyces feadiae*. It is effective against Gram positive as well as Gram negative bacteria. Its mechanism of action is by selective inhibition of protein synthesis on the 70S (prokaryotic) ribosome by inhibiting the interaction of *m*RNA and *t*RNA during translation process.

60. (c) : Messenger RNA or *m*RNA has been named so because it carries the coded information from DNA for the synthesis of proteins. It carries the coded information in a number of base triplets called codons. It is transcribed on DNA by the enzyme RNA polymerase. Hence, its base sequence is complementary to DNA on which it has been synthesized. In eukaryotes each gene transcribes its own *m*RNA, therefore the number of *m*RNAs corresponds to the number of genes. *r*RNA is a type of RNA that forms structural and functional components of ribosomes. *t*RNA is a class of RNA having structures with triplet nucleotide sequences that are complementary to the triplet nucleotide coding sequences of *m*RNA. It binds with amino acids and transfers them to ribosomes.

61. (b)

62. (c) : Telomerase is a ribonucleoprotein molecule that is enzymatic in nature. It uses a special mechanism for the synthesis of DNA at telomeric ends. The DNA repeat sequence of telomere has one G rich strand and other C rich strand. The G rich strand has a single stranded overhand. This overhand works as a primer and for its elongation uses as template the RNA component of telomerase enzyme. Thus telomerase synthesizes only the G rich strand of telomeres.

63. (c) : Streptomycin is broad spectrum (active against both Gram-positive and Gram-negative bacteria) and was the first really effective drug against tuberculosis, but its use is limited by the development of resistant strains and by toxic side-effects. The bactericidal action of streptomycin, as with other aminoglycoside antibiotics (*e.g.*, neomycin) is through selective inhibition of protein synthesis on 70S ribosomes.

To check resistance of mutants against streptomycin they must be grown on plates with streptomycin.

Only those bacterial colonies will propagate from the master that are resistant to the antibiotic.

64. (d) : The mitochondria contains its own set of ribosomes which synthesize proteins, so protein synthesis occures both in mitochondria and cytoplasm.

65. (c) : *Refer to answer 40.*

66. (c) : Endonucleases hydrolyse the internal phosphodiester bond. Exonucleases cleave the terminal nucleotides. Lipase digest fats and proteases break down proteins.

67. (b) : After 25 bases from start of transcription point are TATA boxes. After 40 bases from TATA boxes appears CAAT boxes. Both of these sequences serve as recognitions sites in eukaryotic promoters. Transcription in eukaryotic genes is a far more complicated process than in prokaryotes.

68. (a) : A mutation involves a change in the sequence of nucleotides in a nucleic acid molecule. This change will express itself in the form of a change in the sequence of aminoacids in the protein molecule synthesized through the information, encoded in nucleic acid segment. Therefore mutations at molecule level can be studied both by the study of

the sequence of amino acids in a protein and also by the study of sequence of nucleotides in a segment of nucleic acid.

69. (d) : Transfer RNA (*t*RNA) are species of RNA responsible for the transfer of specific amino acids to the growing end of a polypeptide chain during translation. R.Holly in 1965 gave clover leaf model of *t*RNA for yeast alanyl *t*RNA. It has four major sites - AAbinding site, anticodon, site, TUC loop and DHU loop. The chain is having unpaired base sequence CCA at 3′ end and G at 5′ end.

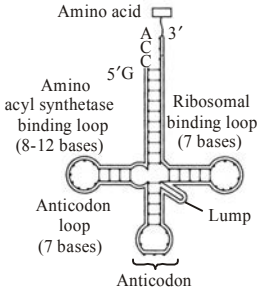


Fig. : Clover leaf model of *t*RNA structure

70. (c) : During transcription RNA synthesis from a DNA template takes place. It involves rewriting of the code without a change in its language. In *m*RNA, adenine pairs with uracil because thymine is not present *m*RNA. So the nucleotide sequence in *m*RNA would be–

DNA template	A	T	A	C	G
	|	|	|	|	|
*m*RNA	U	A	U	G	C

71. (c) : Transition mutant is one in which a purine is substituted by a different purine, or a pyrimidine by a different pyrimidine. Such a change involves a base pair change between a G–C pair and an A–T pair in the DNA whereas transversion results when one nitrogen base is replaced by another different type *e.g.*, C-G and A-T. Transcription is the formation of *m*RNA on DNA templete.

72. (c) : *Refer to answer 52.*

73. (a) : UGA, UAG and UAA are three non sense (or termination) codon which do not code for any amino acid. If in a gene encoding a polypeptide of 50 amino acid, 25th codon is mutated to UAA or any of the termination codon, then the chain will be terminated at that place because it will become difficult for *t*RNA to bring amino acid from amino acid pool. So in that case a polypeptide of 24 amino acid will be formed.

74. (a) : In *lac* operon, *lac* refers to lactose. The *lac* operator is a part of the structural genes (*lac* Z, *lac* Y, *lac* A and *lac* I). It is responsible for the uptake and initial catabolism of lactose.

$$\text{Lactose} \xrightarrow{\beta\text{-galactosidase}} \text{Glucose} + \text{Galactose}$$

75. (c) : The initiation of polypeptide chain in prokaryotes is always brought about by the amino acid methionine but it has to be formylated to form *t*RNA f^{met}. Then methionine binds with *t*RNA f^{met} to form f-^{met}-*t*RNA f^{met}. This f^{met}-*t*RNA fmet complex binds with the *m*RNA-30S subunit complex using initiation factors IF-2 and IF-1 and GTP.

76. (d) : Codon UAC is correctly matched as it codes for amino acid tyrosine. UCG codes for serine, UUU codes for phenylalanine and UGU codes for cysteine. Start codon is AUG and stop codons are UAA, UAG and UGA.

77. (a) : Promoter is region on a DNA molecule upstream from the coding sequence, area to which RNA polymerase initially binds prior to the initiation of transcription. The promoter,or at least part of it, determines the nature of the polymerase that associates with it. Certain consensus sequences within the promoter region seem to be particularly important in the binding of RNA polymerase, and these are known as CAAT and TATA boxes. The promoter region extends from some 40 nucleotides to about five nucleotides upstream from the start of the gene-coding region, the CAAT and TATA boxes being located within the promoter region as short six or seven nucleotide sequence.

78. (d) : In a triplet for a particular amino acid more than one word (synonyms) can be used. This phenomenon is described by saying that the code is degenerate. A degenerate code would be one where there is one to one relation between aminoacids and the codons that 44 codons out of 64 will be useless or nonsense codons. A code is degenerate because of the third base of the codon. It has been shown that the same *t*RNA can recognize more than one codons differing only at the third position. For example GCU, GCC and GCA all code for alanine amino acids.

79. (b) : *Refer to answer 29.*

80. (c) : In a DNA, the percentage of thymine is 20%. So, as it pairs with adenine, it is also 20%. So the guanine and cytosine together forms 60% of DNA and hence, guanine is 30%.

81. (b) : Transformation involves transfer of genetic material of one bacterial cell into another bacterial

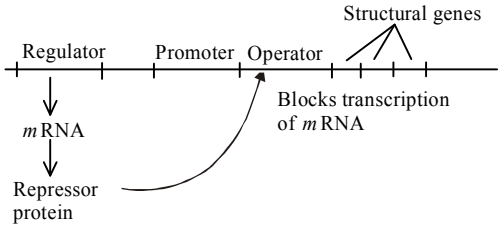
cell by some unknown mechanism and it converts one type of bacterium into another type.

This was first studied by Griffith (1928) in *Diplococcus pneumoniae* and hence is known as Griffith effect.

82. (c) : Operon model was given by Jacob and Monod (1961) for regulation of protein synthesis in prokaryotes. In bacteria, the genes that contain the information for assembling the enzymes for a metabolic pathway are usually clustered together on the chromosome in a functional complex called an operon.

Regulation of protein synthesis in eukaryotes is explained by gene battery model given by Britten and Davidson.

83. (b) : In the *lac* operon of *E.coli* due to the activity of regulator gene synthesis of repressor molecules occurs. These repressor molecules get attached to the operator gene and thus check *m*RNA synthesis and because of this no protein synthesis occurs.



84. (a) : *Refer to answer 29.*

85. (c) : RNA polymerase enzyme catalyses the synthesis of RNA. It is single in prokaryotes. There are three types of RNA polymerases in eukaryotes– I for 28S, 18S and 5.8S RNA, II for *m*RNA and snRNA and III for *t*RNA, 5SRNA and scRNA.

Primase is an RNA polymerase that is used to initiate DNA synthesis. RNA ligase reunites the exon segment after RNA splicing.

86. (a) : Ligases are used to join bits of DNA. Primase is an RNA polymerase, used to initiate DNA synthesis. DNA polymerase enzyme catalyses the synthesis of DNA. Endonuclease, causes the splicing of the intron carrying the coding sequence of the same endonuclease.

87. (a) : DNA transcribes to form *m*RNA. Its function is to carry coded information from DNA for the synthesis of proteins. The RNA consists of a coding region called exon and non-coding region called introns. The exons are thus the functional part that have code for proteins.

88. (b) : *Refer to answer 68.*

89. (a) : *m*RNA is synthesized on DNA template in 5′ – 3′ direction. Synthesis of *m*RNA exhibits several features that are synonymous with DNA replication. RNA synthesis requires accurate and efficient initiation, elongation proceeds in the 5′ – 3′ direction (*i.e.*, the polymerase oves along the template strand of DNA in the 5′ – 3′ direction), and RNA synthesis requires distinct and accurate termination. Transcription exhibits several features that are distinct from replication.

90. (a) : The tryptophan operon (trp operon) in bacteria is a repressible operon. Here, repressor is inactive and it becomes active as DNA binding protein only when complexed with a co-repressor (tryptophan). In absence of tryptophan, the operator site is open to binding by RNA polymerase, which transcribes the structural genes of tryptophan operon, leading to production of enzymes that synthesize tryptophan. When tryptophan becomes available, the enzymes of tryptophan synthetic pathway are no longer needed and tryptophan (co-repressor)-repressor complex blocks transcription. The regulation of this operon is also a negative control.

91. (c) : A gene is a hereditary unit consisting of a sequence of DNA and occupying a specific position or locus within the genome. Gene activity ultimately affects the phenotype of the organism possessing the gene. Thus gene is a physical and functional unit of genetic information. A cistron is a unit of genetic function. In prokaryotes there is one gene one enzyme correspondence. It means that in these organisms genes and cistrons are equivalent.

92. (c) : *Refer to answer 85.*

93. (c) : The method of DNA replication is semi-conservative. According to the semi-conservative model proposed by Watson and Crick, each strand of the two double helices formed would have one old and one new strand. So, the parental identity is conserved upto half extent and hence DNA replication is semi-conservative.

94. (c) : *Refer to answer 55.*

95. (a)

96. (a) : B-DNA is an antiparallel double helix. The double strand or duplex is coiled plectonemically in right handed fashion around a common axis like a rope stair case twisted in a spiral. The coiling produces alternate major and minor grooves. One turn of spiral has a distance between two adjacent nucleotides is 3.4 Å.

97. (a) : 3-D model of *t*RNA looks like flattened L-shaped molecule.

*t*RNA acts as adoptor molecule which carries amino acids to the site of protein synthesis (*i.e.*, ribosomes). Most accepted model for *t*RNA structure is 'clover leaf model.

98. (a) : Deoxyribonucleic acid and ribonucleic acid as the name suggests are made up of several nucleotide monomers. Each nucleotide consists of pentose sugar, phosphate group and nitrogenous bases. DNA has deoxyribose sugar whereas RNA has ribose sugar. The bases in DNA molecule are A, T, G and C whereas in RNA, thymine is absent and instead uracil is found.

99. (c) : Transformation was first discovered by Griffith (1928), in *Pneumococcus* (*Streptococcus pneumoniae*), that causes pneumonia.
Griffith injected a group of mice with nonencapsulated, rough (R), pneumococci; a second group with heat-killed encapsulated pneumococci cells, and a third group a mixture consisting of a few living nonencapsulated, rough pneumococci derived from a type S culture, and heat-killed encapsulated cells (S type). Griffith observed that the mice in the first two groups were not infected, and the mice in the third group died within a few days. The mice of the third group should have survived as the organisms which could kill them had been killed, and the cell of R type were incapable of causing disease. However, the mice died, and living virulent encapsulated cells of the type S were recovered from their dead bodies. It was observed by Griffith, that killed encapsulated pneumococci had liberated some substance which favoured non-capsulated cells (R type) to produce a capsular substance.

This substance in later experiments was proved to be DNA. These experiments showed that DNA is the genetic material.

100. (b) : Regulator gene is a gene whose function is to control the transcriptional activity of other genes, either adjacent or distant in the genome. In the case of the *lac* operon of *E.coli* the regulator gene *lac i* produces a protein product that represses the operator gene of the operon. In bacteria the same regulator gene may affect a series of non-adjacent operons.

101. (c) : *Refer to answer 55.*

102. (b) : DNA is mainly found in nucleus. It is associated with RNA and proteins to form compact chromosomes. But some amount of DNA is also found in chloroplasts and mitochondria. This DNA is called extra-chromosomal DNA.

103. (b) : The genetic material of prokaryotes is circular and single stranded DNA. It has no association of histones. The eukaryotic genetic material is linear and double stranded DNA. It is associated with histone proteins to form nucleosome unit.

104. (a) : DNA molecule has four bases - adenine, guanine, cytosine and thymine. Adenine always pairs with thymine and guanine pairs with cytosine. Their association is A-T and G-C.

105. (b) : Genome refers to the total sets of chromosomes carried by each cell of the organism. In prokaryotes the genetic material is circular and single stranded DNA. It has no association of histones. The eukaryotic genetic material is linear and double stranded DNA. It is associated with histone proteins to form nucleosome unit.

106. (c) : Mutations are rare events in nature and are then described as spontaneous mutations. Some of these mutations originate from mistakes in normal duplication of DNA. Transitions may be produced by tautomeric shift or ionization of bases which leads to mistaken, A – C base pairing and more frequently mistaken G – T base pairing. Guanine pairs with the rare enol form of thymine and is thus considered as hot spot for spontaneous point mutations.

107. (d) : Operator genes are a region of DNA sequence capable of interacting with a specific repressor molecule and in doing so it affects the activity of other genes downstream from it.

108. (b) : Transposons are portable genetic elements which can insert themselves at random into a plasmid or any chromosome independently of the host cell recombination system. It was discovered by Barbara Mc Clintock (1940) in maize and termed as jumping genes. Later Headges and Jacob termed them as transposons.
Introns are nontranslated sequences within the coding sequence of a gene. Such sequences are transcribed into hnRNA but are then spliced out and are not represented in the message. The non-intron sequences of the gene are referred to as exons.
Cistron sequence of nucleotides in a DNA molecule code for one particular polypeptide chain.

109. (b) : *Refer to answer 55.*

110. (a) : Autoradiography is the study of labelled precursors like ^{3}H by knowing the movement of radioactivity with the help of photographic films and emulsions at short intervals.
Radioactive material like tritiated thymidine which is formed by replacing normal hydrogen of thymidine with H^{3} (heavy isotope of hydrogen). Thymidine only is used for this purpose because RNA will not be labelled by this.

111. (d) : Transfer RNA or *t*RNA help in transfer of amino acids to ribosomes *m*RNA complex to form the polypeptide chain. It has four key regions a carrier and recognition end, enzyme site and ribosome site. This recognition end has three anticodons with the help of which amino acids are identified. *r*RNA forms 67% of 70S ribosomes and 50% of 80S ribosomes.

*m*RNA carries the coded information from DNA for the synthesis of proteins.

112. (a) : Protein synthesis or translation consists of ribosomes, amino acids, *m*RNA, *t*RNAs and aminoacyl *t*RNA synthetases. The ribosomes have two binding sites namely aminoacyl site or A-site and peptide site or P-site. The starting amino acid methionine lies at the P-site of the ribosome. The next incoming *t*RNA is called amino acyl *t*RNA, it is bound to A-site. A peptide bond is formed between COOH group of the *t*RNA at P-site and NH_2 group of aminoacyl *t*RNA. This is facilitated by the enzyme peptidyl transferase and does not require high energy phosphate bonds.

113. (a) : *Refer to answer 55.*

114. (d) : Nucleolus is a plasmosome body that is formed around the nucleolus organizer and is located in the secondary constriction on that chromosome. It is made up of RNA and proteins. The associated nucleolar chromatin contains DNA. It forms *m*RNA that has low molecular weight. Ribosomes are mainly concerned with proteins synthesis. They are sites for synthesis of *r*RNA and *t*RNA is synthesized in the cytoplasm.

115. (c) : ^{14}C and ^{3}H are incorporated in bases like thymidine, uridine and amino acids to study the structure of DNA and proteins. Radio tracer technique shows that DNA is in double helical form.

116. (a) : When *E.coli* bacteria are transfered to medium containing lactose, then the *lac* opeon is indueed. The *lac* opeaon consists of 3 structural gene (*lac* Z, *lac* Y and *lac* A). It involves the synthesis of β-galactosidase enzyme in *E.coli*, which hydrolyses lactose into glucose and galactose.

117. (d) : *Refer to answer 43.*

118. (d) : Inducer is a metabolite (or analogue of similar chemical structure), usually of low molecular weight, which promotes the production of an enzyme. Inducers are often substrates for the enzymes they induce, *e.g.* lactose in case of the synthesis of β-galoctosidase in *lac* operon.

119. (d) : In transcription, *m*RNA is formed from DNA template and thymine of DNA is replaced by uracil of RNA. Uracil pairs with adenine.

DNA	A	T	T	C	G	A	T	G
	|	|	|	|	|	|	|	|
*m*RNA	U	A	A	G	C	U	A	C

(transcript)

120. (a) : Nonsense mutation is a mutation which interconverts a nonsense to or from a sense-coding triplet, resulting in an abnormally foreshortened or elongated polypeptide chain. But in this example cytosine is added at the beginning so CAT GAT GATG will result.

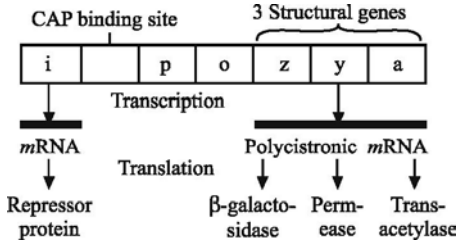
121. (a) : Split gene are those genes that consist of continuous sequence of nucleotide (coding sequence) interrupted by intervening sequences. Most eukaryotic genes are split as are genes of some animal viruses. The continuous coding sequences are called exons and the intervening non-coding sequence are called introns. These introns are not represented in *m*RNA transcribed from the gene and are not utilized for the synthesis of proteins.

122. (a) : Anticodon is the sequence of three nucleotides in a transfer RNA molecule that pairs with a complementary sequence of three nucleotides (codon) on a molecule of messenger RNA. *t*RNA has clove like shape or L shape (three dimensional). It has G at 5′ end CCA at 3′ end. CCA at 3′ end is meant for attaching to a specific amino acid (AA-binding site). On the opposite side lies an anticodon that is complementary to a specific codon of *m*RNA. The two are called recognition sites.

123. (c) : *Lac* operon in *E. coli* is induced by β-galactosidase an enzyme meant for hydrolysis of lactose in glucose and galactose.

$$\text{Lactose} \xrightarrow{\beta\text{-galactosidase}} \text{Glucose} + \text{Galactose}$$

These enzymes are called as inducible enzymes, because the synthesis of such enzymes are induced by adding substrate such as lactose by 10, 000 times.



124. (c) : *Refer to answer 55.*

125. (b) : DNA is a double helical molecule and it opens to form a replication fork for its replication. The two strands of DNA are joined with the help of H-bonds between the strands. Topoisomerases are specialized to cause nicks or breaks in the double helix and helps separate the DNA stands. Helicase unwinds

the DNA helix from that nick caused by the topoisomerase and this seperates the two strands.
DNA gyrase introduces negative supercoils in DNA strands of prokayotes.
DNA polymerase adds nucleotides units to the 3′ end of a DNA chain. DNA ligase joins the ends of DNA.

126. (d) : Transcription is the mechanism of copying the message of DNA on RNA with the help of enzyme RNA polymerase. It is meant for taking the coded information from DNA to the site where it is required for protein synthesis.
Translation or protein synthesis is a complicated process involving several steps such as – activation of amino acid, transfer of amino acid to *t*RNA, initiation of polypeptide synthesis, elongation of polypeptide chain and, termination of polypeptide chain.

127. (d) : Nucleosome core is made up of H_2A, H_2B, H_3 and H_4. It is about 7-10 nm in diameter, consisting of histones around which a DNA strand, about 120 base pair long is wrapped in chromosomes.

128. (d) : *Refer to answer 55.*

129. (b) : The transforming principle of *Pneumococcus* as found out by Avery, MacLeod and McCarty was DNA. In 1944, Avery, MacLeod and McCarty repeated Griffith's experiment successfully. They separated the proteins, carbohydrates and DNA of S III strains and separately mixed them in the pure cultures of R II. Only DNA could bring about transformation of R II type into S III and not the proteins or the carbohydrates.

130. (d) : Hershey and Chase proved that DNA is a basic genetic material. Hershey and Chase, 1952, by using P^{32} and S^{35} with a T-2 type phage concluded that DNA is the genetic material.

131. (c) : Certain amino acids are identified by more than one codons. This phenomenon is called as degeneracy *e.g.*, only AUG codes for methionine and UGG tryptophan.

132. (c) : During DNA replication, the strands separate by unwindase/helicase. The molecule is unwound by DNA unwinding proteins called helicases. The helicases II and III get attached to logging strand and protein to the leading strand. The formation of bands is avoided by single stranded DNA binding proteins (SSB).

133. (b) : The process of translation is protein synthesis. Emil Fischer, a German chemist established that the proteins are polymers of amino acids. There are some twenty amino acids involved in protein synthesis. In translation, the message coded by DNA on *m*RNA is translated into a specific protein.

134. (a) : A DNA with unequal nitrogen bases would most probably be single stranded. Nitrogenous bases are unequal in number in single stranded DNA, because they do not possess complementary base pairs.

135. (a) : Nucleotide arrangement in DNA can be seen by X-ray crystallography. Watson and Crick, 1953 proposed the double helical model for DNA. They were awarded Nobel prize in 1962. This model was developed by them on the basis of several previous observations including the *d*-helix of Pauling, 1951 and X-ray reflection studies of Franklin and Gosling, 1953.

136. (a) : Experimental material in the study of DNA replication has been *Escherichia coli*. *E. coli* fully labelled with ^{15}N is allowed to grow in ^{14}N medium. The two strands of DNA molecule of the first generation bacteria have different density and do not resemble parent DNA. Meselson and Stahl, 1958 by using ^{14}N and ^{15}N confirmed that the replication of DNA in *E. coli* is semi-conservative in nature.

137. (b) : Khorana synthesised a chain of alternate nucleotide GUGUGUGUGU. He found that it stimulated synthesis of a peptide having alternate valine-cysteine-valine-cysteine.

138. (a) : *Refer to answer 136.*

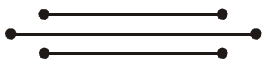
139. (b) : The process in living cells in which the genetic information of DNA is transferred to a molecule of mesenger RNA (*m*RNA) is the first step in protein synthesis. Transcription takes place in the cell nucleus or nuclear region and is regulated by transcription factors.

140. (b) : An octamer of 4 histones complexed with DNA forms nucleosome. The association of histones with DNA is very characteristic. It involves the formation of linear array of spherial structures called nucleosomes. These structures contains four pairs of histones (H_2A, H_2B, H_3 and H_4) in a ball; around which is wrapped a stretch of about 150 base pairs of DNA.

141. (d) : *Refer to answer 29.*

142. (b) : *Refer to answer 93.*

143. (d) : The genetic information is transferred from DNA to *m*RNA to protein. The proteins are made up of some 20 amino acids whose sequence is hidden in the sequence of nucleotides of *m*RNA. Hence, genetic code consists of all 20 amino acids. Thus genetic code is the relationship of amino acids sequence in a polypetide and nucleotide/base sequence in *m*RNA antisense strand and DNA.



Chapter

29

Evolution

1. Genetic drift operates in
(a) small isolated population
(b) large isolated population
(c) non-reproductive population
(d) slow reproductive population.
(NEET-II 2016)

2. In Hardy-Weinberg equation, the frequency of heterozygous individual is represented by
(a) p^2 (b) $2pq$
(c) pq (d) q^2.
(NEET-II 2016)

3. The chronological order of human evolution from early to the recent is
(a) *Australopithecus* → *Ramapithecus* → *Homo habilis* → *Homo erectus*
(b) *Ramapithecus* → *Australopithecus* → *Homo habilis* → *Homo erectus*
(c) *Ramapithecus* → *Homo habilis* → *Australopithecus* → *Homo erectus*
(d) *Australopithecus* → *Homo habilis* → *Ramapithecus* → *Homo erectus*
(NEET-II 2016)

4. Which of the following is the correct sequence of events in the origin of life?
I. Formation of protobionts
II. Synthesis of organic monomers
III. Synthesis of organic polymers
IV. Formation of DNA-based genetic systems
(a) I, II, III, IV (b) I, III, II, IV
(c) II, III, I, IV
(d) II, III, IV, I *(NEET-II 2016)*

5. Which of the following structures is homologus to the wing of a bird?
(a) Hindlimb of rabbit
(b) Flipper of whale
(c) Dorsal fin of a shark
(d) Wing of a moth *(NEET-I 2016)*

6. Analogous structures are a result of
(a) shared ancestry
(b) stabilising selection
(c) divergent evolution
(d) convergent evolution. *(NEET-I 2016)*

7. Following are the two statements regarding the origin of life.
(A) The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
(B) The first autotrophic organisms were the chemoautotrophs that never released oxygen.
Of the above statements which one of the following options is correct?
(a) Both (A) and (B) are correct.
(b) Both (A) and (B) are false.
(c) (A) is correct but (B) is false.
(d) (B) is correct but (A) is false.
(NEET-I 2016)

8. The wings of a bird and the wings of an insect are
(a) phylogenetic structures and represent divergent evolution
(b) homologous structures and represent convergent evolution
(c) homologous structures and represent divergent evolution
(d) analogous structures and represent convergent evolution. *(2015)*

9. Industrial melanism is an example of
(a) mutation (b) Neo-Lamarckism
(c) Neo-Darwinism (d) natural selection.
(2015)

10. A population will not exist in Hardy-Weinberg equilibrium if
(a) there is no migration
(b) the population is large
(c) individuals mate selectively
(d) there are no mutations. *(2015 Cancelled)*

11. Which is the most common mechanism of genetic variation in the population of a sexually reproducing organism?
(a) Genetic drift
(b) Recombination
(c) Transduction
(d) Chromosomal aberrations
(2015 Cancelled)

12. Which of the following had the smallest brain capacity?
(a) *Homo neanderthalensis*
(b) *Homo habilis*
(c) *Homo erectus*
(d) *Homo sapiens* *(2015 Cancelled)*

13. In a population of 1000 individuals 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is
(a) 0.4 (b) 0.5
(c) 0.6 (d) 0.7. *(2014)*

14. Forelimbs of cat, lizard used in walking; forelimbs of whale used in swimming and forelimbs of bats used in flying are an example of
(a) analogous organs
(b) adaptive radiation
(c) homologous organs
(d) convergent evolution. *(2014)*

15. Which one of the following are analogous structures?
(a) Wings of bat and wings of pigeon
(b) Gills of prawn and lungs of man
(c) Thorns of *Bougainvillea* and tendrils of *Cucurbita*
(d) Flippers of dolphin and legs of horse
(2014)

16. According to Darwin, the organic evolution is due to
(a) competition within closely related species
(b) reduced feeding efficiency in one species due to the presence of interfering species
(c) intraspecific competition
(d) interspecific competition. *(NEET 2013)*

17. The tendency of population to remain in genetic equilibrium may be disturbed by
(a) lack of mutations
(b) lack of random mating
(c) random mating
(d) lack of migration. *(NEET 2013)*

18. Variation in gene frequencies within populations can occur by chance rather than by natural selection. This is referred to as
(a) random mating (b) genetic load
(c) genetic flow (d) genetic drift.
(NEET 2013)

19. The process by which organisms with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge, is called
(a) non-random evolution
(b) adaptive radiation
(c) natural selection
(d) convergent evolution. *(NEET 2013)*

20. The eye of octopus and eye of cat show different patterns of structure, yet they perform similar function. This is an example of
(a) analogous organs that have evolved due to convergent evolution.
(b) analogous organs that have evolved due to divergent evolution.
(c) homologous organs that have evolved due to convergent evolution.
(d) homologous organs that have evolved due to divergent evolution. *(NEET 2013)*

21. Random unidirectional change in allele frequencies that occurs by chance in all populations and especially in small populations is known as
(a) migration (b) natural selection
(c) genetic drift (d) mutation.
(Karnataka NEET 2013)

22. Genetic variation in a population arises due to
(a) recombination only
(b) mutation as well as recombination
(c) reproductive isolation and selection
(d) mutations only.
(Karnataka NEET 2013)

23. Dinosaurs dominated the world in which of the following geological eras?
(a) Cenozoic (b) Jurassic
(c) Mesozoic (d) Devonian
(Karnataka NEET 2013)

24. The finch species of Galapagos islands are grouped according to their food sources. Which of the following is not a finch food?
(a) Carrion (b) Insects
(c) Tree buds (d) Seeds
(Karnataka NEET 2013)

25. Evolution of different species in a given area starting from a point and spreading to other geographical areas is known as
(a) adaptive radiation
(b) natural selection
(c) migration
(d) divergent evolution. *(2012)*

26. Which one of the following options gives one correct example each of convergent evolution and divergent evolution?

	Convergent evolution	Divergent evolution
(a)	Eyes of octopus	Bones of forelimbs of mammals and vertebrates
(b)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Wings of butterflies and bird
(c)	Bones of forelimbs of vertebrates	Wings of butterfly and birds
(d)	Thorns of *Bougainvillea* and tendrils of *Cucurbita*	Eyes of octopus and mammals

(2012)

27. What was the most significant trend in the evolution of modern man (*Homo sapiens*) from his ancestors?
(a) Shortening of jaws
(b) Binocular vision
(c) Increasing cranial capacity
(d) Upright posture *(2012, 2011)*

28. The extinct human who lived 1,00,000 to 40,000 years ago, in Europe, Asia and parts of Africa, with short stature, heavy eye brows, retreating fore heads, large jaws with heavy teeth, stocky bodies, a lumbering gait and stooped posture was
(a) *Homo habilis*
(b) Neanderthal human
(c) Cro-magnon human
(d) *Ramapithecus.* *(2012)*

29. The idea of mutations was brought forth by
(a) Hugo de Vries who worked on evening primrose
(b) Gregor Mendel who worked on *Pisum sativum*
(c) Hardy Weinberg who worked on allele frequencies in a population
(d) Charles Darwin who observed a wide variety of organisms during sea voyage.
(Mains 2012)

30. Darwin's finches are a good example of
(a) industrial melanism
(b) connecting link
(c) adaptive radiation
(d) convergent evolution.
(2010, 2008)

31. Given below are four statements (A-D) each with one or two blanks. Select the option which correctly fills up the blanks in two statements.
Statements:
(A) Wings of butterfly and birds look alike and are the results of (i) evolution.
(B) Miller showed that CH_4, H_2, NH_3 and (i) when exposed to electric discharge in a flask resulted in formation of (ii) .
(C) Vermiform appendix is a (i) organ and an (ii) evidence of evolution.
(D) According to Darwin evolution took place due to (i) and (ii) of the fittest.
(a) (D) – (i) small variations, (ii) survival,
(A) – (i) convergent
(b) (A) – (i) convergent,
(B) – (i) oxygen, (ii) nucleosides
(c) (B) – (i) water vapour, (ii) amino acids
(C) – (i) rudimentary, (ii) anatomical
(d) (C) – (i) vestigial, (ii) anatomical
(D) – (i) mutations, (ii) multiplication
(Mains 2010)

32. The most apparent change during the evolutionary history of *Homo sapiens* is traced in
(a) loss of body hair
(b) walking upright
(c) shortening of the jaws
(d) remarkable increase in the brain size
(Mains 2010)

33. *Peripatus* is a connecting link between
(a) mollusca and echinodermata
(b) annelida and arthropoda
(c) coelenterata and porifera
(d) ctenophora and platyhelminthes.
(2009)

34. In the case of peppered moth (*Biston betularia*) the black-coloured form became dominant over the light-coloured form in England during industrial revolution. This is an example of
(a) appearance of the darker coloured individuals due to very poor sunlight
(b) protective mimicry
(c) inheritance of darker colour character acquired due to the darker environment
(d) natural selection whereby the darker forms were selected. *(2009)*

35. Which one of the following scientist's name is correctly matched with the theory put forth by him?
(a) De Vries - Natural selection
(b) Mendel - Theory of Pangenesis
(c) Weismann - Theory of continuity of germplasm
(d) Pasteur - Inheritance of acquired characters
(2008)

36. Which one of the following is incorrect about the characteristics of protobionts (coacervates and microspheres) as envisaged in the abiogenic origin of life?
(a) They were partially isolated from the surroundings.
(b) They could maintain an internal environment
(c) They were able to reproduce.
(d) They could separate combinations of molecules from the surroundings. *(2008)*

37. Thorn of *Bougainvillea* and tendril of *Cucurbita* are examples of
(a) vestigial organs
(b) retrogressive evolution
(c) analogous organs
(d) homologous organs. *(2008)*

38. Which one of the following statements is correct?
(a) There is no evidence of the existence of gills during embryogenesis of mammals.
(b) All plant and animal cells are totipotent.
(c) Ontogeny repeats phylogeny.
(d) Stem cells are specialized cells. *(2007)*

39. The concept of chemical evolution is based on
(a) interaction of water, air and clay under intense heat
(b) effect of solar radiation on chemicals
(c) possible origin of life by combination of chemicals under suitable environmental conditions
(d) crystallization of chemicals. *(2007)*

40. The Finches of Galapagos islands provide an evidence in favour of
(a) evolution due to mutation
(b) retrogressive evolution
(c) biogeographical evolution
(d) special creation. *(2007)*

41. When two species of different genealogy come to resemble each other as a result of adaptation, the phenomenon is termed
(a) microevolution
(b) co-evolution
(c) convergent evolution
(d) divergent evolution. *(2007)*

42. Adaptive radiation refers to
(a) evolution of different species from a common ancestor
(b) migration of members of a species to different geographical areas
(c) power of adaptation in an individual to a variety of environments
(d) adaptations due to geographical isolation. *(2007)*

43. An important evidence in favour of organic evolution is the occurrence of
(a) homologous and analogous organs
(b) homologous and vestigial organs
(c) analogous and vestigial organs
(d) homologous organs only. *(2006)*

44. Which of the following amino acids was not found to be synthesized in Millers's experiment?
(a) Alanine (b) Glycine
(c) Aspartic acid (d) Glutamic acid *(2006)*

45. Jurassic period of the mesozoic era is characterised by
(a) flowering plants and first dinosaurs appear
(b) gymnosperms are dominant plants and first birds appear
(c) radiation of reptiles and origin of mammal like reptiles
(d) dinosaurs become extinct and angiosperms appear. *(2006)*

46. Praying mantis is a good example of
(a) camouflage
(b) mullerian mimicry
(c) warning colouration
(d) social insects. *(2006)*

47. Which one of the following experiments suggests that simplest living organisms could not have originated spontaneously from non-living matter?
(a) Larvae could appear in decaying organic matter.
(b) Microbes did not appear in stored meat.
(c) Microbes appeared from unsterilized organic matter.
(d) Meat was not spoiled, when heated and kept sealed in a vessel. *(2005)*

48. De Vries gave his mutation theory on organic evolution while working on
(a) *Pisum sativum*
(b) *Drosophila melanogaster*
(c) *Oenothera lamarckiana*
(d) *Althea rosea*. *(2005)*

49. There are two opposing views about origin of modern man. According to one view *Homo erectus* in Asia were the ancestors of modern man. A study of variation of DNA however suggested African origin of modern man. What kind of observation on DNA variation could suggest this?
(a) Greater variation in Asia than in Africa
(b) Greater variation in Africa than in Asia
(c) Similar variation in Africa and Asia
(d) Variation only in Asia and no variation in Africa *(2005)*

50. Which one of the following phenomena supports Darwin's concept of natural selection in organic evolution?
(a) Development of transgenic animals
(b) Production of 'Dolly', the sheep by cloning
(c) Prevalence of pesticide resistant insects
(d) Development of organs from 'stem cells' for organ transplantation *(2005)*

51. Which of the following is the relatively most accurate method for dating of fossils?
(a) Radio-carbon method
(b) Potassium-argon method
(c) Electron-spin resonance method
(d) Uranium-lead method *(2005)*

52. At a particular locus, frequency of *A* allele is 0.6 and that of *a* is 0.4. What would be the frequency of heterozygotes in a random mating population at equilibrium?
(a) 0.36 (b) 0.16
(c) 0.24 (d) 0.48 *(2005)*

53. Which of the following is not true for a species?
(a) Members of a species can interbreed.
(b) Gene flow does not occur between the populations of a species.
(c) Each species is reproductively isolated from every other species.
(d) Variations occur among members of a species. *(2005)*

54. Age of fossils in the past was generally determined by radio-carbon method and other methods involve radioactive elements found in the rocks. More precise methods, which were used recently and led to the revision of the evolutionary periods for different groups of organisms, includes
(a) study of carbohydrates/proteins in fossils
(b) study of the conditions of fossilization
(c) electron spin resonance (ESR) and fossil DNA
(d) study of carbohydrates / proteins in rocks. *(2004)*

55. What kind of evidence suggested that man is more closely related with chimpanzee than with other hominoid apes?
(a) Evidence from DNA extracted from sex chromosomes only
(b) Comparison of chromosomes morphology only
(c) Evidence from fossil remains, and the fossil mitochondrial DNA alone
(d) Evidence from DNA extracted from sex chromosomes, autosomes. *(2004)*

56. Which one of the following is a living fossil?
(a) *Cycas* (b) Moss
(c) *Saccharomyces* (d) *Spirogyra* *(2004)*

57. According to Oparin, which one of the following was not present in the primitive atmosphere of the earth?
(a) Methane (b) Oxygen
(c) Hydrogen (d) Water vapour *(2004)*

58. Diversification in plant life appeared
(a) due to long periods of evolutionary changes
(b) due to abrupt mutations
(c) suddenly on earth
(d) by seed dispersal. *(2004)*

59. Convergent evolution is illustrated by
(a) rat and dog
(b) bacterium and protozoan
(c) starfish and cuttle fish
(d) dogfish and whale. *(2003)*

60. Which one of the following sequences was proposed by Darwin and Wallace for organic evolution ?
(a) Overproduction, variations, constancy of population size, natural selection
(b) Variations, constancy of population size, overproduction, natural selection
(c) Overproduction, constancy of population size, variations, natural selection
(d) Variations, natural selection, overproduction, constancy of population size *(2003)*

61. Random genetic drift in a population probably results from
(a) highly genetically variable individuals
(b) interbreeding within this population
(c) constant low mutation rate
(d) large population size. *(2003)*

62. Industrial melanism is an example of
(a) drug resistance
(b) darkening of skin due to smoke from industries
(c) protective resemblance with the surroundings
(d) defensive adaptation of skin against ultraviolet radiations. *(2003)*

63. In a random mating population in equilibrium, which one of the following brings about a change in gene frequency in a non-directional manner ?
(a) Mutations (b) Random drift
(c) Selection (d) Migration *(2003)*

64. Darwin in his "Natural Selection Theory" did not believe in any role of which one of the following in organic evolution ?
(a) Parasites and predators as natural enemies
(b) Survival of the fittest
(c) Struggle for existence
(d) Discontinuous variations *(2003)*

65. Which one of the following describes correctly the homologous structures ?
(a) Organs with anatomical similarities, but performing different functions
(b) Organs with anatomical dissimilarities, but performing same function
(c) Organs that have no function now, but had an important function in ancestor
(d) Organs appearing only in embryonic stage and disappearing later in the adult
(2003)

66. Which one of the following is categorised under living fossils ?
(a) *Pinus* (b) *Cycas*
(c) *Selaginella* (d) *Metasequoia*
(2003)

67. Cause of mimicry is
(a) concealment (b) offence
(c) defence (d) both (b) and (c).
(2002)

68. Which of the following is most important for speciation ?
(a) Seasonal isolation
(b) Reproductive isolation
(c) Behavioural isolation
(d) Tropical isolation *(2002)*

69. Which of the following are homologous organs?
(a) Wings of birds and locust
(b) Wings of birds and pectoral fins of fish
(c) Wings of bat and butterfly
(d) Legs of frog and cockroach *(2002)*

70. Genetic drift operates in
(a) small isolated population
(b) large isolated population
(c) fast reproductive population
(d) slow reproductive population.
(2002)

71. There is no life on moon due to the absence of
(a) O_2 (b) water
(c) light (d) temperature.
(2002)

72. According to fossils discovered up to present time origin and evolution of man started from
(a) France (b) Java
(c) Africa (d) China.
(2002)

73. In which condition, the gene ratio remains constant for any species population ?
(a) Sexual selection (b) Random mating
(c) Mutation (d) Gene flow
(2002)

74. Sequence of which of the following is used to know the phylogeny?
(a) *m*RNA (b) *r*RNA
(c) *t*RNA (d) DNA *(2002)*

75. In which era reptiles were dominant ?
(a) Coenozoic era (b) Mesozoic era
(c) Palaeozoic era (d) Archaeozoic era
(2002)

76. Which statement is correct about centre of origin of plant?
(a) More diversity in improved variety
(b) Frequency of dominant gene is more
(c) Climatic condition more favourable
(d) None of the above *(2001)*

77. Half life period of C^{14} is
(a) 500 years (b) 5000 years
(c) 50 years (d) 5×10^4 years.
(2001)

78. Most abundant organic compound on earth is
(a) protein (b) cellulose
(c) lipids (d) steroids.
(2001)

79. Similarities in organism with different genotype indicates
(a) microevolution
(b) macroevolution
(c) convergent evolution
(d) divergent evolution. *(2001)*

80. Reason of diversity in living being is
(a) mutation
(b) long term evolutionary change
(c) gradual change
(d) short term evolutionary change.
(2001)

81. Which of the following is closest relative of man?
(a) Chimpanzee (b) Gorilla
(c) Orangutan (d) Gibbon
(2001)

82. Which of the following is correct order of the evolutionary history of man?
(a) Peking man, homo sapiens, Neanderthal man, Cromagnon man
(b) Peking man, Heidelberg man, Neanderthal man, Cromagnon man
(c) Peking man, Heidelberg man, Neanderthal man, Cromagnon man
(d) Peking man, Neanderthal man, Homo sapiens, Heidelberg man
(2001)

83. 1st life on earth was
(a) cyanobacteria (b) chemoheterotrophs
(c) autotrophs (d) photoautotrophs.
(2001)

84. Forthcoming generation are less adaptive than the parental generation due to
(a) natural selection (b) mutation
(c) genetic drift (d) adaptation.
(2001)

85. Occurrence of endemic species in South America and Australia is due to
(a) these species has been extinct from other regions
(b) continental separation
(c) there is no terrestrial route to these places
(d) retrogressive evolution. *(2001)*

86. Darwin's theory of pangenesis shows similarity with theory of inheritance of acquired characters then what shall be correct according to it?
(a) Useful organs becomes strong and developed while useless organs become extinct.
(b) Size of organs increase with aging.
(c) Development of organs is due to will power.
(d) There should be some physical basis of inheritance. *(2001)*

87. Which is not a vestigial organ in man?
(a) Third molar
(b) Nails
(c) Segmental muscles of abdomen
(d) Coccyx *(2000)*

88. *Homo sapiens* have evolved in
(a) palaeocene (b) pleistocene
(c) oligocene (d) holocene.
(2000)

89. Character which is closely related to human evolution is
(a) disappearance of tail
(b) reduction in size of jaws
(c) binocular vision
(d) flat nails. *(2000)*

90. Which evidence of evolution is related to Darwin's finches?
(a) Evidences from biogeographical distribution
(b) Evidences from comparative anatomy
(c) Evidences from embryology
(d) Evidences from paleontology *(2000)*

91. Who is directly related to man?
(a) Gorilla (b) Rhesus
(c) Gibbon (d) Orangutan
(2000)

92. Which is the most important factor for continuity of a species from evolutionary point of view?
(a) Replication of genetic material
(b) Formation of gametes
(c) Synthesis of proteins
(d) None of these *(2000)*

93. Phenomenon of 'Industrial melanism' demonstrates
(a) geographical isolation
(b) reproductive isolation
(c) natural selection
(d) induced mutation. *(1999)*

94. Which of the following are homologous organs?
(a) Wings of bird and hands of human
(b) Nails of human being and claws in animals
(c) Wings of bird and wings of insect
(d) Wings of bat and wings of cockroach
(1999)

95. In the developmental history of mammalian heart, it is observed that it passes through a two chambered fish like heart, three chambered frog like heart and finally four chambered stage. To which hypothesis can this above cited statement be approximated?
(a) Lamarck's principle
(b) Mendalian principles
(c) Biogenetic law
(d) Hardy-Weinberg law *(1998)*

96. The age of the fossil of *Dryopithecus* on the geological time scale is
(a) 2.5×10^6 years back
(b) 50×10^6 years back
(c) 75×10^6 years back
(d) 25×10^6 years back. *(1998)*

97. Which one of the following statements is correct?
(a) *Australopithecus* is the real ancestor of modern man.
(b) *Neanderthal man* is the direct ancestor of *Homo sapiens*.
(c) *Homo erectus* is the ancestor of man.
(d) *Cro-magnon man's* fossil has been found in Ethiopia. *(1998)*

98. Species occurring in different geographical area are called as
(a) sympatric (b) allopatric
(c) sibling (d) neopatric. *(1998)*

99. The diversity in the type of beaks of finches adapted to different feeding habits on the Galapagos Islands, as observed by Darwin, provides evidence for
(a) intraspecific competition
(b) interspecific competition
(c) origin of species by natural selection
(d) intraspecific variations. *(1998)*

100. Genetic drift operates only in
(a) larger populations
(b) Mendelian populations
(c) island populations
(d) smaller populations. *(1998)*

101. Which of the following statements is correct regarding evolution of mankind?
(a) *Homo erectus* is preceded by *Homo habilis.*
(b) Neanderthal man and cro-magnon man were living at the same time.
(c) *Australopithecus* was living in Australia.
(d) None of these *(1997)*

102. Common origin of man and chimpanzee is best shown by
(a) binocular vision
(b) chromosome number
(c) dental formula
(d) cranial capacity. *(1997)*

103. Which of the following is a living fossil?
(a) *Mirabilis jalapa* (b) *Ginkgo biloba*
(c) *Pinus longifolia* (d) *Dalbergia sissoo*
(1997)

104. Evolutionary convergence is characterized by
(a) development of dissimilar characteristics in closely related groups
(b) development of a common set of characteristics in groups of different ancestry
(c) development of characteristics by random mating
(d) replacement of common characteristics in different groups.
(1997)

105. The animals of cold countries have relatively shorter and poorly developed ears, eyes, hairs and other phenotypic characters. This is known by which law?
(a) Cope's Law (b) Dollo's Law
(c) Allen's Law (d) Bergamann's Law.
(1996)

106. Which of the following changes for man in the course of evolution is probably useless?
(a) Development of being erect
(b) Development of cranial capacity
(c) Loss of tail
(d) Development of opposable thumb *(1996)*

107. Which of the following is the direct ancestor of *Homo sapiens*?
(a) *Australopithecus*
(b) *H. sapiens neanderthals*
(c) *Homo erectus*
(d) *Homo sapiens fossilis* *(1996)*

108. Which of the following is the correct group of vestigial organs in man?
(a) Nictitating membrane, ear muscles, eyelids and coccyx
(b) Appendix, coccyx, ear muscles and elbow joint
(c) Wisdom tooth, coccyx, body hair and ear muscles
(d) Wisdom tooth, body hairs, nictitating membrane and vermiform appendix
(1996)

109. Which of the following is an example of 'living fossils'?
(a) *Pinus* (b) *Riccia*
(c) *Gnetum* (d) *Ginkgo.* *(1996)*

110. The correct sequence for the manufacture of molecules/organic compounds on the primitive earth is
(a) NH_3, nucleic acid, protein and carbohydrate
(b) protein, carbohydrate, water and nucleic acid
(c) NH_3, protein, carbohydrate and nucleic acid
(d) NH_3, water, nucleic acid and protein.
(1996)

111. The first domesticated animal by primitive man was
(a) cat (b) cow
(c) dog (d) horse. *(1996)*

112. Which of the following isotopes is most dangerous to *Homo sapiens*?
(a) Phosphorus-32 (b) Strontium-90
(c) Caesium-137 (d) Iodine-131 *(1995)*

113. The change of the lighter-coloured variety of peppered moth (*Biston betularia*) to its darker variety (*Biston carbonaria*) is due to
(a) mutation
(b) regeneration
(c) genetic isolation
(d) temporal isolation. *(1995)*

114. The homologous organs are those that show similarity in
(a) appearance (b) function
(c) origin (d) size. *(1995)*

115. Which period is dubbed as the age of prokaryotic microbes?
(a) Precambrian (b) Phanerozoic
(c) Archean (d) Proterozoic
(1995)

116. The presence of gill slits, in the embryos of all vertebrates, supports the theory of
(a) metamorphosis (b) biogenesis
(c) organic evolution (d) recapitulation.
(1995)

117. Two zoogeographical regions, separated by high mountain ranges, are
(a) Nearctic and Palaearctic
(b) Neotropical and Ethiopian
(c) Oriental and Australian
(d) Palaearctic and Oriental. *(1995)*

118. Which one of the following changes involved is irrelevant, in the evolution of man?
(a) Perfection of hand for tool making
(b) Change of diet from hard nuts and hard roots to soft food
(c) Loss of tail
(d) Increase in the ability to communicate with others and develop community behaviour
(1994)

119. Which of the following evidences does not favour the Lamarckian concept of inheritance of acquired characters?
(a) Lack of pigment in cave-dwelling animals
(b) Melanization in peppered moth
(c) Absence of limbs in snakes
(d) Presence of webbed toes in aquatic birds
(1994)

120. The earliest fossil form, in the phylogeny of horse, is
(a) *Equus* (b) *Mesohippus*
(c) *Eohippus* (d) *Merychippus*.
(1994)

121. Which of the following is a pair of homologous organs?
(a) Pectoral fin of rohu and fore-limb of horse
(b) Wings of grasshopper and wings of crow
(c) Lungs of rabbit and gills of rohu
(d) Wings of bat and wings of butterfly *(1994)*

122. The process of mating of individuals, which are more closely related than the average of the population to which they belong, is called
(a) heterosis (b) self breeding
(c) inbreeding (d) hybridization.
(1994)

123. Evolutionary convergence is development of
(a) common set of characters in group of different ancestry
(b) dissimilar characters in closely related groups
(c) common set of characters in closely related groups
(d) random mating. *(1993)*

124. Weismann cut off tails of mice generation after generation but tails neither disappeared nor shortened showing that
(a) Darwin was correct
(b) tail is an essential organ
(c) mutation theory is wrong
(d) lamarckism was wrong in inheritance of acquired characters. *(1993)*

125. Theory of Natural Selection dwells on
(a) role of environment in evolution
(b) natural selection acting on favourable variations
(c) changes in gene complex resulting in heritable variations
(d) none of the above. *(1993)*

126. Genetic drift is change of
(a) gene frequency in same generation
(b) appearance of recessive genes
(c) gene frequency from one generation to next
(d) none of the above. *(1993)*

127. The first organisms were
(a) chemoautotrophs
(b) chemoheterotrophs
(c) autotrophs
(d) eukaryotes. *(1992)*

128. Which was absent in the atmosphere at the time of origin of life?
(a) NH_3 (b) H_2
(c) O_2 (d) CH_4 *(1991)*

129. Correct order is
(a) Palaeozoic → archaeozoic → coenozoic
(b) Archaeozoic → palaeozoic → proterozoic
(c) Palaeozoic → mesozoic → coenozoic
(d) Mesozoic → archaeozoic → proterozoic
(1991)

130. Study of fossils is
(a) palaeontology (b) herpetology
(c) saurology (d) organic evolution.
(1991)

131. Parallelism is
(a) adaptive divergence
(b) adaptive divergence of widely separated species
(c) adaptive convergence of widely different species
(d) adaptive convergence of closely related groups. *(1990)*

132. Basic principles of embryonic development were pronounced by
(a) von Baer (b) Weismann
(c) Haeckel (d) Morgan. *(1990)*

133. Evolution is
(a) progressive development of a race
(b) history and development of race along with variations
(c) history of race
(d) development of race. *(1989)*

134. "Continuity of germplasm" theory was given by
(a) De Vries (b) Weismann
(c) Darwin (d) Lamarck. *(1989)*

135. Theory of inheritance of acquired characters was given by
(a) Wallace (b) Lamarck
(c) Darwin (d) De Vries. *(1989)*

136. 'Origin of Species' was written by
(a) Oparin (b) Weismann
(c) Lamarck (d) Darwin. *(1989)*

137. Humming birds and Hawk illustrate
(a) convergent evolution
(b) homology
(c) adaptive radiation
(d) parallel evolution. *(1988)*

Answer Key

1.	(a)	**2.**	(b)	**3.**	(b)	**4.**	(c)	**5.**	(b)	**6.**	(d)	**7.**	(a)	**8.**	(d)	**9.**	(d)	**10.**	(c)
11.	(b)	**12.**	(b)	**13.**	(c)	**14.**	(c)	**15.**	(a,b)	**16.**	(c)	**17.**	(b)	**18.**	(d)	**19.**	(d)	**20.**	(a)
21.	(c)	**22.**	(b)	**23.**	(b)	**24.**	(a)	**25.**	(a)	**26.**	(a)	**27.**	(c)	**28.**	(b)	**29.**	(a)	**30.**	(c)
31.	(a)	**32.**	(d)	**33.**	(b)	**34.**	(d)	**35.**	(c)	**36.**	(c)	**37.**	(d)	**38.**	(c)	**39.**	(c)	**40.**	(c)
41.	(c)	**42.**	(a)	**43.**	(b)	**44.**	(d)	**45.**	(b)	**46.**	(a)	**47.**	(d)	**48.**	(c)	**49.**	(b)	**50.**	(c)
51.	(c)	**52.**	(d)	**53.**	(b)	**54.**	(c)	**55.**	(d)	**56.**	(a)	**57.**	(b)	**58.**	(a)	**59.**	(d)	**60.**	(c)
61.	(b)	**62.**	(c)	**63.**	(b)	**64.**	(d)	**65.**	(a)	**66.**	(b)	**67.**	(d)	**68.**	(b)	**69.**	(b)	**70.**	(a)
71.	(b)	**72.**	(c)	**73.**	(b)	**74.**	(b)	**75.**	(b)	**76.**	(a)	**77.**	(b)	**78.**	(b)	**79.**	(c)	**80.**	(b)
81.	(a)	**82.**	(c)	**83.**	(b)	**84.**	(b)	**85.**	(b)	**86.**	(d)	**87.**	(b)	**88.**	(d)	**89.**	(a)	**90.**	(a)
91.	(a)	**92.**	(a)	**93.**	(c)	**94.**	(a)	**95.**	(c)	**96.**	(a)	**97.**	(c)	**98.**	(b)	**99.**	(c)	**100.**	(d)
101.	(a)	**102.**	(d)	**103.**	(b)	**104.**	(b)	**105.**	(c)	**106.**	(c)	**107.**	(d)	**108.**	(d)	**109.**	(d)	**110.**	(d)
111.	(c)	**112.**	(b)	**113.**	(a)	**114.**	(c)	**115.**	(a)	**116.**	(d)	**117.**	(d)	**118.**	(b)	**119.**	(b)	**120.**	(c)
121.	(a)	**122.**	(c)	**123.**	(a)	**124.**	(d)	**125.**	(c)	**126.**	(d)	**127.**	(b)	**128.**	(c)	**129.**	(c)	**130.**	(a)
131.	(d)	**132.**	(a)	**133.**	(b)	**134.**	(b)	**135.**	(b)	**136.**	(d)	**137.**	(c)						

EXPLANATIONS

1. (a) : The random changes in gene frequencies in a population occurring by chance alone rather than by natural selection are called genetic drift or Sewall wright effect. The effects of genetic drift are most marked in very small isolated population, although it occurs in all populations.

2. (b) : In a stable population, for a gene with two alleles, 'A' (dominant) and 'a' (recessive), if the frequency of 'A' is p and the frequency of 'a' is q, then the frequencies of the three possible genotypes (AA, Aa and aa) can be expressed by the Hardy-Weinberg equation:

$p^2 + 2pq + q^2 = 1$

where p^2 = Frequency of AA (homozygous dominant) individuals

q^2 = Frequency of aa (homozygous recessive) individuals

$2pq$ = Frequency of Aa (heterozygous) individuals

3. (b) **4. (c)**

5. (b) : Homologous organs have same fundamental structure but different function. The wing of a bird and flipper of a whale are structurally forelimbs, which consist of humerus, radio-ulna, carpals, metacarpals and digits but they perform different function. The wings of birds help them to fly while flipper helps the whale to swim.

6. (d) : The organs which have similar functions but are different in their structural details and origin are called analogous organs. The analogous structures are the result of convergent evolution.

7. (a)

8. (d) : Analogous organs are the organs which have similar function but are different in their structural details and origin. The analogous structures are the result of convergent evolution. The wings of an insect are analogous to wings of a bird because the basic structure of the wings of the insects is different from the wings of bird. However, their function is similar.

9. (d) : Natural selection is the most widely accepted theory concerning the principal causal mechanism of evolutionary change profounded by Charles Darwin and Alfred Russel Wallace. It results from the differential reproduction (some members of a population produce abundant offspring, some only a few and still others none), one phenotype as compared with other phenotypes in the same population. This determines the relative share of different genotypes which individuals possess and propagate in a population. Industrial melanism supports evolution by natural selection. It is an adaptation where the moths living in the industrial areas developed melanin pigments to match their bodies to the tree trunks.

10. (c) : Hardy-Weinberg law states that allele frequencies in a population are stable and remain constant from generation to generation when there is random and non-selective mating. In case of lack of random mating, genetic equilibrium may be disturbed.

11. (b) : The genetic variations exist due to reshuffling of genes caused by recombinations or by mutations. The recombinations are produced by the routine reshuffling of genes during independent assortment of chromosomes, reciprocal crossing of genes during crossing over and random fertilization of gametes.

12. (b) : The brain capacity gradually increased from early human ancestors to modern man. *Homo habilis* had 650 - 800cc brain capacity which increased around 900cc in *Homo erectus*. The Neanderthal man (*Homo neanderthalensis)* had 1400cc brain capacity which evolved to around 1450cc in *Homo sapiens*.

13. (c) : According to Hardy Weinberg principle

$p^2 + 2pq + q^2 = 1$; $(p + q)^2 = 1$

(AA) p^2 = 360 out of 1000 individual

or $p^2 = 0.36$

Therefore, $p = 0.6$.

14. (c) : The organs which have the same fundamental structure but are different in functions are called homologous organs. These organs follow the same basic plan of organisation during their development. But in the adult condition, these organs are modified to perform different functions as an adaptation to different environments. The fore-limbs of cat, lizard, whale and bat have the same basic structural plan. In each case the fore-limb consists of humerus, radio-ulna, carpals, metacarpals and digits. The skeletal parts of the fore-limbs of all these vertebrates are similar in structure and arrangement. But the fore-limbs of these animals have different shapes and functions. In lizard they are used for walking, in cat for running, in whale for swimming and in bat for flying.

15. (a, b) : The organs which have similar functions but are different in their structural details and origin

are called analogous organs. The wings of bat are analogous to wings of pigeon. It is due to the fact that the basic structure of the wings of the mammal is different from the wings of bird. However, their function is similar. Similarly, gills of prawn and lungs of man, both are respiratory organs yet they have very different basic structure.

16. (c) : Intraspecific competition leads to evolution. Variations arise naturally in a growing population due to crossing over etc. Organisms with variations better suited to their environment are favoured by natural selection, while less fitted ones are eliminated. Gradually this continued process of natural selection leads to evolution. Interspecfic struggle also plays a role in evolution but intraspecific struggle is more intense and prominent one.

17. (b) : Hardy-Weinberg law states that allele frequencies in a population are stable and remain constant from generation to generation when there is random and non-selective mating. In case of lack of random mating, genetic equilibrium may be disturbed.

18. (d) : Genetic drift (Sewall Wright effect) is the random change in the frequency of alleles in a population over successive generations in the gametes. Each new generation differs from its parental generation with regard to allele frequencies simply because of random variation in the distribution of gametes. This process is more rapid in smaller populations, or when the alleles concerned confer no apparent benefit compared to their counterparts.

19. (d) : Convergent evolution is the development of superficially similar structures in unrelated organisms, usually because the organisms live in the same kind of environment. Examples are the wings of insects and birds and the streamlined bodies of whales and fish. One can say that it is the similar habitat that has resulted in selection of similar adaptive features in different groups of organisms but toward the same function. An example of convergent evolution is the similar nature of the flight/wings of insects, birds, pteridosaurs, and bats. All four serve the same function and are similar instructure, but each evolved independently. Some species of the lens of eyes also evolved independently in various animals.

20. (a)

21. (c) : *Refer to answer 18.*

22. (b) : The genetic variations exist due to reshuffling of genes caused by recombinations or by mutations. The recombinations are produced by the routine reshuffling of genes during independent assortment of chromosomes, reciprocal crossing of genes during crossing over and random fertilization of gametes. Mutation is the sudden inheritable discontinuous variation which appears in an organism due to permanent changes in its genotype. Mutation can occur at any stage during the development. Mutations are heritable changes, that is, if they appear in somatic cells they are inherited to daughter cells by mitosis but if they appear in gamete cells they are inherited to the offsprings. The former are known as somatic mutations and latter as germ mutations. They bring about a change in the genetic message and cause variation.

23. (b) : Dinosaurs dominated in Jurassic period of mesozoic era and were extinct by cretaceous period.

24. (a) : Darwin's finches show adaptive radiation. This radiation occurred in response to various food resources available. These finches feed on insects, tree buds, seeds, cactus etc. Carrion are dead bodies and no finches feed on them.

25. (a) : Adaptive radiation (divergent evolution) is the evolution from one species of animals or plants of a number of different forms. As the original population increases in size it spreads out from its centre of origin to exploit new habitats and food sources. In time, this results in a number of populations each adapted to its particular habitat, eventually these populations will differ from each other sufficiently to become new species.

26. (a) : Development of similar adaptive functional structures in unrelated groups of organisms is called convergent evolution. It shows analogy. Examples are wings of butterfly and birds, eye of the octopus and the mammals, flippers of penguins & dolphins, etc. On the other hand, divergent evolution involves development of different functional structures along different directions due to adaptations to different needs from a common ancestral form. For example, forelimbs of vertebrates (whales, bat, cheetah, human). Though these perform different functions, they have similar anatomical structures.

27. (c) : Binocular vision, smaller jaw and upright posture are the main adaptations that led to evolution of man from its ancestors. But, during human evolution major and most significant changes occurred in the cranial capacity of man. In living modern man it is about 1450 cc compared to 500 cc in *Australopithecus*. Increased cranial capacity accommodates larger brain and forms the basis of social, cultural and educational evolution of modern man.

28. (b)

29. (a) : The term mutation was coined by Hugo de Vries (1901) for large spontaneous inheritable changes which occur suddenly in naturally reproducing population. He also proposed mutation theory of evolution in his book "The Mutation Theory" published in 1903 in which he put forth that evolution occurred due to large discontinuous variations. He worked on *Oenothera lamarckiana* or evening primrose. During his experiments he found 834 mutations in a population of 54343 plants. It was later on found that the mutations observed by Hugo de Vries were actually chromosomal aberrations.

30. (c) : *Refer to answer 24.*

31. (a) : *Refer to answer 27.*

32. (d) : The most apparent change during evolutionary history of modern man (*Homo sapiens*) is the increase in the brain size. The brain capacity gradually increased from early human ancestors. *Homo habilis* had 650-800 c.c. brain capacity which increased to 900 c.c. in *Homo erectus*. The true men including the living modern man also displayed the gradual increase in cranial size. The neanderthal man had 1400 cc brain capacity which evolved to around 1450 c.c. (1300 – 1600 c.c.) in living modern man (*Homo sapiens sapiens*).

33. (b) : *Peripatus* belongs to phylum onychophora. It shows characters of annelids as well as arthropods. Owing to its resemblance with two different phyla, *Peripatus* is often referred to as connecting link between them. This shows an important morphological and anatomical evidence of evolution.

34. (d) : During post industrialisation period the tree trunk became dark due to industrial smoke and soots. White winged moths did not survive due to predators and dark winged moths survived because they were less easily seen by them against a dark background. Thus industrial melanism supports evolution by natural selection that favours the establishment of one particular advantageous mutation within a population.

35. (c) : Theory of continuity of germplasm was put forward by August Weismann. According to this, the characters influencing the germ cells are only inherited. There is a continuity of germ plasm but the somataplasm is not transmitted to the next generation hence it doesn't carry characters to next generation.

36. (c) : The condition for origin of life, partial isolation, has been attained within aggregates of artificially formed prebiotic molecules. These aggregates are called protobionts which can separate combinations of molecules from the surroundings. They maintain an internal environment but are unable to reproduce. Two important protobionts are coacervates and microspheres.

37. (d) : The organs which have the same fundamental structure but are different in function are called homologous organs. Thorn of *Bougainvillea* and tendril of *Cucurbita* both arises in the axillary position, but have different functions.

38. (c) : Haeckel (1810) proposed that developing animal embryo passes through stages resembling adult forms of its ancestors. Earnst Haeckel (1868, 1874) formulated biogenetic law or racapitulation theory which states that ontogeny (developmental history of an individual) repeats phylogeny (development history of races).

39. (c) : Chemical evolution has two meanings and uses. The first refers to the theories of evolution of the chemical elements in the universe through nucleosynthesis. The second use of chemical evolution or chemosynthesis is as a hypothesis to explain how life might possibly have developed or evolved from non-life.

40. (c) : Biogeographical evolution is a process in which gene pool of a population gradually changes in response to environmental pressures, natural selection and genetic mutations.

41. (c) : *Refer to answer 19.*

42. (a) : *Refer to answer 25.*

43. (b) : Homologous organ and vestigial organs provide an important evidence in favour of organic evolution (process by which changes in the genetic composition of populations of organisms occur in response to environmental changes). For example, human appendix is a developmental derivative and evolutionary vestige of the end of the much larger herbivorous caecum found in our primate ancestors. They both are structurally homologous and have different functions. In most vertebrates, the caecum is a large, complex gastrointestinal organ, enriched in mucosal lymphatic tissue and specialized for digestion of plants. The caecum varies in size among species, but in general the size of the caecum is proportional to the amount of plant matter in a given organism's diet. It is largest in obligate herbivores, animals whose diets consist entirely of plant matter. However, even though humans are herbivorous, the small human caecum does not house cellulose-digesting bacteria, and lost an essential function of cellulose digestion.This shows the close evolutionary relationships between homologous and vestigial organs.

44. (d) : Stanley Miller in 1953, who was then a graduate student of Harold Urey at the University of Chicago, circulated four gases - methane, ammonia, hydrogen and water vapour in an air tight apparatus and passed electrical discharges from electrodes. He passed the mixture through a condenser. He circulated the gases continuously in this way for one week and then analysed the chemical composition of the liquid inside the apparatus. He found a large number of simple organic compounds including some amino acid such as alanine, glycine and aspartic acid. Glutamic acid was not found.

45. (b) : Jurassic period of mesozoic era is characterised by gymnosperms as dominant plant and the appearance of first toothed bird. Conifers, cycads and ferns were widespread.

46. (a) : Praying mantis shows the phenomenon of camouflage by blending itself into the background. This enables it to elude predators.

47. (d) : Microbes were killed by heating the meat and the sealed vessel formed a closed system wherein the new microbes could not come in contact with the nutrient medium and hence no spoilage of meat.

48. (c) : *Refer to answer 29.*

49. (b)

50. (c) : According to Darwin's theory of survival of the fittest (Natural selection), the organisms which are provided with favourable variations would survive, because they are the fittest to face their surroundings, while the unfit are destroyed. Darwin considered that useful variations are transmitted to the offspring and appear more prominently in succeeding generations. After some generations these continuous and gradual variations in the possessor would be so distinct that they form a new species. This is proved by, the pesticide resistant insects that have the ability to survive as they have resistance genes and so they are selected by nature. Other insects lacking these genes will be killed by pesticides.

51. (c) : Electron spin resonance (ESR) measures the number of charges occupying deep traps in the crystal bandgap. By measuring the change in absorption of microwave energy within a continuously varying strong magnetic field, this method detects the number of "unpaired spins" of electronic charges trapped at various defects in the mineral lattice.

The principle of ESR dating is that radiation damage occurs in minerals as a result of uranium uptake, and external effects. This damage is usually repaired in living tissue, but in dead tissue it accumulates. If the method of uptake can be judged, then the approximate age of the tissue can be deduced from the extent of the radiation damage.

52. (d) : In a stable population, for a gene with two alleles, *A* (dominant) and *a* (recessive), if the frequency of *A* is *p* and the frequency of *a* is *q*, then the frequencies of the three possible genotypes (*AA*, *Aa*, and *aa*) can be expressed by the given Hardy-Weinberg equation :

$$p^2 + 2pq + q^2 = 1.$$

where p^2 = frequency of *AA* (homozygous dominant) individuals, $2pq$ = frequency of *Aa* (heterozygous) individuals, and q^2 = frequency of *aa* (homozygous recessive) individuals. The equation can be used to calculate allele frequencies if the numbers of homozygous recessive individuals in the population is known. The equation and the equilibrium are named after British mathematician G.H. Hardy and German physician W. Weinberg.

So $p = 0.6$ and $q = 0.4$ (given)

$\therefore$ $2pq$ (frequency of heterozygote)

$= 2 \times 0.6 \times 0.4 = 0.48$

53. (b) : Species may be defined as an uniform interbreeding population or group of individuals which freely interbreed among themselves. Gene flow occurs between populations of a species by gene migration *i.e.*, emigration and immigration.

54. (c) : *Refer to answer 51.*

55. (d) : Apes are the members of the hominoidea superfamily of primates, which includes humans. Under the current classification system there are two families of hominoids:

- The family hylobatidae consists of 4 genera and 13 species of gibbons, including the Lar Gibbon and the Siamang, collectively known as the "lesser apes"
- The family hominidae consisting of orangutans, gorillas, chimpanzees, and humans, collectively known as the "great apes".

Within the superfamily Hominoidea, gibbons are the outgroup: this means that the rest of the hominoids are more closely related to each other than any of them are to gibbons.

Investigation showed orangutans to be the outgroup, but comparing humans to all three other hominid genera showed that African apes (chimpanzees and gorillas) and humans are more closely related to each other than any of them are to orangutans.

However, DNA comparisons from sex chromosomes and autosomes provide convincing evidence that

within the subfamily homininae, gorillas are the outgroup. This suggests that chimpanzees should be in hominini along with humans.

56. (a) : *Cycas* and *Ginkgo* are often considered as the living fossil because they are one of the few representative of once a large group of plants (which was once a well flourished group) and possess traits of extinct pteridosperms and other gymnosperms.

57. (b) : The first scientific explanation of origin of life was put forward by a Russian Scientist, A.I. Oparin in 1923. J.B.S. Haldane (1928), England-born Indian Scientist, also made similar observations regarding the origin of life. According to them primitive atmosphere was reducing atmosphere because hydrogen atoms (most numerous and most reactive) combined with all available oxygen atoms to form water and leaving no free oxygen.

58. (a) : Diversification in plant life appeared due to long periods of evolutionary changes. Initially plants were thalloid. There were no differentiation among root, stem and leaves. Vascular tissues were absent.

59. (d) : Convergent evolution is the formation of similar traits by unrelated groups of organisms. Dogfish and whale are the interesting examples of convergent evolution in animals as both of them have more or less similar body organization.

60. (c) : The gist (in brief) of Darwin - Wallace theory is as follows.

(i) Individuals within species show considerable but continuous variation in the form and physiology.

(ii) This variation arises in a random fashion and is heritable.

(iii) The potential for increase within population of animals and plants is considerable.

(iv) Since resources are limited, so individuals in a population struggle for their own existence.

(v) Only some survive and leave offsprings with the same trait - through this natural selection of the fittest species become represented by individuals which are better adapted.

61. (b) : *Refer to answer 18.*

62. (c) : Industrial melanism is an adaptation where the moths living in the industrial areas developed melanin pigments to match their body to the soot-covered surroundings. These melanic forms are mainly distributed in and around large industrial cities, where the environment has been altered by the pollution of the atmosphere; and is manifested by the appearance of dark colour of lichen-covered tree trunks, on which the moths rest during the day time. The peppered moth exists in two strains (forms) : light coloured (white) and melanic (black). In the past, bark of trees was covered by whitish lichens, so white moths escaped unnoticed from predatory birds. After industrialization barks got covered by smoke, so the white moths were selectively picked up by birds. But black moths escaped unnoticed so they managed to survive resulting in more population of black moths and less population of white moths.

63. (b) : In a random mating population in equilibrium, random drift brings about a change in gene frequency in a non-directional manner. Random drift is a non-directional factor. In actual practice, the gene frequencies due to random drift may approach to limits, *i.e.*, 0 and 1. This would be possible only when new population arises due to a very small sample leading to the fixation of one allele at the cost of other. In this manner the changes in the gene frequency can be brought about without the existence of any directional force i.e. mutation, selection and migration and this change in gene frequency has been called random genetic drift.

64. (d) : The theory of natural selection is based on the following factors :

(i) Rapid multiplication and limited food and space which leads to struggle for existence.

(ii) Struggle for existence and variations which leads to natural selection or survival of the fittest.

(iii) Natural selection and inheritance of useful variation over many generation which leads to formation of new species.

Darwin in his "Natural Selection Theory" did not believe in the role of discontinuous variation in natural selection. Darwin always believed in the universal occurrence of variation. In his opinion, variation is continuous in nature. Darwin did not understand the cause of variation and assumed it was one of the innate properties of living things. Now it is known that variation is due to mutation and thus it may be discontinuous.

65. (a) : *Refer to answer 14.*

66. (b) : *Refer to answer 56.*

67. (d) : Mimicry is specially evolved primarily for concealment and protection. Concealment itself may prove to be defensive and may also help in offence. Mimicry is defined as the resemblance of one organism to another or to any natural object.

68. (b) : The phenomenon of development of a new species from pre-existing one is called speciation.

Reproductive isolation is the prevention of interbreeding between the populations of two different species. It maintains the characters of the species but can lead to the origin of new species.

69. (b)

70. (a) : *Refer to answer 18.*

71. (b) : Water is the most essential material to survive. One can thrive without O_2 (anaerobic bacteria) and light and in a wide range of temperature but one cannot live without water which is the most important component of the body (about 90% of plasma consists of water) and life was originated from abiogenetic materials in water.

72. (c) : The common ancestor of both ape and man is *Dryopithecus* – a 20 million years old fossil discovered from Africa. *Austroalopithecus* also lived in Africa between 6 million to 1 million years ago. The genus *Homo* evolved 2 million years ago from one of such Australopithecines in Africa and then only moved out of the continent.

The first such *Homo* lived throughout Asia, some parts of Europe and Africa. But obviously its evolution took place in Africa.

73. (b) : Allele frequency in a population can remain constant only if individuals of the population randomly interbreed. Generally it never happens in nature and species populations exist in small groups of randomly breeding subpopulations. Thus allele frequency between two subpopulations may differ but allele frequency within the subpopulation will remain constant. Such subpopulations are termed Mendelian populations or deme. Exchange of genes between demes takes place occasionally. Mutation, gene flow (due to migration), etc. may tend to change the allele frequency of the subpopulation.

74. (b) : Carl Woese came up with the theory of life based on his discovery that the genes encoding ribosomal RNA are ancient and distributed over all lineages of life with little or no gene transfer. Therefore, *r*RNA are commonly recommended as molecular clocks to the phylogeny.

75. (b) : Mesozoic era is the era during which reptiles were dominant. It includes three periods : Triassic (240 million years ago), Jurassic (195 million years ago) and Cretaceous (135 million years ago). Origin of dinosaurs occurred during triassic period. During Jurassic period, lizards, crocodiles and alligators originated. Dinosaurs became large and reptiles were dominant during this period. During cretaceous period, dinosaurs got extinct.

76. (a) : The two criteria on basis of which Nikolai Ivanwitch Vavilov proposed different centre of origin were (a) occurrence of maximum variation in the crop and (b) occurrence of wild relatives.

77. (b) : ^{14}C has a half life of 5570 years and is used in radio carbon dating. Carbon in living things contains a uniform amount of radioactive ^{14}C produced constantly in the atmosphere. From the amount of ^{14}C in the dead sample, the age of the organism can be determined.

78. (b)

79. (c) : *Refer to answer 19.*

80. (b) : The organisms which are provided with favourable variations would survive, because they are the fittest to face their surroundings, while the unfit are destroyed. Darwin considered that useful variations are transmitted to the offspring and appear more prominently in succeeding generations. After some generations these continuous and gradual variations in the possessor would be so distinct that they form a new species.

81. (a) : *Refer to answer 55.*

82. (c)

83. (b) : The first living beings were prokaryotic, like bacteria. They were single-celled. Nucleic acid core consisted of naked DNA. These living beings were present in the environment of soupy sea having abundant organic molecules. Nutritionally they were chemoheterotrophs. They absorbed the organic materials from outside both for body building and liberation of energy. Respiration was anaerobic since free oxygen was absent in the environment.

84. (b) : Mutation is any hereditary change in the make up of an individual other than that which may be caused by the simple recombination of genes. Mutations may occur in any direction.

85. (b) : Occurrence of endemic species in South America and Australia is due to geographic isolation (continental separation). Animals occupy all diverse habitats. The distribution, continuous or discontinuous of a species or a group of organisms depends on many factors like evolutionary, climatic, physical or biological barriers etc.

86. (d) : According to theory of pangenesis Darwin thought that every somatic cell of the body produces a tiny particle called gemmule or pangene which contains both the parental and acquired characters. All gemmules or pangenes of the body cells collect in the gametes and are passed on to the zygote where they guide the growth of different parts of the embryo.

87. (b) : The vestigial organs are the useless remnants of structures or organs which might have been large and functional in the ancestors. Segmental muscles in abdomen, coccyx, third molar (wisdom teeth) of human are vestigial organs. Nail is not a vestigial organ of human.

88. (d) : *Homo sapiens sapiens* appeared about 25000 years ago in holocene epoch and started spreading all over the world about 10000 years ago. It is believed that the man of today first appeared about 11000 or 10000 years ago in the region around Caspean and Mediterraneasn Seas. From there, its members migrated westwards, eastwards and southwards, respectively changing into the present day white or Caucasoid, Mongoloid and black or Negroid races.

89. (a) : Humans differ from most primates in that they lack a tail. The lower primates have tails, and the apes, which are believed by many to be our closest relatives, likewise are tailless.

90. (a) : Galapagos Islands are a chain of 14 islands in the Pacific ocean on the west coast of South America. Charles Darwin visited these islands during his famous voyage on HMS Beagle (name of his ship) in 1835. The flora and fauna of these islands resemble with those of the South American mainland with which the Galapagos Islands were once connected. However, Darwin's finches (birds of Galapagos Islands) influenced Darwin to think about the evolutionary change. These birds designated as Darwins' finches by Dr. David Lack (1947) do not resemble the birds of the South American species. These finches were the first to reach the Galapagos Islands as migrants from the mainland (South America). When they reached the islands, they faced many problems for obtaining food. Thus, they had to change their feeding habits.

91. (a) : *Refer to answer 55.*

92. (a) : Replication of genetic material is the most important factor for continuity of a species from evolutionary point of view. When genetic material replicates, only then it could be transferred from one generation to next resulting in continuity of a species. Asexual animals do not produce gametes while sexual animals do. So, formation of gametes is not an important factor in asexual animals though replication of genetic material takes place in both asexual as well as sexual animals. Synthesis of proteins does not play any role in continuity of species.

93. (c) : *Refer to answer 62.*

94. (a) : Wings of birds and hands of human have the same structure but different functions. Birds use their wings for flying while humans use their hands for grasping. Other options show examples of analogous organs. Analogous organs are those organs which have similar functions but different structural details.

95. (c) : Haeckel's biogenetic law states that "Ontogeny repeats phylogeny". Ontogeny is the life history of an organism while phylogeny is the evolutionary history of the race of that organism. In other words an organism repeats its ancestral history during development. Therefore, during embryonic development the mammalian heart first takes the form of fish, then frog and at last mammal.

96. (a) : The fossil of *Dryopithecus africanus* was discovered from Miocene rocks of Africa and Europe. It lived about 20-25 million years ago. It was ape-like but had arms and legs of the same length. Heels in its feet indicate its semi-erect *Dryopithecus africanus* is regarded a common ancestor of man and apes (gibons, organgutan, chimpanzee and gorilla).

97. (c) : *Homo erectus* is the ancestor of man (not the direct ancestor of modern man). It includes three fossils: Java Ape-man, Peking man and Heidelberg man. Neanderthal man is the direct ancestor of Cro-magnon man which in turn is the direct anceston of modern man. Fossils of Cro-magnon were discovered from France. *Australopithecus* is the first ape man.

98. (b) : Allopatric species are those that could interbreed but do not because they are geographically isolated. Sympatric are groups of similar organisms that, although in close proximity and theoretically capable of interbreeding, do not interbreed because of differences in behaviour, flowering time, etc. Siblings are offspring of the same parents.

99. (c) : Darwin observed great variations among the organisms that lived on Galapagos islands. The common birds of Galapagos islands, the finches were markedly different from the finches of main land. In fact Darwin took idea from the finches found on the Galapagos Islands for his theory of natural selection.

100. (d) : *Refer to answer 18.*

101. (a) : *Homo habilis* lived during Pleistocene. He lived in Africa about 2 million years ago. He was about 1.2 to 1.5 metres tall. He had bipedal locomotion, moved erect and was omnivorous. *Homo habilis* (*habilis* = mentally able or skilful) was the first tool maker and used tools of chipped stones extensively.

Homo erectus appeared about 1.7 million years ago in middle Pleistocene. *H. erectus* evolved from *Homo habilis*. He had erect posture, protruding jaws, projecting brow ridges and small canines and large molar teeth. He was omnivorous. He made more elaborate tools of stones and bones, hunted big game and perhaps knew use of fire.

102. (d) : A close relationship of apes with man is revealed by their relatively larger brain and cranial capacity, efficient memory. Cranial capacity of apes is under 650 cc. Cranial capacity of man is 1350 to 1600 cc.

103. (b) : *Refer to answer 56.*

104. (b) : Development of similar adaptive functional structures in unrelated groups of organisms is called convergent evolution. Example : wings of insect, bird and bat. Thus analogous organs show convergent evolution (adaptive convergence).

105. (c) : Allen's law states, animals that live in very cold climates, their extremities such as ears, tails etc. become progressively smaller. Cope's law states that there is a tendency for animals to increase in size during the long course of evolution. Dollo's law states that evolution is irreversible. Bergman's law states that warm blooded animals become larger in the northern and colder parts of their range.

106. (c) : Loss of tail is probably the useless change for the man in the course of evolution. The volume of cranial cavity and size of skull also increased in order to accommodate the large and complex brain. The modern man excels all other animals in intelligence. Erect posture of human beings is due to major changes in the muscle skeletal system. During the course of evolution of man, thumb (pollex) has been brought opposite to the fingers thus enabling the hand for better grasping power.

107. (d) : *Homo sapiens fossilis* is also known by the name of Cro-magnon man. He was the direct ancestor of modern man (*Homo sapiens*). Cro-Magnon man emerged about 34000 years ago in Holocene epoch. Thus, it is regarded as most recent ancestor of today's man. Its cranial capacity was, however, somewhat more than ours, being about 1650 cc. It became extinct about 10000-11000 years ago.

108. (d) : Human body has been described to possess about 90 vestigial organs. Some of these are nictitating membrane, muscles of pinna (part of external ear), vermiform appendix, caudal vertebrae (also called coccyx or tail bone), third molars (wisdom teeth), hair on body, and nipples in male.

109. (d) : *Refer to answer 56.*

110. (d) : Hydrogen atoms were most numerous and most reactive in primitive atmosphere. First hydrogen atoms combined with all oxygen atoms to form water and leaving no free oxygen. Hydrogen atoms also combined with nitrogen, forming ammonia (NH_3). So water and ammonia were probably the first compound molecules of primitive earth. Later methane, water and NH_3 join to form amino acids which gets converted into proteins while hydrogen bases, sugars and phosphates combine to form nucleic acids.

111. (c) : The first domesticated animal by primitive man was dog. Cro-magnon man used to carry domesticated dogs while going for hunting.

112. (b) : The radioactive strontium - 90 can lead to various bone disorders and diseases, including bone cancer. It emits high energy beta radiations. Phosphorus - 32 also emit high energy beta radiations but they cannot penetrate human skin. Caesium - 137 (beta emitter) and iodine - 131 (β and γ emitter) also pose danger to human health but not as much as strontium - 90 which is a long-lived radioactive element and tends to cycle like calcium.

113. (a) : *Refer to answer 62.*

114. (c) : *Refer to answer 43.*

115. (a) : Precambrian period extends from 2300 to 3800 million years ago, which is considered as period of early life. During this period prokaryotes (monera) and eukaryotes (protista) originate.

116. (d) : In the embryos of all vertebrates, the presence of gill slits support the theory of recapitulation (repeating the early stages of embryogenesis in earlier evolved animals.)

117. (d) : Sclatter in 1857 recognised six zoogeographical regions on the basis of the distribution of terrestrial vertebrates, chiefly mammals.

(i) The Palaearctic region
(ii) The Ethiopian region
(iii) The Indian region (Oriental)
(iv) The Australian region
(v) The Neotropical region
(vi) The Neoarctic region

The Palaearctic region includes the whole northern part of the Old World, *i.e.* whole of Europe, northern part of Africa and Asia, North of the Himalayas. Oriental region includes the whole of India, Ceylon, South China, Burma, Thailand, Malaya of Peninsula, Malayan Islands. The Palaearctic and Oriental regions are separated by Himalayan range.

118. (b) : In ancient period hands were used to collect food and to save themselves. Gradually men learnt to cook food, to make tools for their own purpose, this change in habit brings perfection in their hand. Similarly, there is an increase in the ability to communicate with others and develop community behaviour. But as in ancient period, men still eat hard nuts and hard roots (though they often take soft food also). Thus change in diet is the most irrelevant change in the evolution of man.

119. (b) : Melanization in peppered moth is an example in support of the theory of natural selection. Lamarckism is the first theory of evolution, which was proposed by Jean Baptiste de Lamarck. Its theory of inhertance of acquired characters cannot be explained by melanization in peppered moth.

120. (c) : The first fossil of the horse was found in north America. It was named *Eohippus*. This horse was about the size of a fox having short head and neck. The fore feet were with four complete fingers and one splint of first finger and the hind feet with three functional toes and one splint of fifth toe. Other stages in the evolution of horse were mesohippus, merychippus, pliohippus and equus.

121. (a)

122. (c) : Inbreeding is mating between closely related individuals, the extreme condition being self-fertilization, which occurs in many plants and some primitive animals. Heterosis is also known as hybrid vigour which is the increased vigour displayed by the offspring from a cross between genetically different parents. Hybridization is the production of one or more hybrid organisms by the mating of genetically different parents. In self-breeding the male and female gametes are derived from the same individual.

123. (a) : *Refer to answer 19.*

124. (d) : Lamarck gave theory of Lamarckism in which he explained inheritance of acquired characters which states that whatever an individual acquires characters in its life time due to internal vital force, effect of environment, new needs and use and disuse of organs, they are inherited to the next generations. The process continues. After several generations, the variations are accumulated upto such extent that they give rise to new species. This theory was proved wrong by August Weismann. Weismann cut off the tails of rats for as many as 22 generations and allowed them to breed, but tailless rats were never born.

125. (c) : *Refer to answer 64.*

126. (d)

127. (b) : *Refer to answer 83.*

128. (c) : The primitive atmosphere was reducing atmosphere *i.e.,* without free oxygen.

129. (c) : The first geological time scale was developed by Giovanni Avduina, Italian scientist in 1760. The history of the earth has been divided into a number of major divisions called eras. The eras are sub-divided into periods. The modern periods are further divided into epochs. There are four eras. The correct sequence is Precambrian Palaeozoic (era of ancient life) → Mesozoic (era of medieval life) → Coenozoic (era of modern life).

130. (a) : Palaeontology is the study of extinct organisms, including their structure, environment, evolution, and distribution, as revealed by their fossil remains. Herpetology is the study of reptiles and amphibians. Saurology is the study of snakes. Organic evolution deals with study of origin of life and origin of new species.

131. (d) : Development of similar adaptive functional structures in unrelated groups of organisms is called adaptive convergence or convergent evolution *e.g.* wings of insect, bird and bat show marked convergent evolution. When convergent evolution is found in closely related species, it is called "Parallel evolution". Example : development of running habit in deer (2-toed) and horse (1-toed) with two vestigial splint bones.

132. (a)

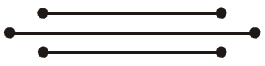
133. (b) : The term evolution was coined by Herbert Spencer, an English philosopher which means unrolling or unfolding of nature that brings about an orderly change from one form or condition to another resulting in descendents becoming different from ancestors. Thus, it is history and development of race alongwith variations.

134. (b)

135. (b) : *Refer to answer 119.*

136. (d) : Darwin published his observations and conclusions regarding evolution in the book "Origin of Species" in 1859. Darwin's this book became very popular and changed people's thinking about organic evolution.

137. (c)



Chapter
30

Human Health and Diseases

1. Transplantation of tissues/organs fails often due to non-acceptance by the patient's body. Which type of immune response is responsible for such rejections?
(a) Cell-mediated immune response
(b) Hormonal immune response
(c) Physiological immune response
(d) Autoimmune response *(NEET 2017)*

2. MALT constitutes about _____ percent of the lymphoid tissue in human body.
(a) 20% (b) 70% (c) 10% (d) 50%
(NEET 2017)

3. Which of the following sets of diseases is caused by bacteria?
(a) Cholera and tetanus
(b) Typhoid and smallpox
(c) Tetanus and mumps
(d) Herpes and influenza *(NEET-II 2016)*

4. Which of the following is correct regarding AIDS causative agent HIV?
(a) HIV is enveloped virus containing one molecule of single-stranded RNA and one molecule of reverse transcriptase.
(b) HIV is enveloped virus that contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase.
(c) HIV is unenveloped retrovirus.
(d) HIV does not escape but attacks the acquired immune response. *(NEET-II 2016)*

5. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain
(a) gamma globulin
(b) attenuated pathogens
(c) activated pathogens
(d) harvested antibodies. *(NEET-I 2016)*

6. Which of the following statements is not true for cancer cells in relation to mutations?
(a) Mutations inactivate the cell control.
(b) Mutations inhibit production of telomerase.
(c) Mutations in proto-oncogenes accelerate the cell cycle.
(d) Mutations destroy telomerase inhibitor.
(NEET-I 2016)

7. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to
(a) autoimmune disease
(b) active immunity (c) allergic response
(d) graft rejection. *(NEET-I 2016)*

8. If you suspect major deficiency of antibodies in a person, to which of the following would you look for confirmatory evidence?
(a) Haemocytes
(b) Serum globulins
(c) Fibrinogen in plasma
(d) Serum albumins *(2015)*

9. Which of the following immunoglobulins does constitute the largest percentage in human milk?
(a) IgA (b) IgG (c) IgD (d) IgM
(2015)

10. Which of the following diseases is caused by a protozoan?
(a) Babesiosis (b) Blastomycosis
(c) Syphilis (d) Influenza
(2015)

11. Grafted kidney may be rejected in a patient due to
(a) passive immune response
(b) innate immune response
(c) humoral immune response
(d) cell-mediated immune response. *(2015)*

12. Match each disease with its correct type of vaccine.

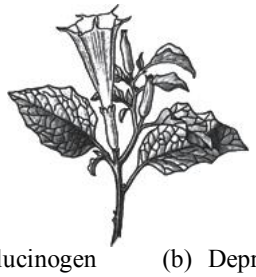
	Column I	Column II
A.	Tuberculosis	(i) Harmless virus
B.	Whooping cough	(ii) Inactivated toxin
C.	Diphtheria	(iii) Killed bacteria
D.	Polio	(iv) Harmless bacteria

(a) A-(iv), B-(iii), C-(ii), D-(i)
(b) A-(i), B-(ii), C-(iv), D-(iii)
(c) A-(ii), B-(i), C-(iii), D-(iv)
(d) A-(iii), B-(ii), C-(iv), D-(i)
(2015 Cancelled)

13. The active form of *Entamoeba histolytica* feeds upon
(a) food in intestine
(b) blood only
(c) erythrocytes, mucosa and submucosa of colon
(d) mucosa and submucosa of colon only.
(2015 Cancelled)

14. HIV that causes AIDS, first starts destroying
(a) helper T-lymphocytes
(b) thrombocytes
(c) B-lymphocytes
(d) leucocytes. *(2015 Cancelled)*

15. Which is the particular type of drug that is obtained from the plant whose one flowering branch is shown here?



(a) Hallucinogen (b) Depressant
(c) Stimulant (d) Pain killer *(2014)*

16. At which stage of HIV infection does one usually show symptoms of AIDS?
(a) Within 15 days of sexual contact with an infected person
(b) When the infected retro virus enters host cells
(c) When HIV damages large number of helper T - lymphocytes
(d) When the viral DNA is produced by reverse transcriptase *(2014)*

17. Infection of *Ascaris* usually occurs by
(a) Tse-tse fly
(b) mosquito bite
(c) drinking water containing eggs of *Ascaris*
(d) eating imperfectly cooked pork.
(NEET 2013)

18. Which one of the following statements is correct regarding sexually transmitted diseases (STDs)?
(a) A person may contact syphilis by sharing milk with one already suffering from the disease.
(b) Haemophilia is one of the STDs.
(c) Genital herpes and sickle-cell anaemia are both STDs
(d) The chances of a 5-years boy contracting a STD are very little.
(Karnataka NEET 2013)

19. Identify the site where *Wuchereria bancrofti* is normally found in human body.
(a) Muscles of the legs
(b) Blood vessels of the thigh region
(c) Skin between the fingers
(d) Lymphatic vessels of the lower limbs
(Karnataka NEET 2013)

20. Which one of the following is a hallucinogenic drug?
(a) Caffeine (b) Morphine
(c) Lysergic acid diethylamide
(d) Opium *(Karnataka NEET 2013)*

21. Motile zygote of *Plasmodium* occurs in
(a) gut of female *Anopheles*
(b) salivary glands of *Anopheles*
(c) human RBCs
(d) human liver. *(2012)*

22. Widal test is carried out to test
(a) malaria (b) diabetes mellitus
(c) HIV/AIDS (d) typhoid fever.
(2012)

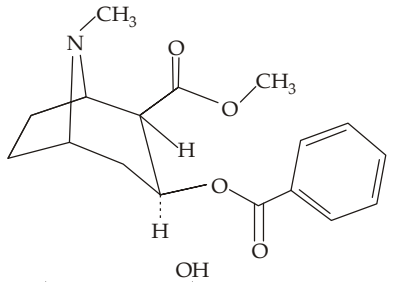
23. Common cold differs from pneumonia in that
(a) pneumonia is a communicable disease whereas the common cold is a nutritional deficiency disease
(b) pneumonia can be prevented by a live attenuated bacterial vaccine whereas the common cold has no effective vaccine
(c) pneumonia is caused by a virus while the common cold is caused by the bacterium *Haemophilus influenzae*
(d) pneumonia pathogen infects alveoli whereas the common cold affects nose and respiratory passage but not the lungs. *(2012)*

24. Which one of the following is not a property of cancerous cells whereas the remaining three are?
(a) They compete with normal cells for vital nutrients.
(b) They do not remain confined in the area of formation.
(c) They divide in an uncontrolled manner.
(d) They show contact inhibition. *(2012)*

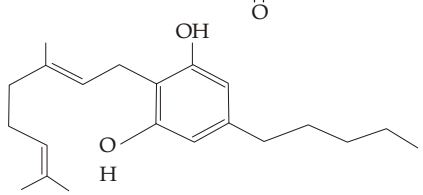
25. Cirrhosis of liver is caused by the chronic intake of
(a) opium (b) alcohol
(c) tobacco (chewing) (d) cocaine. *(2012)*

26. Identify the molecules (A) and (B) shown below and select the right option giving their source and use.

(A)



(B)



	Molecule	Source	Use
(a)	(A) Cocaine	*Erythroxylum coca*	Accelerates the transport of dopamine
(b)	(B) Heroin	*Cannabis sativa*	Depressant and slows down body functions
(c)	(B) Cannabinoid	*Atropa belladonna*	Produces hallucinations
(d)	(A)Morphine	*Papaver somniferum*	Sedative and pain killer

(Mains 2012)

27. Where will you look for the sporozoites of the malarial parasite?
(a) Saliva of infected female *Anopheles* mosquito
(b) Red blood corpuscles of human suffering from malaria
(c) Spleen of infected humans
(d) Salivary glands of freshy moulted female *Anopheles* mosquito *(2011)*

28. Which one of the following options gives the correct match of a disease with its causative organism and mode of infection?

	Disease	Causative organism	Mode of infection
(a)	Typhoid	*Salmonella typhi*	with inspired air
(b)	Pneumonia	*Streptococcus pneumoniae*	droplet infection
(c)	Elephantiasis	*Wuchereria bancrofti*	with infected water and food
(d)	Malaria	*Plasmodium vivax*	bite of male *Anopheles* mosquito

(Mains 2011)

29. Common cold is not cured by antibiotics because it is
(a) caused by a virus
(b) caused by a Gram-positive bacterium
(c) caused by a Gram-negative bacterium
(d) not an infectious disease. *(Mains 2011)*

30. Ringworm in humans is caused by
(a) bacteria (b) fungi
(c) nematodes (d) viruses. *(2010)*

31. Widal test is used for the diagnosis of
(a) malaria (b) pneumonia
(c) tuberculosis (d) typhoid. *(2010)*

32. Which one of the following statements is correct with respect to AIDS?
(a) The HIV can be transmitted through eating food together with an infected person
(b) Drug addicts are least susceptible to HIV infection
(c) AIDS patients are being fully cured cent per cent with proper care and nutrition
(d) The causative HIV retrovirus enters helper T-lymphocytes thus reducing their numbers. *(2010)*

33. Infectious proteins are present in
(a) gemini viruses (b) prions
(c) viroids (d) satellite viruses. *(2010)*

34. Select the correct statement from the ones given below.
(a) Barbiturates, when given to criminals, make them tell the truth.
(b) Morphine is often given to persons, who have undergone surgery, as a pain killer.
(c) Chewing tobacco lowers blood pressure and heart rate.
(d) Cocaine is given to patients after surgery as it stimulates recovery. *(2010)*

35. Which one of the following techniques is safest for the detection of cancers?
(a) Magnetic resonance imaging (MRI)
(b) Radiography (X-ray)
(c) Computed tomography (CT)
(d) Histopathological studies *(Mains 2010)*

36. A person suffering from a disease caused by *Plasmodium*, experiences recurring chill and fever at the time when
(a) the sporozoites released from RBCs are being rapidly killed and broken down inside spleen
(b) the trophozoites reach maximum growth and give out certain toxins
(c) the parasite after its rapid multiplication inside RBCs ruptures them, releasing the stage to enter fresh RBCs
(d) the microgametocytes and megagametocytes are being destroyed by the WBCs.
(Mains 2010)

37. Which one of the following statements is correct?
(a) Benign tumours show the property of metastasis
(b) Heroin accelerates body functions
(c) Malignant tumours may exhibit metastasis
(d) Patients who have undergone surgery are given cannabinoids to relieve pain.
(2009)

38. Which of the following is a pair of viral diseases?
(a) Common cold, AIDS
(b) Dysentery, common cold
(c) Typhoid, tuberculosis
(d) Ringworm, AIDS *(2009)*

39. Match the disease in column I with the appropriate items (pathogen/prevention/treatment) in column II.

Column I	Column II
(A) Amoebiasis	(i) *Treponema pallidum*
(B) Diphtheria	(ii) Use only sterilized food and water
(C) Cholera	(iii) DPT Vaccine
(D) Syphilis	(iv) Use oral rehydration therapy

(a) A – (i), B – (i), C – (iii), D – (iv)
(b) A – (ii), B – (iii), C – (iv), D – (i)
(c) A – (i), B – (ii), C – (iii), D – (iv)
(d) A – (ii), B – (iv), C – (i), D – (iii) *(2008)*

40. Which one of the following is the correct statement regarding the particular psychotropic drug specified?
(a) Morphine leads to delusions and disturbed emotions.
(b) Barbiturates cause relaxation and temporary euphoria.
(c) Hashish causes after thought perceptions and hallucinations.
(d) Opium stimulates nervous system and causes hallucinations. *(2008)*

41. Increased asthmatic attacks in certain seasons are related to
(a) eating fruits preserved in tin containers
(b) inhalation of seasonal pollen
(c) low temperature
(d) hot and humid environment. *(2007)*

42. If you suspect major deficiency of antibodies in a person, to which of the following would you look for confirmatory evidence?
(a) Serum globulins
(b) Fibrinogen in the plasma
(c) Haemocytes
(d) Serum albumins. *(2007)*

43. Lysozyme that is present in perspiration, saliva and tears, destroys
(a) certain types of bacteria
(b) all viruses
(c) most virus-infected cells
(d) certain fungi. *(2007)*

44. The causative agent of mad-cow disease is a
(a) virus (b) bacterium
(c) prion (d) worm. *(2006)*

45. The bacterium (*Clostridium botulinum*) that causes botulism is
(a) an obligate aerobe
(b) a facultative anaerobe
(c) an obligate anaerobe
(d) a facultative aerobe. *(2006)*

46. HIV that causes AIDS, first starts destroying
(a) helper T-lymphocytes
(b) B-lymphocytes (c) leucocytes
(d) thrombocytes. *(2006)*

47. A person showing unpredictable moods, outbursts of emotion, quarrelsome behaviour and conflicts with others is suffering from
(a) addictive disorders
(b) schizophrenia
(c) borderline personality disorder (BPD)
(d) mood disorders. *(2006)*

48. Antibodies in our body are complex
(a) glycoproteins (b) lipoproteins
(c) steroids (d) prostaglandins.
(2006)

49. Which one of the following depresses brain activity and produces feelings of calmness, relaxation and drowsiness?
(a) Morphine (b) Valium
(c) Amphetamines (d) Hashish *(2005)*

50. Damage to thymus in a child may lead to
(a) a reduction in haemoglobin content of blood
(b) a reduction in stem cell production
(c) loss of antibody mediated immunity
(d) loss of cell mediated immunity. *(2005)*

51. Which one of the following is *not* correctly matched?
(a) *Glossina palpalis* - Sleeping sickness
(b) *Culex pipiens* - Filariasis
(c) *Aedes aegypti* - Dengue fever
(d) *Anopheles culifacies* - Leishmaniasis
(2004)

52. Carcinoma refers to
(a) malignant tumours of the connective tissue
(b) malignant tumours of the skin or mucous membrane
(c) malignant tumours of the colon
(d) benign tumours of the connective tissue.
(2003)

53. Short-lived immunity acquired from mother to foetus across placenta or through mother's milk to the infant is categorised as
(a) active immunity
(b) passive immunity
(c) cellular immunity
(d) innate non-specific immunity. *(2003)*

54. Christmas disease is another name for
(a) haemophilia B (b) hepatitis B
(c) Down's syndrome (d) sleeping sickness.
(2003)

55. Cancerous cells can easily be destroyed by radiations due to
(a) rapid cell division (b) lack of nutrition
(c) fast mutation (d) lack of oxygen.
(2002)

56. Which one of the following is correct match?
(a) Reserpine - tranquilliser
(b) Cocaine - opiatic narcotic
(c) Morphine - hallucinogenic
(d) Bhang - analgesic *(2001)*

57. L.S.D. is
(a) hallucinogenic (b) sedative
(c) stimulant (d) tranquilliser.
(2001)

58. *Salmonella* is related with
(a) typhoid (b) polio
(c) T.B. (d) tetanus. *(2001)*

59. Which is the most infectious disease?
(a) Hepatitis-B (b) AIDS
(c) Cough and cold (d) Malaria. *(2001)*

60. Interferons are synthesized in response to
(a) mycoplasma (b) bacteria
(c) viruses (d) fungi. *(2001)*

61. Reason of lung cancer is
(a) coal mining (b) calcium fluoride
(c) cement factory (d) bauxite mining.
(2001)

62. Which is showing accurate pairing?
(a) Syphilis - *Treponema pallidum*
(b) AIDS - *Bacillus conjugalis*
(c) Gonorrhoea - *Leishmania donovani*
(d) Typhoid - *Mycobacterium leprae.*
(2000)

63. Which disease of man is similar with cattle's, bovine spongiform encephalopathy?
(a) Encephalitis
(b) Jakob-Cruetzfeldt disease
(c) Spongiocitis of cerebrum
(d) Spondylitis *(2000)*

64. Saline solution is given to patients of cholera because
(a) Na^+ prevents water loss from body
(b) NaCl function as regulatory material
(c) NaCl produces energy
(d) NaCl is antibacterial. *(2000)*

65. The antibodies are
(a) proteins (b) carbohydrates
(c) lipids (d) germs. *(1999)*

66. The term 'active immunity' means
(a) increasing rate of heart beat
(b) increasing quantity of blood
(c) resistance developed after disease
(d) resistance developed before disease.
(1999)

67. Human immuno deficiency virus (HIV) has a protein coat and a genetic material which is
(a) double stranded RNA
(b) double stranded DNA
(c) single stranded DNA
(d) single stranded RNA. *(1998)*

68. Botulism caused by *Clostridium botulinum* affects the
(a) lymph glands
(b) central nervous system
(c) spleen (d) intestine. *(1998)*

69. Typhoid fever is caused by
(a) *Shigella* (b) *Escherichia*
(c) *Giardia* (d) *Salmonella*.
(1998)

70. Which of the following is an opiate narcotic?
(a) Amphetamines (b) LSD
(c) Barbiturates (d) Morphine *(1997)*

71. Which of the following will be curable in next two decades?
(a) Tuberculosis (b) Cancer
(c) Poliomyelitis (d) None of these
(1997)

72. Diphtheria is caused by
(a) nematodes (b) bacteria
(c) virus (d) none of these.
(1997)

73. Which of the following diseases is now considered completely eradicated from India?
(a) Small pox (b) Poliomyelitis
(c) Plague (d) Kala-azar *(1997)*

74. Which of the following symptoms indicate red sickness?
(a) Nausea and loss of hair
(b) Ulcerated skin, nausea and loss of hair
(c) Red and ulcerated skin
(d) Nausea and anaemia *(1997)*

75. If a person shows production of interferons in his body, the chances are that he has got an infection of
(a) tetanus (b) malaria
(c) typhoid (d) measles. *(1997)*

76. Which of the following pair of diseases is caused by virus?
(a) Rabies, mumps
(b) Cholera, tuberculosis
(c) Typhoid, tetanus
(d) AIDS, syphilis *(1996)*

77. Antibodies are produced by
(a) leucocytes (b) monocytes
(c) lymphocytes (d) spleen. *(1996)*

78. The interferons are
(a) antigen proteins
(b) antiviral proteins
(c) antibiotic proteins
(d) all of these. *(1996)*

79. Which of the following is the false statement about antibiotics?
(a) Some persons have allergy from antibiotics.
(b) Antibiotics are capable of curing any disease.
(c) This term was given by Waksman in 1942.
(d) Antibiotics is produced by micro-organisms.
(1996)

80. Nicotine acts as a stimulant, because it mimics the effect of
(a) testosterone (b) dopamine
(c) thyroxine (d) acetylcholine.
(1995)

81. The blood cancer is known as
(a) haemolysis (b) haemophilia
(c) leukaemia (d) thrombosis.
(1995)

82. Which one of the following pairs is not correctly matched?
(a) Syphilis - *Trichuris trichiura*
(b) Sleeping sickness - *Trypanosoma gambiense*
(c) Dengue fever - arbovirus
(d) Plague - *Yersinia pestis*
(1995)

83. Which one of the following diseases is due to an allergic reaction?
(a) Enteric fever (b) Skin cancer
(c) Goitre (d) Hay fever
(1995)

84. Which of the following causes plague?
(a) *Trichinella spiralis*
(b) *Salmonella typhimuium*
(c) *Yersinia pestis*
(d) *Leishmania donovani* *(1995)*

85. Antigens are present
(a) inside the cytoplasm
(b) on nuclear membrane
(c) inside the nucleus
(d) on cell surface. *(1995)*

86. A cell-coded protein that is formed in response to infection, with most animal viruses, is called
(a) histone (b) antibody
(c) interferon (d) antigen.
(1994)

87. Which one of the following does correctly match a sexually transmitted disease with its pathogen?
(a) Syphilis-*Treponema pallidum*
(b) Gonorrhoea-*Entamoeba histolytica*
(c) Urethritis-*Bacillus anthracis*
(d) Softsore-*Bacillus brevis*. *(1994)*

88. A metastatic cancerous tumour is termed 'sarcoma' if the disorder is in
(a) fibroblasts (b) circulatory system
(c) immune system (d) epithelial cells.
(1994)

89. The main reason why antibodies could not solve all the problems of bacteria mediated disease is
(a) decreased efficiency of the immune system
(b) insensitivity of the individual following prolonged exposure to antibiotics
(c) development of mutant strains resistant to antibodies
(d) inactivation of antibiotics by bacterial enzymes.
(1994)

90. Opiate narcotic is
(a) bhang (b) charas
(c) heroin (d) nicotine.
(1993)

91. Give the correct matching of causative agent/ germ and disease.
(a) *Anopheles* – Malaria
(b) *Leishmania* – Sleeping sickness
(c) *Glossina* – Kala-azar
(d) *Wuchereria* – Filariasis *(1993)*

92. Analgesic drugs
(a) form tissues (b) relieve pain
(c) relieve fatigue (d) cause pain.
(1990)

93. Which one engulfs pathogens rapidly?
(a) Acidophils (b) Monocytes
(c) Basophils (d) Neutrophils
(1989)

Answer Key

1.	(a)	**2.**	(d)	**3.**	(a)	**4.**	(b,d)	**5.**	(b)	**6.**	(b)	**7.**	(a)	**8.**	(b)	**9.**	(a)	**10.**	(a)
11.	(d)	**12.**	(a)	**13.**	(c)	**14.**	(a)	**15.**	(a)	**16.**	(c)	**17.**	(c)	**18.**	(d)	**19.**	(d)	**20.**	(c)
21.	(a)	**22.**	(d)	**23.**	(d)	**24.**	(d)	**25.**	(b)	**26.**	(d)	**27.**	(a)	**28.**	(b)	**29.**	(a)	**30.**	(b)
31.	(d)	**32.**	(d)	**33.**	(b)	**34.**	(b)	**35.**	(a)	**36.**	(c)	**37.**	(c)	**38.**	(a)	**39.**	(b)	**40.**	(c)
41.	(b)	**42.**	(a)	**43.**	(a)	**44.**	(c)	**45.**	(c)	**46.**	(a)	**47.**	(c)	**48.**	(a)	**49.**	(b)	**50.**	(d)
51.	(d)	**52.**	(b)	**53.**	(b)	**54.**	(a)	**55.**	(a)	**56.**	(a)	**57.**	(a)	**58.**	(a)	**59.**	(a)	**60.**	(c)
61.	(a)	**62.**	(a)	**63.**	(b)	**64.**	(a)	**65.**	(a)	**66.**	(c)	**67.**	(d)	**68.**	(b)	**69.**	(d)	**70.**	(d)
71.	(b)	**72.**	(b)	**73.**	(a)	**74.**	(b)	**75.**	(d)	**76.**	(a)	**77.**	(c)	**78.**	(b)	**79.**	(b)	**80.**	(d)
81.	(c)	**82.**	(a)	**83.**	(d)	**84.**	(c)	**85.**	(d)	**86.**	(c)	**87.**	(a)	**88.**	(a)	**89.**	(c)	**90.**	(c)
91.	(d)	**92.**	(b)	**93.**	(d)														

EXPLANATIONS

1. (a) : Transplantation of tissue/organ often fails due to non-acceptance by the patient's body therefore, tissue matching and blood group matching are essential before undertaking any graft/transplant. When the immune system recognises the protein in the transplanted tissue or organ as foreign, it initiates cellular immunity. As a result of this, there is a rejection of transplanted organs. To suppress the immune response during transplantation, histocompatibility antigen and immunosuppressants play an important role.

2. (d) : MALT are significant aggregations of lymphoid tissues which are seen in relation to the mucosa of the major tracts like respiratory, alimentary canal and urinogenital tracts. It constitutes about 50 percent of the lymphoid tissue in human body.

3. (a) : Cholera is caused by bacterium *Vibrio cholerae*, tetanus is caused by bacterium *Clostridium tetani*, typhoid is caused by bacterium *Salmonella typhi*, small pox is caused by *Variola* virus, mumps is caused by *Paramyxo* virus, Herpes is caused by *Herpis simplex* virus and influenza is caused by *Orthomyxovirus*.

4. (b, d) : HIV is spherical virus with a diameter of about 90-120 nm. Its genome consists of a single-stranded RNA filament segmented into two identical filaments and associated with reverse transcriptase enzymes. The envelope consists of a lipid bilayer derived from host cell membrane and projecting knob like glycoprotein spikes. It contains two protein coats. HIV is a retrovirus that attacks helper T cells. Without an adequate supply of helper cells, the immune system cannot signal B cells to produce antibodies to kill infected cells, thus body becomes susceptible to infections. This immune deficiency is described by the name acquired immune deficiency syndrome or AIDS.

5. (b) : The Sabin vaccine or trivalent 'oral polio vaccine' consists of attenuated viral strains.

6. (b)

7. (a) : Autoimmunity is a disorder of the body's defence mechanisms in which an immune response is elicited against its own tissues, which are thereby damaged or destroyed. Autoimmunity may be caused due to genetic or environmental factors.

8. (b) : Serum globulins are proteins that include gamma globulins (antibodies) and a variety of enzymes and carrier/ transport proteins. The specific profile of the globulins is determined by protein electrophoresis (SPEP), which separates the proteins according to size and charge. There are four major groups that can be identified : alpha-1 globulins, alpha-2 globulins, beta globulins and gamma globulins. Once the abnormal group has been identified, further studies can determine the specific protein excess or deficit. Since the gamma fraction usually makes up the largest portion of the globulins, therefore antibody deficiency is mainly related with the low level of serum globulins.

9. (a) : IgA immunoglobulins are the second most abundant class of immunoglobulins, which are mainly found in sweat, tears, saliva, mucus, colostrum and gastrointestinal secretions.

10. (a) : Babesiosis is a malaria-like parasitic disease caused by infection with *Babesia*, a parasitic protozoan. Babesiosis has long been recognised as a disease of cattle and other domestic animals, until human forms of babesiosis had been discovered. *Babesia* parasites reproduce in red blood cells of mammals and cause haemolytic anaemia, quite similar to malaria. The parasite is transmitted by ticks.

11. (d) : Cell-mediated immune response (CMIS) consists of T-lymphocytes. It reacts against transplants. Transplantation may result in the rejection of the transplanted organs. The immune system recognises the protein in the transplanted tissue or organ as foreign and initiates cellular immunity against it.

12. (a) :

13. (c) : *Entamoeba histolytica* (Gr., *entos* : within + *amoeba* : change + *histos* : tissue + *lysis* : dissolve) is the causative organism of amoebic dysentery or amoebiasis in man. It is a microscopic endoparasite of man. It is commonly found in the upper part of the large intestine (colon) and is very often lodged in the liver, lungs, brain and testes. In its life cycle, it occurs in three distinct forms (i) trophozoite or magna form, (ii) precystic or minuta form, and (iii) cystic form. Trophozoite is the most active, motile and feeding form which is pathogenic to man. It lives in the mucous and submucous layers of the colon and feeds on these layers and erythrocytes.

14. (a) : The AIDS retrovirus, called human immunodeficiency virus (HIV), mounts a direct attack on $CD4^+$ T helper cells because it recognizes the CD4 coreceptors associated with these cells.

HIV's attack on $CD4^+$ T cells cripples the immune system in at least three ways. First, HIV-infected cells die only after releasing replicated viruses that infect other $CD4^+$ T cells, until the entire population of $CD4^+$ T cell is destroyed. Second, HIV causes infected $CD4^+$ T cells, to secrete a soluble suppressing factor that blocks other T cells from responding to the HIV antigen. Finally, HIV may block transcription of MHC genes, hindering the recognition and destruction of infected $CD4^+$ T cells, and thus protecting those cells from any remaining vestiges of the immune system. The combined effect of these responses to HIV infection is to wipe out the human immune defense.

15. (a) : The plant illustrated in the diagram is *Datura*. Seeds of *Datura stramonium* are misused for their hallucinogenic properties because of the presence of anticholinergic alkaloids atropine, hyoscyamine and scopolamine (= hyoscine). However, even in slight excess, they can cause death.

16. (c) : AIDS is a disorder of cell-mediated immune system of the body. Virus responsible for AIDS is HIV (Human immunodeficiency virus). There is a reduction in the number of helper T-cells which stimulate antibody production by B-cells. This results in the loss of natural defence against viral infection.

17. (c) : Man acquires infection of *Ascaris* by directly ingesting *Ascaris* eggs, containing the infective second stage larva, with contaminated food or water. Life cycle of *Ascaris* is monogenetic. There is no vector or intermediate host.

18. (d) : Syphilis is caused by bacterium *Treponema pallidum*. It is a sexually transmitted disease (STD) which is transferred through sexual intercourse with infected person. Haemophilia is a X-linked genetic disorder of blood. It is not transmitted *via* any sexual practice. Genital herpes is an STD while sickle-cell anaemia is an autosomal hereditary disorder.

The chances of a 5 year boy contracting an STD are very little since he is unlikely to have sex at this age.

19. (d) : *Wuchereria bancrofti* is a dreaded human parasite. It is a digenetic parasite completing its life cycle in two hosts, the final host is man harbouring the adult worm.

The disease passes through four stages in human beings:

In the first stage, the patient has increased eosinophils, enlarged lymph nodes. Second or carrier stage is symptomless.Third stage is characterised by filarial fever, inflammation of lymph nodes (lymphadenitis) and lymph vessels (lymphangiectasis) and reversible lymphoedema (excess fluid in tissues due to obstruction of lymph vessels) in various body parts. The fourth or final stage is manifestated by lymphoedema accompanied by thickening of subcutaneous tissues and skin so that there is permanent swelling mostly of feet, legs, thighs, scrotal sacs, breast etc. It is called elephantiasis.

20. (c) : LSD is a psychedelic drug since it causes optical and auditory hallucinations and induces behavioural abnormalities. Opium and morphine are opiate narcotics that suppress brain activity and relieve pain. Caffeine is a stimulant that temporarily stimulates the nervous system.

21. (a) : *Plasmodium*, a tiny protozoan parasite causes malaria in humans, and is transmitted through the bite of infected female *Anopheles* mosquito. When female *Anopheles* sucks the blood of infected human it takes up gametocytes (sexual stages of parasite) with blood meal. The gametocytes come out of the RBCs into the lumen (cavity) of the stomach of the mosquito. In the stomach, the male gametocyte divides and forms 6 to 8 long, motile, whip-like microgametes (male gametes). The female gametocyte does not divide but undergoes a process of maturation to become the macrogamete (female gamete). A microgamete penetrates a macrogamete and fertilization (syngamy) takes place, resulting in the formation of a zygote. The zygote elongates and becomes worm like motile organism called ookinete. Ookinete further changes into sporozoites (mature infective stage of *Plasmodium*).

22. (d) : Widal test (developed by G.F.I Widal) is an agglutination test for the presence of antibodies against the *Salmonella* organism that cause typhoid fever. It is used to diagnose the presence of the disease in a patient.

23. (d) : Common cold or rhinitis is one of the most infectious diseases caused by *Rhino* viruses. It affects nose and respiratory passage but not lungs. It spreads by droplet infection or contaminated objects. Pneumonia, caused by bacteria *Streptococcus pneumoniae* and *Haemophilus influenzae* is a serious disease of lungs, in which fluid collects in the alveoli and bronchioles. The disease spreads by sputum of the patient.

24. (d) : Contact inhibition is a property of normal cells by virtue of which contact with other cells inhibits their uncontrolled growth. Cancerous cells lack this property.

25. (b) : Cirrhosis is a condition in which the liver responds to injury or death of some of its cells by producing interlacing strands of fibrous tissue

between which are nodules of regenerating cells. The liver becomes tawny and characteristically knobbly (due to the nodules). One of the causes include alcoholism (alcoholic cirrhosis).

26. (d) : The given chemical structures (A) and (B) are of morphine and cannabinoid respectively. Morphine is the principal opium alkaloid. It is a strong analgesic. It also has sedative and calming effect. Morphine depresses respiratory centre, it contributes to the fall in blood pressure. Morphine is a very effective sedative and painkiller. It is very useful in patients who have undergone surgery. Natural cannabinoids are obtained from the inflorescence of hemp plant *Cannabis sativa*, family Cannabinaceae. They affect the cardiovascular system of the body.

27. (a) : Sporozoites represent the infective forms of malarial parasite. A healthy person acquires infection, when a female *Anopheles* mosquito, containing sporozoites, bites the person for sucking his blood. The mosquito punctures the host's skin by its proboscis and first introduces some saliva into the blood stream. Along with saliva, thousands of sporozoites are inoculated in the host also.

28. (b)

29. (a) : Common cold is caused by some 100 types of *Rhino* viruses. It is one of the most common infectious disease in human. Antibiotics are substances that destroy or inhibit the growth of microorganisms, particularly disease-producing bacteria and fungi. Antibiotics are obtained from microorganisms (especially moulds) or synthesized. Many antibiotics interfere with the pathogen protein synthesis. Some (*e.g.* Penicillin) prevent cross-linking of the glycan chains of peptidoglycan molecules in bacterial cell walls. Since the viruses do not possess cell wall and their own protein synthesising apparatus, they are not attacked by antibiotics.

30. (b) : Ringworm (tinea) is a fungal infection of the skin, the scalp, or the nails. Ringworm is caused by the dermatophyte fungi-species of microsporum, trichophyton, and epidermophyton and also affects animals, a source of infection for humans. It can be spread by direct contact or via infected materials. The lesions of ringworm may form partial or complete rings and may cause intense itching. The disease is treated with antifungal agents taken by mouth or applied locally.

31. (d) : *Refer to answer 22.*

32. (d) : AIDS (acquired immuno deficiency syndrome) a syndrome, is caused by the retrovirus HIV (human immunodeficiency virus). The virus destroys a subgroup of lymphocytes, the helper T-cells (or CD4 lymphocytes), resulting in suppression of the body's immune response. HIV is transmitted in blood, semen and vaginal fluid; the major routes of infection are unprotected vaginal and anal intercourse, intravenous drug abuse, and the administration of contaminated blood and blood products. A combination of antiviral drugs can delay the development of full-blown AIDS for many years but cannot fully care the disease.

33. (b) : Prions are named by Stanley Prusiner (got Nobel Prize in 1997). Prions are infectious agents which are made of proteins only (without nucleic acid). Prions are the causal agents of scrapie disease of sheep.

34. (b) : Morphine is an potent opioid analgesic used mainly to relieve severe and persistent pain, particularly in terminally ill patients or who have undergone surgery. It also induces feelings of euphoria. It is administered by mouth, injection, or in suppositories. Common side-effects are nausea and vomiting, constipation, and drowsiness. With regular use, tolerance develops and dependence may occur.

35. (a) : Histopathological study is the invasive technique. Radiography and CT involves X-rays which are harmful.
In MRI strong magnetic fields and non-ionising radiations are used to detect any physiological changes in the concerned tissue. Hence it is safe for detection of cancers.

36. (c) : *Plasmodium* is a tiny protozoan which is responsible for malaria in the human. In malaria the patient experiences high fever which periodically rises and also experiences recurring chills with fever. Such symptoms are seen because when the RBCs carrying *Plasmodium* (one of the stage in the life cycle of the parasite) ruptures it releases a toxic substance called haemozoin which is chiefly responsible for the chill and high fever recurring every three to four days.

37. (c) : Tumour is of two types : benign and malign. Malign or malignant tumour exhibit metastasis. It is the phenomenon in which cancer cells spread to distant sites through body fluids to develop secondary tumour.

38. (a) : Common cold is a viral disease. It is caused by Rhino viruses. It causes fever and pain all over the body and affects the nose, throat and air passages. AIDS (Acquired immuno deficiency syndrome) is a disorder of cell mediated immune system of the body. It is caused by HIV (Human immunodeficency virus). HIV is a retrovirus that attacks helper T-cells.

39. (b)

40. (c) : Hashish or charas is a pure resin obtained from female flowers and leaves of selected varieties of *Cannabis sativa*. It is the most potent hemp product (cannabinoids), and is usualy smoked with tobacco. Its use may lead to euphoria, hallucination, drowsiness and continuous laughing. The hallucinogens act mainly on CNS and greatly alter one's thought, feelings and perceptions.

41. (b) : Increased asthmatic attacks in certain seasons are related to inhalation of seasonal pollen. Pollens are microscopic grains produced by plants in order to reproduce. Pollen allergy is a hypersensitive reaction to pollen. Pollen induced reactions include extrinsic asthma, rhinitis and bronchitis.

42. (a) : Serum globulin are globulins occurring in blood serum and containing most of the antibodies of the blood. Serum globulin electrophoresis is a laboratory test that examines specific proteins in the blood called globulins. Globulins are roughly divided into alpha, beta, and gamma globulins. These can be separated and quantitated in the laboratory by electrophoresis and densitometry.

43. (a) : Lysozyme is an antibacterial enzyme with natural antibiotic properties. Normally excreted in the tears, nasal mucus, milk, and saliva in most animals, lysozyme is part of the body's first natural defence against bacteria and viruses. Lysozyme is an enzyme that degrade the polysaccharide protective coating on the surface of many bacteria and viruses (glycoprotein covering) to allow other enzymes and antibodies to find their appropriate attachment sight. Most of the bacteria affected by lysozyme are not pathogenic. Lysozyme serves as a non-specific innate opsonin by binding to the bacterial surface, reducing the negative charge and facilitating phagocytosis of the bacterium before opsonins from the acquired immune system arrive at the scene. In other words, lysozyme makes it easier for phagocytic white blood cells to engulf bacteria.

44. (c) : Mad cow disease is the common term for Bovine spongiform encepholopathy (BSE), a progressive neurological disorder of cattle. It is caused by prions. Symptoms include an excitable or nervous temperament to external stimuli such as touch to the skin. A prion (short for proteinaceous infectious particle) is a unique type of infectious agent, as it is made only of protein. Prions are abnormally-structured forms of a host protein, which are able to convert normal molecules of the protein into the abnormal structure.

45. (c) : *Clostridium* is a genus of gram-positive bacteria. They are obligate anaerobes capable of producing endospores. Individual cells are rod-shaped.

Foodborne disease caused by *C. botulinum* is referred to as botulism (a muscle-paralyzing disease). It is caused by the ingestion of a neurotoxin (botulin) produced by the microorganism in the food. Botulin blocks nerve function leading to respiratory and musculoskeletal paralysis. Symptoms of botulism include weakness, fatigue and dizziness, followed by blurred vision and progressive difficulty in speaking and swallowing. Weakening of the respiratory muscles is also observed and death may occur due to respiratory failure.

46. (a) : *Refer to answer 32.*

47. (c) : Borderline personality disorder (BPD) is a serious mental illness characterized by pervasive instability in moods, interpersonal relationships, self-image, and behaviour. This instability often disrupts family and work life, long-term planning, and the individual's sense of self-identity. Originally thought to be at the "borderline" of psychosis, people with BPD suffer from a disorder of emotion regulation.
Schizophrenia is a group of severe mental disorders characterized by disturbances of language and communication; thought disturbances that may involve distortion of reality, misperceptions, delusions and hallucinations; mood changes and withdrawn, regressive, or bizarre behaviour, lasting longer than six months. A mood disorder is a condition where the prevailing emotional mood is distorted or inappropriate to the circumstances. Addiction is a state of dependence produced by the habitual taking of drugs, alcohol etc.

48. (a) : Antibody are members of a class of proteins known as immunoglobulins. Immunoglobulins are glycoproteins in the immunoglobulin superfamily. The terms antibody and immunoglobulin are often used interchangeably. They are found in the blood and tissue fluids, as well as many secretions. In structure, they are globulins (in the γ-region of protein electrophoresis). They are synthesized and secreted by plasma cells that are derived from the B cells of the immune system.

49. (b) : Valium is a benzodiazephine (sedative) that gives a feeling of relaxation, calmness or drowsiness in the body. Morphine is the main opium alkaloid that depresses respiratory centre and contributes to the fall in blood pressure. Amphetamines are synthetic drugs and are stimulant in nature. Hashish is a hallucinogen.

50. (d) : The thymus is the major gland of our immune system. The thymus is responsible for many immune system functions including the production of T-lymphocytes, a type of white blood cell responsible for cell mediated immunity. Cell mediated immunity is a type of immunity in which specialized cells carry out defensive activities. They protect the body against pathogens including the protists and fungi which have entered the host's cells. T-cells and B-cells are the type of lymphocytes that develop from bone marrow cells. Those lymphocytes that migrate to the thymus and differentiate are called T-cells and those cells that continue to be in the bone marrow for differentiation are known as B-cells. T-cells are responsible for cell mediated immunity, however, B-cells produce antibodies and take part in antibody mediated immunity.

51. (d) : All the options given are diseases with their associated vector which transmit the respective diseases.

Leishmaniasis, also called kala azar is caused by *Leishmania donovani.* It is spread by sand fly (*Phlebotomus*) and characterised by enlarged spleen and liver with high fever.

Sleeping sickness is caused by a protozoan *Trypanosoma gambiense*. Filariasis is caused by worm *Wuchereria bancrofti*. Dengue fever is caused by arbo virus.

52. (b) : Carcinoma is a cancer that arises in epithelium, the tissue that lines the skin and internal organs of the body. It may occur in any tissue containing epithelial cells. It includes cervical cancer, breast cancer, skin cancer, stomach cancer etc.

53. (b) : Short-lived immunity acquired from mothers to foetus across placenta or through mother's milk to the infant is categorised as passive immunity. Passive immunity, an acquired immunity, is resistance based on antibodies performed in another host. In this case, the foetus is not directly responsible for its body immunity but it becomes immunised by mother's milk across placenta.

54. (a) : Haemophilia B, a type of haemophilia is also known as christmas disease. It is due to deficiency of a blood coagulation factor, the christmas factor (factor IX). Christmas was the person (20th century) in whom the factor was first identified. Haemophilia B is a defect of the blood which prevents its clotting.

55. (a) : Cancerous cells are the cells that undergo rapid cell division. These cells are destroyed by X-ray radiaton. During cell division, the DNA double helix opens up and undergo various other processes. Such processes are disrupted when exposed to radiation and the cancerous cells die selectively when radiated.

56. (a) : Tranquillisers are drugs that have good effect in all types of psychosis, especially in schizophrenia. In a psychotic patient, these drugs reduce aggressiveness, thoughts and behaviour are gradually normalized and anxiety is relieved, *e.g.*, reserpine which is an alkaloid extracted from the roots of *Rauwolfia serpentina*. Higher doses of it can cause sedation and mental depression. Cocaine is a stimulant. Morphine is an opiate narcotic. Bhang is a hallucinogenic.

57. (a) : Hallucinogens are drugs that change thoughts, feelings and perceptions of individuals. They cause hallucinations. LSD (Lysergic acid diethylamide) is one such hallucinogen that causes horrible dreams, chronic psychosis and severe damage to the central nervous system. Sedatives give a feeling of calmness, relaxation or drowsiness in the body. Their high doses induce sleep. Tranquillisers lower tension and anxiety without inducing sleep. Stimulants are the drugs that stimulate the nervous system, make a person more wakeful, alert and active; and cause excitement.

58. (a) : Typhoid is caused by *Salmonella typhi*. The organisms of the disease are present in the stool. They may be present in urine. They can, therefore, be carried by water and contaminated food. Their spread through water can give rise to severe epidemics.

Polio is caused by *Enterovirus*. TB is caused by *Mycobacterium tuberculosis*. Tetanus is caused by *Clostridium tetani*.

59. (a) : Hepatitis B (serum hepatitis) occurs at any age and mode of transmission is through contact or blood. Infection is severe, often fatal and is accompanied by loss of appetite, nausea, whitish stool (due to lack of bile) and jaundice. 0.0002% of hepatitis B infected blood contact is enough to transmit hepatitis B.

60. (c) : Interferons are proteins that increase the resistance of a cell to attack by viruses by unmasking genes that synthesize antiviral proteins. In humans, three groups of interferons have been discovered: α-interferons from white blood cells; β-interferons from connective tissue fibroblasts; and γ-interferons from lymphocytes.

61. (a) : Lung cancer is a disease where tissue in the lung grows out of control. This may lead to metastasis, invasion of adjacent tissue and infiltration beyond the lungs. The vast majority of primary lung cancers are carcinomas of the lung, resulting from epithelial cells. One of the causes of lung cancer is exposure to coal dust. Exposure to coal dust can cause some coal mine workers to develop pneumoconiosis, or "black lung." This occurs when inhaled coal dust becomes embedded in the lungs, causing them to harden and making breathing difficult.

62. (a) : Syphilis is caused by a spirochete (spiral bacterium) *Treponema pallidum*. The symptoms of syphilis occur in three stages. The first stage usually consists of a painless lesion called a chancre at the organism's site of entry. The second stage begins as the organism enters the blood. Symptoms such as fever, a flu like illness, a skin rash, hair loss, and swollen joints may come and go over a period of several years. In the third stage permanent brain damage, heart disease, and blindness often occurs.

AIDS is a viral disease caused by Human Immuno deficiency virus. Gonorrhoea is a sexual disease and its causative organism is *Neisseria gonorrhoea*. Typhoid is caused by bacillus bacteria *Salmonella typhi.*

63. (b) : The common term for bovine spongiform encephalopathy is mad cow disease, which is a progressive neurological disorder of cattle. In humans it is called Creutzfeldt-Jakob disease, after the two doctors who first described the symptoms of the disease. It is caused by prions (proteinaceous infectious particles). It is characterized by rapidly progressive dementia associated with myoclonic jerks. The brains of affected individuals show a characteristic cystic degenerations.

64. (a) : Cholera is an acute infection of the small intestine by the bacterium *Vibrio cholerae*, which causes severe vomiting and diarrhoea (known as ricewater stools) leading to dehydration. The disease is contracted from food or drinking water contaminated by faeces from a patient. The resulting dehydration and the imbalance in the concentration of body fluids can cause death within 24 hours. Since, a large quantity of fluid and salts are rapidly lost through stools and vomit, therefore, the most important treatment is to replace the lost fluid and salts equally rapidly. Rapid replacement of fluid and elecrolytes is needed by oral rehydration-therapy. The electrolytes consists of Na^+ ions that prevents water loss from the body.

65. (a) : *Refer to answer 48.*

66. (c) : Active immunity is the immune response generated in an individual due to contact with infectious pathogen or vaccination. In many cases, it is life long.

67. (d) : HIV is a retrovirus, which contains single stranded RNA, surrounded by protein coat (core shell) as genetic material. It causes AIDS. HIV is different in structure from other retroviruses. It is around 120 nm in diameter (around 60 times smaller than a red blood cell) and roughly spherical.

68. (b) : *Refer to answer 45.*

69. (d) : *Refer to answer 58.*

70. (d) : Opiates are derived from opium along with their synthetic relatives. Opiates have narcotic, analgesic, sedative and astringent effects. Narcotic is a drug that induces stupor and relieves pain. Morphine is the main opium alkaloid, which is a strong analgesic and also has sedative and calming effect. It depresses respiratory centre and contributes to the fall in blood pressure. It can cause release of ADH, reduction in urine output, constipation and mild hyperglycaemia etc. It causes addiction.

Barbiturates are substituted derivatives of barbituric acid. They reduce anxiety and induce sleep. Amphetamines are synthetic drugs which are strong stimulants. LSD (Lysergic acid diethylamide) is the most powerful hallucinogens that causes severe damage to central nervous system.

71. (b) : Cancer may be curable in next two decades. The completion of the human genome is causing profound changes in thinking and direction of biomedical research. Cancer is caused by malfunctioning of genes, either through activation of cancer causing oncogens, or through inactivation of tumor suppressor genes. By comparing the active genes in the tumor to that of normal cells, the genes causing the cancer can be determined. Side by side there is a huge progress in the field of genetic engineering and biotechnology. All these aspects give us hope that cancer may be curable in next two decades. TB is curable by taking anti-tubercular drugs and polio may be on the verge of eradication if the pulse polio programme succeeds.

72. (b) : Diphtheria is caused by *Corynebacterium diphtheriae* (bacteria) usually affecting children upto five years of age. It may start as sore throat, chills with mild fever, sometimes vomiting and headache. Throat and/or tonsils show a grey membrane which may spread down and cause hoarseness and difficulty in breathing. Nose may be affected giving rise to a

blood-tinged nasal discharge from one nostril. If the disease is not treated early and properly the toxin produced by the bacteria affects the heart and the nervous system, and proves fatal. The germs are present in the discharges from the nose and throat of patients and also of healthy people who act as the "carriers". The patients and the carriers spread the disease through acts like kissing, talking, coughing and sneezing. Incubation period is of 2 - 5 days. The patient should be kept in a well-ventilated room if there is no isolation hospital in the town. The most important preventive measure-against this disease is that all babies should be immunised within the first six weeks of birth using DPT vaccine.

73. (a) : Small pox is an acute highly communicable disease. It is caused by virus named *Variola* virus. Now it is eradicated from world including India. It is highly infectious disease starting with high fever, chill, backache and headache, followed by appearance of rash on the third day of illness. The rash appears first on the face, then on the rest of the body. The rash starts as small reddish spots which change into papules. These in turn change into small vesicles containing clear fluid. Vesicles change into postules. Finally, a scab is formed and it falls off by the third week. These scabs leave deep pits or scars known as pock marks. The virus is present in the oral and nasal discharges of the patients and is ejected during the acts of coughing, sneezing, etc., and infects the healthy people.

74. (b) : The symptoms of red sickness are ulcerated skin, nausea and loss of hair.

75. (d) : Interferons are antiviral proteins that increase the resistance of a cell to attack by viruses. As measles is a viral disease, so body produces interferons. Measles is an acute infectious eruptive viral disease of childhood, caused by an RNA containing Rubeola virus/Polynosa morbillorum. Typhoid and tetanus are bacterial diseases caused by *Salmonella typhi* and *Clostridium tetani* respectively. Malaria is a protozoan disease caused by *Plasmodium* species.

76. (a) : Mumps is an infectious disease causing fever, difficulty in opening the mouth and painful swelling of the parotid glands which lie just below the lobe of the ears. It is caused by a *Paramyxovirus*, which comes out in the saliva of the infected person. Rabies (Hydrophobia) is caused by a virus named as rabies virus. It is introduced in the body by the bite of rabid (mad) dogs usually. Fear of water is the most important characteristic symptom of this disease. Other symptoms are saliva from the mouth, severe headache, high fever, alternating periods, of excitement and depression, inability to swallow even fluids due to choked throat. The virus destroys the brain and spinal cord. Rabies is 100% fatal.

Cholera and tuberculosis are bacterial diseases caused by *Vibrio cholerae* and *Mycobacterium tuberculosis* respectively. Typhoid and tetanus are bacterial diseases caused by *Salmonella typhi* and *Clostridium tetani* respectively. AIDS is caused by HIV (human immunodeficiency virus). Syphillis is caused by spirochaete *Treponema pallidum*.

77. (c) : Lymphocytes secrete antibodies to destroy microbes and their toxins, reject grafts and kill tumor cells. Antibodies are protein in nature. Monocytes (type of WBC) is phagocytic in nature and engulf bacteria and cellular debris. Spleen is an organ that produces lymphocytes.

78. (b) : *Refer to answer 60.*

79. (b) : Antibiotics are not capable of curing any disease. Antibiotics are those substances that destroy or inhibit the growth of micro-organisms, particularly disease producing bacteria and fungi. The term antibiotic was introduced by Waksman in 1942. Antibiotics are obtained form micro-organisms (especially moulds) or synthesized. Common antibiotics include penicillins, streptomycin and tetracyclines. They are used to treat various infections but tend to weaken the body's natural defence mechanisms and can cause allergies. Overuse of antibiotic can lead to the development of resistant strains of micro-organism.

80. (d) : Nicotine is the major stimulatory component of tobacco products including cigarettes. Nicotine has a number of effects on the human body similar to acetylcholine. It stimulates passage of nerve impulses, causes muscles to relax and causes the release of adrenaline, increasing both blood pressure and heart beat rate.

81. (c) : The normal count of WBCs is 5000 to 10000 per cubic millimeter of blood. Leukaemia or blood cancer is characterized by abnormal increase of WBCs count, 20000–1000000/mm^3 due to their increased formation in the bone marrow. Haemolysis is breakdown of RBCs. Haemophilia is a disease in which blood clots slowly. Thrombosis is a clot formation inside the blood vessels.

82. (a) : Syphilis is caused by a spirochete (spiral bacterium) *Treponema pallidum*.

Sleeping sickness is a disease of tropical Africa caused by the presence in the blood of the parasitic protozoan, *Trypanosoma gambiense*. Plague is an epidemic disease of rats which is transmitted to humans by rat fleas. Dengue is a disease transmitted to humans by mosquito, *Aedes aegypti*.

83. (d) : Hay fever is a form of allergy due to the pollen of grasses, trees, and other plants, characterized by inflammation of the membrane lining the nose and sometimes of the conjunctiva. The symptoms of sneezing, running or blocked nose, and watering eyes are due to histamine released by the mast cells.

84. (c) : Plague is an acute epidemic disease of rats and other wild rodents caused by the bacterium *Yersinia pestis*, which is transmitted to humans by rat fleas. Headache, fever, weakness, aching limbs, and delirium develop and are followed by acute painful swellings of the lymph nodes. Bleeding under the skin, producing black patches, can lead to ulcers, which may prove fatal. Treatment with tetracycline, streptomycin, and chloramphenicol is effective.

Trichinosis is caused by *Trichinella spiralis* which lives as an endoparasite in human intestine. *Salmonella typhimurium* causes enteric fevers. *Leishmania donovani* causes kala-azar.

85. (d) : An antigen is any foreign substance like protein or polysaccaharide present on the external coating of pathogen, feathers, constituent of a vegetable, fruit, meat, drug, chemical, tissue or organ transplant which induces the immune system to produce antibodies.

86. (c) : *Refer to answer 60.*

87. (a) : Syphilis is caused by a spirochete (spiral bacterium) *Treponema pallidum*. Gonorrhoea is caused by *Neisseria gonorrhoea*. Urethritis is inflammation of urethra.

88. (a) : Fibroblasts are the cells present in connective tissue. Sarcomas are cancers that are located in connective and muscular tissues derived from mesoderm. Thus, they include the cancers of bones, cartilages, tendons, adipose tissue, lymphoid tissue and muscles.

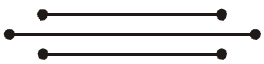
89. (c) : Bacteria develop mutant strains that become resistant to antibodies, so these antibodies become incapable of removing bacteria mediated diseases.

90. (c) : The drugs derived from opium alongwith their synthetic relatives are called opioids or opiates. Opiates have narcotic, analgesic, astringent (that causes contraction of body parts), and sedative effect.

91. (d) : *Wuchereria bancrofti* is a parasitic filarial nematode worm spread by a mosquito vector. It is one of the three parasites that cause lymphatic filariasis. Elephantiasis can result if the infection is left untreated. Limited treatment modalities exist and no vaccines have been developed . Malaria is caused by protozoan parasites of the genus *Plasmodium*. Malaria parasites are transmitted by female Anopheles mosquitoes. Sleeping sickness or African trypanosomiasis is a parasitic disease in people and animals, caused by protozoa of genus *Trypanosoma* and transmitted by the tsetse fly. Kala-azar is caused by *Leishmania* (protozoan) and is transmitted by sand fly.

92. (b) : A substance that reduces pain without causing unconsciousness, either by reducing the pain threshold or by increasing pain tolerance. There are several categories of analgesic drugs, including morphine and its derivatives which produce analgesia by acting on the central nervous system; nonsteroidal anti-inflammatory drugs (*e.g.* aspirin); and local anaesthetics.

93. (d) : Neutrophils, are the most abundant type of white blood cells and form an integral part of the immune system. These phagocytes are normally found in the blood stream. However, during the acute phase of inflammation, particularly as a result of bacterial infection, neutrophils leave the vasculature and migrate toward the site of inflammation in a process called chemotaxis. They are the predominant cells in pus, accounting for its whitish/yellowish appearance. Neutrophils react within an hour of tissue injury and are the hallmark of acute inflammation. Monocytes are also phagocytes but take 7-8 hours to reach at the site of injury. Acidophils and basophils are not phagocytic in nature.



Chapter 31 Strategies for Enhancement in Food Production

1. Artificial selection to obtain cows yielding higher milk output represents
(a) directional as it pushes the mean of the character in one direction
(b) disruptive as it splits the population into two, one yielding higher output and the other lower output
(c) stabilising followed by disruptive as it stabilises the population to produce higher yielding cows
(d) stabilising selection as it stabilises this character in the population.
(NEET 2017)

2. Homozygous purelines in cattle can be obtained by
(a) mating of unrelated individuals of same breed
(b) mating of individuals of different breed
(c) mating of individuals of different species
(d) mating of related individuals of same breed.
(NEET 2017)

3. A true breeding plant is
(a) one that is able to breed on its own
(b) produced due to cross-pollination among unrelated plants
(c) near homozygous and produces offspring of its own kind
(d) always homozygous recessive in its genetic constitution.
(NEET-II 2016)

4. Interspecific hybridisation is the mating of
(a) animals within same breed without having common ancestors
(b) two different related species
(c) superior males and females of different breeds
(d) more closely related individuals within same breed for 4-6 generations.
(NEET-II 2016)

5. Among the following edible fishes, which one is a marine fish having rich source of omega-3 fatty acids?
(a) *Mystus* (b) Mangur
(c) Mrigala (d) Mackerel
(NEET-II 2016)

6. A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called
(a) strip farming
(b) shifting agriculture
(c) ley farming
(d) contour farming. *(NEET-I 2016)*

7. A protoplast is a cell
(a) undergoing division
(b) without cell wall
(c) without plasma membrane
(d) without nucleus. *(2015)*

8. Outbreeding is an important strategy of animal husbandry because it
(a) is useful in overcoming inbreeding depression
(b) exposes harmful recessive genes that are eliminated by selection
(c) helps in accumulation of superior genes
(d) is useful in producing purelines of animals.
(2015)

9. A technique of micropropagation is
(a) protoplast fusion
(b) embryo rescue
(c) somatic hybridisation
(d) somatic embryogenesis.
(2015 Cancelled)

10. Which of the following enhances or induces fusion of protoplasts?
(a) IAA and kinetin
(b) IAA and gibberellins
(c) Sodium chloride and potassium chloride
(d) Polyethylene glycol and sodium nitrate
(2015 Cancelled)

11. *In vitro* clonal propagation in plants is characterized by
(a) PCR and RAPD
(b) northern blotting
(c) electrophoresis and HPLC
(d) microscopy. *(2014)*

12. To obtain virus - free healthy plants from a diseased one by tissue culture technique, which part/parts of the diseased plant will be taken?
(a) Apical meristem only
(b) Palisade parenchyma
(c) Both apical and axillary meristems
(d) Epidermis only *(2014)*

13. In plant breeding programmes, the entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called
(a) evaluation and selection of parents
(b) germplasm collection
(c) selection of superior recombinants
(d) cross-hybridisation among the selected parents. *(NEET 2013)*

14. Tissue culture technique can produce infinite number of new plants from a small parental tissue. The economic importance of the technique is in raising
(a) genetically uniform population identical to the original parent
(b) homozygous diploid plants
(c) new species
(d) variants through picking up somaclonal variations. *(Karnataka NEET 2013)*

15. The viability of seeds is tested by
(a) 2, 6 dichlorophenol indophenols
(b) 2, 3, 5 triphenyl tetrazolium chloride
(c) DMSO
(d) Safranine. *(Karnataka NEET 2013)*

16. Which of the following statements is not true about somatic embryogenesis?
(a) The pattern of development of a somatic embryo is comparable to that of a zygotic embryo.
(b) Somatic embryos can develop from microspores.
(c) Somatic embryo is induced usually by an auxin such as 2, 4-D.
(d) A somatic embryo develops from a somatic cell. *(Karnataka NEET 2013)*

17. Which one of the following is a case of wrong matching?
(a) Somatic - Fusion of two diverse hybridization cells
(b) Vector DNA - Site for *t*RNA synthesis
(c) Micropropagation - *in vitro* production of plants in large numbers
(d) Callus - Unorganised mass of cells produced in tissue culture. *(2012)*

18. Which part would be most suitable for raising virus-free plants for micropropagation ?
(a) Bark (b) Vascular tissue
(c) Meristem (d) Node *(2012)*

19. Green revolution in India occurred during
(a) 1960's (b) 1970's
(c) 1980's (d) 1950's. *(Mains 2012)*

20. A collection of plants and seed having diverse alleles of all the genes of a crop is called
(a) herbarium (b) germplasm
(c) gene library (d) genome. *(2011)*

21. "Jaya" and "Ratna" developed for green revolution in India are the varieties of
(a) maize (b) rice
(c) wheat (d) bajra. *(2011)*

22. 'Himgiri' developed by hybridisation and selection for disease resistance against rust pathogens is a variety of
(a) chilli (b) maize
(c) sugarcane (d) wheat. *(2011)*

23. Breeding of crops with high levels of minerals, vitamins and proteins is called
(a) somatic hybridisation
(b) biofortification
(c) biomagnification
(d) micropropagation. *(2010)*

24. Polyethylene glycol method is used for
(a) biodiesel production
(b) seedless fruit production
(c) energy production from sewage
(d) gene transfer without a vector. *(2009)*

25. Somaclones are obtained by
(a) plant breeding
(b) irradiation
(c) genetic engineering
(d) tissue culture. *(2009)*

26. Haploids are more suitable for mutation studies than the diploids. This is because
(a) haploids are more abundant in nature than diploids
(b) all mutations, whether dominant or recessive are expressed in haploids
(c) haploids are reproductively more stable than diploids
(d) mutagens penetrate in haploids more effectively than in diploids. *(2008)*

27. Which one of the following is linked to the discovery of Bordeaux mixture as a popular fungicide?
(a) Loose smut of wheat
(b) Black rust of wheat
(c) Bacterial leaf blight of rice
(d) Downy mildew of grapes *(2008)*

28. Consider the following four measures (1-4) that could be taken to successfully grow chickpea in an area where bacterial blight disease is common.
(1) Spray with Bordeaux mixture
(2) Control of the insect vector of the disease pathogen
(3) Use of only disease-free seeds
(4) Use of varieties resistant to the disease

Which two of the above measures can control the disease?
(a) 3 and 4 (b) 1 and 4
(c) 2 and 3 (d) 1 and 2 *(2008)*

29. Compared to a bull a bullock is docile because of
(a) higher levels of cortisone
(b) lower levels of blood testosterone
(c) lower levels of adrenaline/noradrenaline in its blood
(d) higher levels of thyroxine. *(2007)*

30. In cloning of cattle a fertilized egg is taken out of the mother's womb and
(a) in the eight cell stage, cells are separated and cultured until small embryos are formed which are implanted into the womb of other cows
(b) in the eight cell stage the individual cells are separated under electrical field for further development in culture media
(c) from this upto eight identical twins can be produced
(d) the egg is divided into 4 pairs of cells which are implanted into the womb of other cows. *(2007)*

31. Which one of the following is a viral disease of poultry?
(a) Coryza (b) New castle disease
(c) Pasteurellosis (d) Salmonellosis *(2007)*

32. In maize, hybrid vigour is exploited by
(a) crossing of two inbred parental lines
(b) harvesting seeds from the most productive plants
(c) inducing mutations
(d) bombarding the seeds with DNA. *(2007)*

33. Crop plants grown in monoculture are
(a) highly prone to pests
(b) low in yield
(c) free from intraspecific competition
(d) characterised by poor root system. *(2006)*

34. In maize, hybrid vigour is exploited by
(a) inducing mutations
(b) bombarding the protoplast with DNA
(c) crossing of two inbred parental lines
(d) harvesting seeds from the most productive plants. *(2006)*

35. In order to obtain virus-free plants through tissue culture the best method is
(a) meristem culture (b) protoplast culture
(c) embryo rescue (d) anther culture. *(2006)*

36. *Triticale,* the first man-made cereal crop, has been obtained by crossing wheat with
(a) barley (b) rye
(c) pearl millet (d) sugarcane. *(2006)*

37. Three crops that contribute maximum to global food grain production are
(a) wheat, rice and maize
(b) wheat, rice and barley
(c) wheat, maize and sorghum
(d) rice, maize and sorghum. *(2005)*

38. Which of the following is generally used for induced mutagenesis in crop plants?
(a) X-rays
(b) UV (260 nm)
(c) Gamma rays (from cobalt-60)
(d) Alpha particles *(2005)*

39. The name of Norman Borlaug is associated with
(a) white revolution (b) green revolution
(c) yellow revolution (d) blue revolution. *(2005)*

40. The world's highly prized wool yielding 'Pashmina' breed is
(a) goat
(b) sheep
(c) goat-sheep cross
(d) Kashmir sheep - Afghan sheep cross. *(2005)*

41. The technique of obtaining large number of plantlets by tissue culture method is called
(a) plantlet culture (b) organ culture
(c) micropropagation
(d) macropropagation. *(2004)*

42. India's wheat yield revolution in the 1960s was possible primarily due to
(a) hybrid seeds

(b) increased chlorophyll content
(c) mutations resulting in plant height reduction
(d) quantitative trait mutations. *(2004)*

43. Which one of the following plants are used as green manure in crop fields and in sandy soils ?
(a) *Crotalaria juncea* and *Alhagi camelorum*
(b) *Calotropis procera* and *Phyllanthus niruri*
(c) *Saccharum munja* and *Lantana camara*
(d) *Dichanthium annulatum* and *Azolla nilotica* *(2003)*

44. Maximum application of animal cell culture technology today is in the production of
(a) insulin (b) interferons
(c) vaccines (d) edible proteins. *(2003)*

45. If a diploid cell is treated with colchicine then it becomes
(a) triploid (b) tetraploid
(c) diploid (d) monoploid. *(2002)*

46. In tissue culture medium, the embryoids formed from pollen grains is due to
(a) cellular totipotency
(b) organogenesis
(c) double fertilization
(d) test tube culture. *(2002)*

47. Which of the following crops have been brought to India from New world?
(a) Cashewnut, potato, rubber
(b) Mango, tea
(c) Tea, rubber, mango
(d) Coffee *(2002)*

48. Before the European invader which vegetable was absent in India?
(a) Potato and tomato
(b) Shimla mirch and brinjal
(c) Maize and chichinda
(d) Bitter gourd *(2001)*

49. *Triticale* is obtained by crossing wheat with
(a) oat (b) barley
(c) maize (d) rye. *(2001)*

50. Which fish selectively feed on larva of mosquito?
(a) *Gambusia* (b) *Rohu*
(c) *Clarias* (d) *Exocoetus (2001)*

51. Coconut milk is used in tissue culture in which present
(a) cytokinin (b) auxin
(c) gibberellin (d) ethylene. *(2000)*

52. Which statement is correct?
(a) *A. indica* is largest wild honey bee.
(b) Wax is waste material of honey bee.
(c) Workers are the smallest of the three castes.
(d) Drone of honey bee is diploid. *(2000)*

53. The new varieties of plants are produced by
(a) introduction and mutation
(b) selection and introduction
(c) selection and hybridization
(d) mutation and selection. *(1999)*

54. Due to which of the following organism, yield of rice is increased?
(a) *Sesbania* (b) *Bacillus popilliae*
(c) *Anabaena* (d) *Bacillus subtilis* *(1999)*

55. The term aquaculture means
(a) inland fisheries (b) aspergillosis
(c) marine fisheries (d) both (a) and (c). *(1999)*

56. Fish, which eradicate the mosquito larva, is
(a) *Gambusia* (b) cutter fish
(c) *Anabus* (d) rohu. *(1999)*

57. Life span of a worker bee is
(a) 6 weeks (b) 10 weeks
(c) 10 days (d) 15 days. *(1999)*

58. Hybridoma cells are
(a) only cells having oncogenes
(b) product of spore formation in bacteria
(c) nervous cells of frog
(d) hybrid cells resulting from myeloma cells. *(1999)*

59. The reason for vegetatively reproducing crop plants to suit for maintaining hybrid vigour is that
(a) they are more resistant to diseases
(b) once a desired hybrid produced, no chances of losing it
(c) they can be easily propagated
(d) they have a longer life span. *(1998)*

60. High milk yielding varieties of cows are obtained by
(a) use of surrogate mothers
(b) superovulation
(c) artificial insemination
(d) all of these. *(1997)*

61. Honey is
(a) alkaline
(b) basic after some days
(c) acidic
(d) neutral. *(1997)*

62. Pebrine is a disease of
(a) silk worm (b) lac insect
(c) honey bee (d) fish *(1997)*

63. Which one of the following constitutes natural silk?
(a) Nitrogen (b) Magnesium
(c) Potassium (d) Phosphorus
(1996)

64. Which one of the following fish is introduced into India by foreigners?
(a) *Mystus singhala* (b) *Clarius batrachus*
(c) *Labeo rohita* (d) *Pomphret*
(1996)

65. When scientists make an animal superior by view of genotype, introducing some foreign genes in it, is called
(a) immunization (b) genetic engineering
(c) tissue culture (d) biotechnology.
(1996)

66. Improvement of human race by controlled selective breeding between individual with desirable characteristics is called
(a) inbreeding (b) euthenics
(c) eugenics (d) none of these.
(1996)

67. Which of the following is the New World spice, that has become an essential part of Indian cuisine?
(a) Red pepper (b) Black pepper
(c) Ginger (d) Cardamom *(1995)*

68. The silkworm silk is the product of
(a) salivary gland of the larva
(b) salivary gland of the adult
(c) cuticle of the larva
(d) cuticle of the adult. *(1995)*

69. Haploid plants can be obtained by culturing
(a) pollen grains (b) root tips
(c) young leaves (d) endosperm.
(1994)

70. Silk is produced by
(a) adult moth (b) cocoon
(c) larva (d) both (a) and (c).
(1994)

71. Which among the following is the real product of the honey bee?
(a) Honey (b) Propolis
(c) Pollen (d) Bee wax *(1994)*

72. Haploid plants are preferred over diploids for mutation study because in haploids
(a) recessive mutation express immediately
(b) induction of mutations is easier
(c) culturing is easier
(d) dominant mutation express immediately.
(1993)

73. Which crop variety is not due to induced mutations?
(a) Reimei of rice
(b) Prabhat of arhar
(c) Sharbati sonora of wheat
(d) Aruna of castor *(1993)*

74. Cellular totipotency was demonstrated by
(a) Theodore Schwann
(b) A.V. Leeuwenhoek
(c) F.C. Steward
(d) Robert Hooke. *(1991)*

75. Which ones produce androgenic haploids in anther cultures?
(a) Anther wall
(b) Tapetal layer of anther wall
(c) Connective tissue
(d) Young pollen grains *(1990)*

76. In crop movement programme, haploids are important because they
(a) require one half of nutrients
(b) are helpful in study of meiosis
(c) grow better under adverse conditions
(d) form perfect homozygous. *(1989)*

Answer Key

1.	(a)	**2.**	(d)	**3.**	(c)	**4.**	(b)	**5.**	(d)	**6.**	(c)	**7.**	(b)	**8.**	(a)	**9.**	(d)	**10.**	(d)
11.	(a)	**12.**	(c)	**13.**	(b)	**14.**	(a)	**15.**	(b)	**16.**	(b)	**17.**	(b)	**18.**	(c)	**19.**	(a)	**20.**	(b)
21.	(b)	**22.**	(d)	**23.**	(b)	**24.**	(d)	**25.**	(d)	**26.**	(b)	**27.**	(d)	**28.**	(b)	**29.**	(b)	**30.**	(a)
31.	(b)	**32.**	(a)	**33.**	(a)	**34.**	(c)	**35.**	(a)	**36.**	(b)	**37.**	(a)	**38.**	(c)	**39.**	(b)	**40.**	(a)
41.	(c)	**42.**	(d)	**43.**	(a)	**44.**	(c)	**45.**	(b)	**46.**	(a)	**47.**	(a)	**48.**	(a)	**49.**	(d)	**50.**	(a)
51.	(a)	**52.**	(c)	**53.**	(c)	**54.**	(c)	**55.**	(d)	**56.**	(a)	**57.**	(a)	**58.**	(d)	**59.**	(b)	**60.**	(d)
61.	(c)	**62.**	(a)	**63.**	(a)	**64.**	(d)	**65.**	(b)	**66.**	(c)	**67.**	(a)	**68.**	(a)	**69.**	(a)	**70.**	(c)
71.	(d)	**72.**	(a)	**73.**	(d)	**74.**	(c)	**75.**	(d)	**76.**	(d)								

EXPLANATIONS

1. (a)

2. (d) : When breeding is between animals of the same breed for 4-6 generation, it is called inbreeding. Inbreeding, as a rule, increases homozygosity. Thus, inbreeding is necessary if we want to obtain a pureline in any animal.

3. (c)

4. (b) : In interspecific hybridisation, a species is mated with a different related species of the same genus. Interspecific hybrids are generally difficult to produce, but they are important in plant breeding, particularly in breeding for disease resistance. This is also called intrageneric hybridisation.

5. (d) : Mackerel is a marine fish, rich in omega-3-fatty acids. *Mystus*, Mangur and Mrigala are freshwater fishes.

6. (c) : Ley farming is an agricultural system where the field is alternately seeded for grain and left fallow for growing hay or used for pasture. During the fallow/pasture period the soil is filled with roots of grasses and other plants. New ploughing mixes them in the soil and also increases the amount of nitrogen in the soil especially when legume forage are used. It also protects soil from erosion by maintaining constant soil coverage.

7. (b) : A protoplast is a cell which has its cell wall removed by mechanical or enzymatic means.

8. (a) : Outbreeding is the breeding of unrelated animals, which may be between individuals of the same breed (but having no common ancestors), or between different breeds (cross breeding) or different species (inter specific hybridisation). Outbreeding is an important strategy of animal husbandry as it helps to overcome inbreeding depression.

9. (d) : Micropropagation is the latest method of obtaining a large number of plantlets from plant tissue culture. It is called micropropagation because of the minute size of the propagules. It involves repeated subculture of the explant by changing the medium so as to form a large number of plantlets from that single explant. Somatic embryogenesis *i.e.*, developing embryos from somatic cells is one of the techniques of micropropagation.

10. (d) : When a hybrid is produced by fusion of somatic cells of two varieties or species, it is known as somatic hybrid. The process of producing somatic hybrids is called somatic hybridization. First, the cell wall of the plant cells are removed then the protoplasts of the two cells are brought in contact and made to fuse by means of electrofusion or chemicals like polyethylene glycol (PEG) and sodium nitrate. The fused protoplasts soon develop their own walls and are called somatic hybrids.

11. (a) : Clonal propagation can be characterized by PCR and RAPD. The polymerase chain reaction (PCR) technique, generates microgram (μg) quantities of DNA copies (upto billion copies) of the desired DNA (or RNA) segment, present even as a single copy in the initial preparation, in a matter of few hours. RAPD stands for Random Amplification of Polymorphic DNA. It is a type of PCR, but the segments of DNA that are amplified are random. No knowledge of the DNA sequence for the targeted gene is required, as the primers will bind somewhere in the sequence, but it is not certain exactly where. Its resolving power is much lower than targeted, species specific DNA comparison methods, such as short tandem repeats.

12. (c) : Meristem is a localized group of cells, which are actively dividing and undifferentiated but ultimately giving rise to permanent tissue. Although the plant is infected with a virus, yet the meristem is free of virus. Therefore, meristem can be removed and grown *in vitro* to obtain virus free plants. Cultivation of axillary or apical shoot meristems is called meristem culture. The apical or axillary meristems are generally free from virus.

13. (b) : Germplasm of any crop species consists of (i) cultivated improved varieties, (ii) improved varieties that are no more in cultivation, (iii) old local or '*desi*' varieties, (iv) pure lines and (v) wild species related to the crop species.

14. (a) : Plant tissue culture, also called micro-propagation, is the growth of plant cells outside the plant body in a suitable culture medium which contains mixture of nutrients in solid or liquid form, under controlled environmental condition. Tissue culture technique is based on totipotent nature of plant cell or phenomenon of totipotency *i.e.*, each and every plant cell has inherent capacity to develop into complete plant. The entirely vegetatively produced descendents of somatic cells are collectively called clone. They are genetically identical to parents.

15. (b) : Viability of seeds can be known by two methods: (i) ability to germinate, (ii) testing their ability to respire. All viable seeds respire. This can be tested by immersing a section of seed containing the embryo in 0.1% solution of triphenyl tetrazolium chloride. The viable embryo will turn pink due to conversion of colourless triphenyl tetrazolium chloride into insoluble

coloured dye called triphenyl formazone due to reduction.

16. (b) : Somatic embryos develop from somatic cells.Their development is comparable to that of a zygotic embryo. They are just like a normal embryo except that their development is induced from a diploid somatic cell. Somatic embryo culture is induced by a high concentration of an auxin. Microspores are haploid cells which do not give rise to somatic embryo.

17. (b) : Vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell. They are used in recombinant DNA technology.

18. (c) : *Refer to answer 12.*

19. (a) : The development and usage of several high yield varieties of wheat and rice, better irrigation facilities, fertilizer application, weed, pest and pathogen control and better agricultural management in 1960s, increased the yields per unit area. This phase is often called green revolution. In India, it was witnessed during mid 1960s. Norman E. Borlaug is known as Father of Green Revolution as he developed the semi-dwarf varieties of wheat. In 1963, many lines like Sonalika and Kalyan Sona were selected from these and introduced all over India. Semi-dwarf varieties of rice were developed from IR-8 at International Rice Research Institute (IRRI), Philippines and Taichung Native -1 from Taiwan which were introduced in 1966, in India. Dr. M.S. Swaminathan, pioneer mutation breeder has produced Sharbati Sonora, a variety of wheat by mutation, which is responsible for green revolution in India. Dr. Swaminathan is called Father of Green Revolution in India.

20. (b) : The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called germplasm collection.

21. (b) : Green Revolution was one of the major task for agricultural scientists in India to produce sufficient food for increasing population. Better yielding semi-dwarf varieties of rice, "Jaya" and "Ratna" were developed for green revolution.

22. (d) : 'Himgiri' is a variety of wheat. HS-375 and HS375 are the two common varieties of Himgiri. HS-375 is produced on irrigated/rain-fed area. It is medium fertility and late sown hybrid of Himgiri, while HS375 is produced on very high altitude *i.e.*, in the Northern Himalayan and Garhwal region. 'Himgiri' is resistance to leaf and stripe rust and hill bunt diseases.

23. (b) : Breeding of crops with higher levels of vitamins and minerals or higher protein and healthier fats is called biofortification. This is the most practical aspect to improve the health of the people.

24. (d) : Direct gene transfer is the transfer of naked DNA into plant cells, but the presence of rigid plant cell wall acts as a barrier to uptake. Therefore, protoplasts are the favoured target for direct gene transfer. Polyethylene glycol mediated DNA uptake is a direct gene transfer method that utilizes the interaction between PEG, naked DNA, salts and the protoplast membrane to effect transport of the DNA into the cytoplasm.

25. (d) : Genetic variation present among plant cells during tissue culture is called somaclonal variation. The term somaclonal variation is also used for the genetic variation present in plants regenerated from a single culture. This variation has been used to develop several useful varieties.

26. (b) : Haploid plants, are always pure because they possess only one set of chromosomes. So, the mutations are expressed very easily in haploid plants as compared to diploid plants.

27. (d) : First inorganic fungicide was developed by R.M.A. Millardet (1882) against downy mildew (*Plasmopara viticola*) of grape-vine at the University of Bordeaux and commonly known as Bordeaux mixture. It consists of copper sulphate, lime and water.

28. (b) : Bacterial blight of chickpea is caused by bacterium *Xanthomonas campestris*. The stems and the leaves of infected plant give blighted or burnt up appearance. Control measures includes rogueing, 3-year crop rotation, disease free seeds, spray of copper fungicides (Bordeaux mixture) and antibiotics besides sowing disease resistant varieties.

29. (b) : A bullock is a castrated bull. Bulls have castrated to make them more meek and docile. Castration is any action, surgical, chemical, or otherwise, by which a male loses the functions of the testes or a female loses the functions of the ovaries. Castration is the removal or destruction of one or both testicles and results in sterility, decreased sexual desire, and inhibition of secondary sex characteristics. It is performed for the purpose of improving the quality of meat and decreasing the aggressiveness of farm animals; in pet animals it prevents unwanted mating behaviour, reproduction, and wandering.

30. (a)

31. (b) : New castle disease is a highly contagious zoonoic bird disease affecting many domestic and wild avian species.The causal agent, New castle disease virus (NDV), is a negative-sense single-stranded RNA virus. Transmission occurs by exposure to faecal and other excretions from infected birds, and through contact with contaminated feed, water, equipment and clothing. Signs of infection with NDV vary greatly depending on factors such as the strain of virus and the health, age and species of the host. They can include respiratory signs (gasping, coughing), nervous signs (depression, inappetence, drooping wings, paralysis), swelling of the eyes and neck, diarrhoea, rough or thin-shelled aggs and reduced egg production.

32. (a): Hybridisation or heterosis or hybrid vigour is defined as superiority of hybrid over parents. It has been commercially exploited in different commercial crops like maize, sorghum, bajra, etc. The main steps include: selection of parents, selfing of parents, emasculation, bagging, crossing of desired and selected parents and finally seed setting and harvesting.

33. (a) : Monoculture describes systems that have very low diversity. Monoculture is the destruction of a diverse ecosystem and replacement with a single species or crop. It depletes the soil, fruits and vegetables become more susceptible to pests and diseases than those grown in a diverse crop environment, thus requiring larger amount of chemical spray.

34. (c) : *Refer to answer 32.*

35. (a) : *Refer to answer 12.*

36. (b) : *Triticale* is the first man made cereal or crop, which has been produced by intergeneric hybridization between common wheat (*Triticum aestivum*) and European rye (*Secale cereale*) with a view to combine characters of these two parent plants. *Triticale* is hexaploid, *i.e,* 2n = 6x = 62 (when tetraploid wheat is used) or octaploid, *i.e.,* 2n = 8x = 56 (when hexaploid wheat is used). *Triticale* or *Triticosecale* is not suitable for purpose of bread making due to low glutein content, but it is a good forage crop.

37. (a) : Most important source of food in the world are cereals. They are a rich source of carbohydrates, present in endosperms which is the edible portion in cereals. Wheat, corn and rice contribute to about two thirds of the total world's food. Rice alone is the staple food of 60% of world population and more than 50% Indians. Wheat is world's most widely cultivated crop. Maize is an important kharif crop of India and also contributes to food production.

38. (c) : Gamma rays are produced when an unstable atomic nucleus like cobalt-60 releases energy to gain stability. Sharbati Sonora and Pusa Lerma are the two important varieties of wheat that are responsible for green revolution in India. These are produced by gamma rays treatment of Sonora-64 and Lerma Rojo-64 which are Mexican dwarf wheat varieties.

39. (b) : *Refer to answer 19.*

40. (a) : Pashmina refers to a type of cashmere wool and textiles made from it. This wool comes from a special breed of goat indigenous to high altitudes of the Himalayan mountains. The Himalayan mountain goat, *Capra hircus*, sheds its winter coat every spring and the fleece is caught on thorn bushes. One goat sheds approximately 3-8 ounces of the fibre.

41. (c) : *Refer to answer 9.*

42. (d)

43. (a) : Green manures are fast growing herbaceous crops which are ploughed down and mixed with the soil while still green for enrichment of soil. These provide both organic matter and nitrogen to the soil, in which Indian soils are generally poor. The green manure checks soil erosion by forming protective soil cover and also prevents leaching. Increase in yield by 30-50% has been observed by use of green manures. Some important green manure crops, which are mostly members of Family Leguminosae are *Alhagi* and *Crotolaria juncea*.

44. (c) : Maximum application of animal cell culture technology is in the production of vaccines. Vaccines are chemical substances prepared from the proteins of other animals which confer immunity to a particular virus. Some of the vaccines synthesized biologically through genetic engineering are vaccines for hepatitis B virus, vaccines for rabies virus, vaccines for poliovirus and vaccines for small pox virus, etc.

45. (b) : Colchicine is an alkaloid extracted from seed and corm of *Colchicum autumnale*. It has the property of arresting and breaking the spindle so that a cell division without cell wall formation may be affected leading to doubling of chromosome number. So a diploid cell will become tetraploid by chromosome doubling.

46. (a) : Totipotency refers to the capacity of each living cell of a multicellular organism being capable of independent development when provided with suitable conditions. Guha and Maheshwari (1966) cultured anthers of *Datura*. The haploid pollen grain inside the anther divides to form a multicellular mass of cells called callus. Using varying quantities of auxins and cytokinins in the culture medium, this callus is differentiated into embryoids which later germinates to form the entire plant.

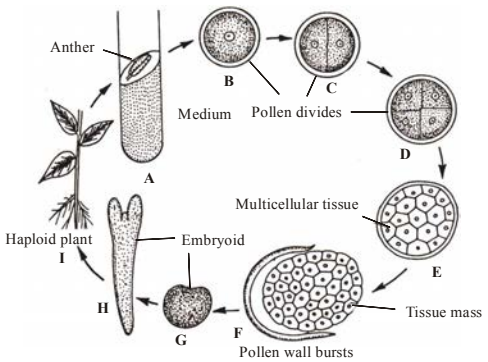


Fig.: Differentiation of embryoids from pollen grains in culture.

47. (a) : New world crops are those which have their center of origin as America. Cashewnut and rubber have their center of origin in Brazil and potato has Peru as its center of origin. All of them have been brought to India from New world.

48. (a) : Potato and tomato are new world crops. Their center of origin is Peru, so they are new world crops. They were brought to India by the European invaders.

49. (d) : *Refer to answer 36.*

50. (a) : *Gambusia affinis* is regarded as a larvicidal fish as it selectively feeds on mosquito larvae. It forms an effective tool for biological control of mosquitoes.

51. (a) : Coconut milk or liquid endosperm of coconut could initiate as well as sustain the proliferation of tissues in a culture. Eventually coconut milk was shown to contain the cytokinin zeatin, but this finding was not obtained until several years after the discovery of cytokinins. The first cytokinin to be discovered was the synthetic analog kinetin.

52. (c) : A highly organised division of labour is found in the colony of honey bees. A good and well developed colony of bees had 40 to 50 thousand individuals consisting of 3 castes *viz*., queen, drone and worker. Although the workers are the smallest of the three castes but they function as the main spring of the complicated machinery like honey bee colony. It takes 21 days in the development from the egg to the adult and the total life span of a worker is about 6 weeks. The workers are atrophid female which sacrifice themselves for the well-being of the colony. The total indoor and outdoor duties of the colony are performed by the workers only. *Apis dorsata* is the largest honey bee and *A. indica* is slightly smaller than it. Bees wax is a by product of honey bee and drone of honey bee is haploid in nature.

53. (c) : The new plant varieties are produced by selection and hybridization. Selection is a non-random process which leads to individuals of different genotypes being represented unequally in their progeny in later generations of a population of self propagating units. It can be natural or artificial. Hybridization is the crossing of two varieties, species or genera having desired genes by bringing together the useful characters of these into one progeny. Both these processes produce new plant varieties.

54. (c) : *Azolla* plays a very important role in rice production. *Azolla* and its nitrogen-fixing partner, *Anabaena*, has been used as green manure to fertilize rice paddies and increase production. With the help of *Azolla*, rice can be grown year after year, several crops a year, with little or no decline in productivity; hence no rotation of crops is necessary.

55. (d) : Aquaculture involves production of useful aquatic plants and animals such as fishes, prawns, shrimps, lobsters, crabs, molluscs by proper utilization of small and large bodies of water. The production of fishes is called pisciculture. Inland fishery deals with the fishery aspects of waters other than marine water. Marine fishery deals with the fishery aspects of the sea water or ocean.

56. (a) : *Refer to answer 50.*

57. (a) : *Refer to answer 52.*

58. (d) : Hybridoma is hybrid cell resulting from the artificial fusion of an antibody-producing lymphocyte and a myeloma cell from a lymphoid tumour. Such cells can produce a clone that may be maintained in tissue culture and used for the continuing production of monoclonal antibody.

59. (b) : Hybrid vigour or heterosis is defined as the superiority of the hybrid over its parents. It is lost on inbreeding. It is lost in the F_2 generation in self pollinated plants and declines slowly in cross pollinated plants. So it is more profitable in vegetatively propagated plants as they do not involve sexual reproduction and so hybrid vigour is not lost in subsequent crops, *e.g*., sweet potato, sugarcane, strawberry and grapes, etc.

60. (d) : High milk yielding varieties of cows are obtained by use of surrogate mothers, super ovulation, artificial insemination. To get an increased yield of milk surrogate mothers are used in dairy. Superovulation is the hormonal stimulation of multiple ovarian follicles resulting in release from the ovary of a larger number of oocytes (ova) than normal. So, implantation into surrogate mothers increases the number of offspring, usually from highly selected cows. Artificial insemination is a reasonably straight forward process to remove semen from a chosen male animal, and transfer it into a female, at the appropriate stage of the oestrous cycle. This process is well developed in case of dairy cattle breeding for more milk production.

61. (c) : Honey is very acidic. Its pH is between 3 and 4 about the same as orange juice or a can of coke.

62. (a) : Pebrine is a disease of silkworm caused by a small parasite *Nosema* which has a devastating effect on silk industry.

63. (a) : Silk is a pasty secretion of the silkworm produced by the salivary gland of the larva. As this pasty secretion comes in contact with air, it becomes hard and forms strong and pliable silk strands. This secretion forms two cores of fibroin: (i) a tough elastic insoluble protein consisting of 75% of the fibre's weight and cemented together with sericin from the middle region of the silk gland at the time of secretion, and (ii) a gelatious protein which is easily soluble in warm water. As proteins consist of nitrogen component so, it is a main constituent of natural silk.

64. (d) : *Pomphret* fish is the one, which was introduced in India by foreigners. It is consumed as an edible fish.

65. (b) : Genetic engineering is experimental manipulation of genetic material, especially for industrial or medical uses. It encompasses the techniques of gene cloning, the modification DNA by changes in sequence arrangement or deletion, and the introduction of novel genes into cells and organisms. It may prove possible to advantageously modify the genes of farmed animals, to correct genetic deficiencies of the human by inserting novel genes. This can be done by breakage of a DNA molecule at two desired places into another DNA molecule of the desired animal.

66. (c) : Euthenics is the suitable environment for human well being, health and intellect.
Inbreeding involves production of progenies by mating between relatives.

67. (a) : New world crops are those which have their centre of origin in America. Red peppers are the dried ripe fruits of *Capsicum* sp., indigenous to the American tropics and subtropics and the West Indies. It is a new world crop.

68. (a) : *Refer to answer 63.*

69. (a) : Haploid plants are those plants which have single set of chromosomes. Pollen grains are haploid as they are produced after meiosis so they are used for haploid production. It was first made in *Datura innoxia* by Guha and Maheshwari in 1964.
Haploids are important in plant breeding as mutation can be easily detected in them and they are also used to produce homozygous diploids.

70. (c) : *Refer answer 63.*

71. (d) : Bee wax is a very useful by-product of bee keeping industry. It is yellowish to greyish brown in colour and insoluble in water but completely soluble in ether. Bee wax is a natural secretion of the worker bees and is poured out in thin delicate scales or flakes. It is secreted by pair of wax glands placed ventrally on the abdomen. Bee wax is used in the manufacture of cosmetics, for Catholic churches, face cream, paints, ointments, insulators, plastic works, polishes, carbon paper, lubricant etc. Honey is not the real product of honey bees. It is a mixture of nectar, pollen, cane-sugar and saliva of honey-bees.

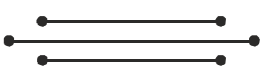
72. (a) : Haploids are preferred over diploids for mutation study because in haploids recessive mutation is easier. Most of the induced mutations are recessive and these have to be in double to be expressed phenotypically. Mutations are not seen in heterozygous conditions. So, in haploid plants, recessive mutation express immediately.

73. (d) : Aruna of castor is a crop variety which is not due to induced mutations. Aruna variety has been developed by mutation, where maturity period has been reduced from normal 270 days to 102 days.

74. (c) : Cellular totipotency is the technique of regeneration or development of complete plant from explant or cell or tissue of the plant. This technique was established by F. C. Steward and developed the new carrot plant from carrot root culture

75. (d) : Haploid production through a culture has been referred to as androgenesis. The androgenic method of haploid production is from the male gametophyte of an angiosperm plant *i.e.*, microspore (immature pollen). Young pollen grains produced androgenic haploids in anther cultures while anther wall, tapetal layer of anther wall and connective tissue are the parts of anther. Tapetal layer is the nutritive tissue.

76. (d) : In crop movement programme, haploids are important because they form perfect homozygous lines. Homozygous are the pure line selection plants resulting from self pollination. In this way, considerable homozygosity is obtained. Haploids are those plants which possess a gametophytic number of chromosomes. Haploids are used in plant breeding, especially for the production of homozygous plants and in their studies in the detection of mutation.



Chapter

32

Microbes in Human Welfare

1. Select the mismatch.
(a) *Rhodospirillum* – Mycorrhiza
(b) *Anabaena* – Nitrogen fixer
(c) *Rhizobium* – Alfalfa
(d) *Frankia* – Alnus *(NEET 2017)*

2. Which of the following in sewage treatment removes suspended solids?
(a) Secondary treatment
(b) Primary treatment (c) Sludge treatment
(d) Tertiary treatment *(NEET 2017)*

3. Which of the following is correctly matched for the product produced by them?
(a) *Methanobacterium* : Lactic acid
(b) *Penicillium notatum* : Acetic acid
(c) *Sacchromyces cerevisiae* : Ethanol
(d) *Acetobacter aceti* : Antibiotics
(NEET 2017)

4. Match column I with column II and select the correct option using the codes given below.

Column I	**Column II**
A. Citric acid	(i) *Trichoderma*
B. Cyclosporin A	(ii) *Clostridium*
C. Statins	(iii) *Aspergillus*
D. Butyric acid	(iv) *Monascus*

(a) A-(iii), B-(i), C-(ii), D-(iv)
(b) A-(iii), B-(i), C-(iv), D-(ii)
(c) A-(i), B-(iv), C-(ii), D-(iii)
(d) A-(iii), B-(iv), C-(i), D-(ii) *(NEET-II 2016)*

5. Which of the following is wrongly matched in the given table?

	Microbe	**Product**	**Application**
(a)	*Streptococcus*	Streptokinase	Removal of clot from blood vessel
(b)	*Clostridium butylicum*	Lipase	Removal of oil stains
(c)	*Trichoderma polysporum*	Cyclosporin A	Immuno-suppressive drug
(d)	*Monascus purpureus*	Statins	Lowering of blood cholesterol

(NEET-I 2016)

6. Match the following list of microbes and their importance.

Column I	**Column II**
A. *Saccharomyces cerevisiae*	(i) Production of immuno-suppressive agent
B. *Monascus purpureus*	(ii) Ripening of Swiss cheese
C. *Trichoderma polysporum*	(iii) Commercial production of ethanol
D. *Propionibacterium sharmanii*	(iv) Production of blood-cholesterol lowering agents

(a) A-(iv), B-(ii), C-(i), D-(iii)
(b) A-(iii), B-(i), C-(iv), D-(ii)
(c) A-(iii), B-(iv), C-(i), D-(ii)
(d) A-(iv), B-(iii), C-(ii),D-(i) *(2015)*

7. The guts of cow and buffalo possess
(a) Methanogens (b) Cyanobacteria
(c) *Fucus* sp. (d) *Chlorella* sp.
(2015 Cancelled)

8. Which one of the following fungi contains hallucinogens?
(a) *Morchella esculenta*
(b) *Amanita muscaria*
(c) *Neurospora* sp.
(d) *Ustilago* sp. *(2014)*

9. An alga which can be employed as food for human being is
(a) *Ulothrix* (b) *Chlorella*
(c) *Spirogyra* (d) *Polysiphonia.*
(2014)

10. What gases are produced in anaerobic sludge digesters?
(a) Methane and CO_2 only
(b) Methane, Hydrogen sulphide and CO_2
(c) Methane, Hydrogen sulphide and O_2
(d) Hydrogen sulphide and CO_2 *(2014)*

11. A good producer of citric acid is
(a) *Clostridium* (b) *Saccharomyces*
(c) *Aspergillus* (d) *Pseudomonas*.
(NEET 2013)

12. Microbe used for biocontrol of pest butterfly caterpillars is
(a) *Saccharomyces cerevisiae*
(b) *Bacillus thuringiensis*
(c) *Streptococcus sp*.
(d) *Trichoderma sp*. *(Karnataka NEET 2013)*

13. *Monascus purpureus* is a yeast used commercially in the production of
(a) ethanol
(b) streptokinase for removing clots from the blood vessels
(c) citric acid
(d) blood cholesterol lowering statins.
(2012)

14. A patient brought to a hospital with myocardial infarction is normally immediately given
(a) penicillin (b) streptokinase
(c) cyclosporin-A (d) statins. *(2012)*

15. A nitrogen-fixing microbe associated with *Azolla* in rice fields is
(a) *Spirulina* (b) *Anabaena*
(c) *Frankia* (d) *Tolypothrix*.
(2012)

16. Which one of the following is an example of carrying out biological control of pests/diseases using microbes?
(a) *Trichoderma* sp. against certain plant pathogens.
(b) *Nucleopolyhedrovirus* against white rust in *Brassica*.
(c) Bt-cotton to increase cotton yield.
(d) Lady bird beetle against aphids in mustard.
(2012)

17. In gobar gas, the maximum amount is that of
(a) butane (b) methane
(c) propane (d) carbon dioxide.
(Mains 2012)

18. Read the following four statements (A-D).
(A) Colostrum is recommended for the new born because it is rich in antigens.
(B) Chikungunya is caused by a Gram negative bacterium.
(C) Tissue culture has proved useful in obtaining virus-free plants.
(D) Beer is manufactured by distillation of fermented grape juice.
How many of the above statements are wrong?
(a) Two (b) Three
(c) Four (d) One *(Mains 2012)*

19. The domestic sewage in large cities
(a) has a high BOD as it contains both aerobic and anaerobic bacteria
(b) is processed by aerobic and then anaerobic bacteria in the secondary treatment in Sewage Treatment Plants (STPs)
(c) when treated in STPs does not really require the aeration step as the sewage contains adequate oxygen
(d) has very high amount of suspended solids and dissolved salts. *(Mains 2012)*

20. Consider the following four statements (A - D) and select the option which includes all the correct ones only.
(A) Single cell *Spirulina* can produce large quantities of food rich in protein, minerals, vitamins, etc.
(B) Body weight-wise the microorganism *Methylophilus methylotrophus* may be able to produce several times more proteins than the cows per day.
(C) Common button mushrooms are a very rich source of vitamin C.
(D) A rice variety has been developed which is very rich in calcium.
(a) Statements (C) and (D)
(b) Statements (A), (C) and (D)
(c) Statement (B), (C) and (D)
(d) Statement (A) and (B) *(Mains 2012)*

21. The most common substrate used in distilleries for the production of ethanol is
(a) corn meal (b) soya meal
(c) ground gram (d) molasses. *(2011)*

22. Which one of the following is not a biofertiliser?
(a) *Agrobacterium* (b) *Rhizobium*
(c) *Nostoc* (d) Mycorrhiza
(2011)

23. Secondary sewage treatment is mainly a
(a) physical process (b) mechanical process
(c) chemical process (d) biological process.
(2011)

24. Which of the following is mainly produced by the activity of anaerobic bacteria on sewage?
(a) Laughing gas (b) Propane
(c) Mustard gas (d) Marsh gas *(2011)*

25. An organism used as a biofertilizer for raising soyabean crop is
(a) *Azotobacter* (b) *Azospirillum*
(c) *Rhizobium* (d) *Nostoc*. *(2011)*

26. Ethanol is commercially produced through a particular species of
(a) *Saccharomyces* (b) *Clostridium*
(c) *Trichoderma* (d) *Aspergillus*. *(2011)*

27. Continuous addition of sugars in 'fed batch' fermentation is done to
(a) produce methane (b) obtain antibiotics
(c) purify enzymes (d) degrade sewage. *(2011)*

28. Organisms called methanogens are most abundant in a
(a) sulphur rock (b) cattle yard
(c) polluted stream (d) hot spring. *(2011)*

29. Read the following statement having two blanks (A and B).
A drug used for _A_ patients is obtained from a species of the organism _B_.
The one correct option for the two blanks is

	A	B
(a)	heart	*Penicillium*
(b)	organ-transplant	*Trichoderma*
(c)	swine flu	*Monascus*
(d)	AIDS	*Pseudomonas*.

(Mains 2011)

30. Consider the following statements (A–D) about organic farming.
(A) Utilizes genetically modified crops like Bt cotton
(B) Uses only naturally produced inputs like compost
(C) Does not use pesticides and urea
(D) Produces vegetables rich in vitamins and minerals

Which of the above statements are correct?
(a) B, C and D (b) C and D only
(c) B and C only (d) A and B only *(Mains 2011)*

31. Which one of the following is a wrong matching of a microbe and its industrial product, while the remaining three are correct?
(a) Yeast – statins
(b) *Acetobacter aceti* – acetic acid
(c) *Clostridium butylicum* – lactic acid
(d) *Aspergillus niger* – citric acid *(Mains 2011)*

32. Select the correct statement from the following.
(a) Biogas is produced by the activity of aerobic bacteria on animal waste
(b) *Methanobacterium* is an aerobic bacterium found in rumen of cattle
(c) Biogas, commonly called gobar gas, is pure methane
(d) Activated sludge-sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria. *(2010)*

33. A common biocontrol agent for the control of plant diseases is
(a) baculovirus
(b) *Bacillus thuringiensis*
(c) *Glomus*
(d) *Trichoderma*. *(2010)*

34. The common nitrogen-fixer in paddy fields is
(a) *Rhizobium* (b) *Azospirillum*
(c) *Oscillatoria* (d) *Frankia*. *(2010)*

35. Which one of the following is not used in organic farming?
(a) *Glomus* (b) Earthworm
(c) *Oscillatoria* (d) Snail *(2010)*

36. An example of endomycorrhiza is
(a) *Nostoc* (b) *Glomus*
(c) *Agaricus* (d) *Rhizobium*. *(Mains 2010)*

37. Which one of the following pairs is wrongly matched?
(a) Alcohol - Nitrogenase
(b) Fruit juice - Pectinase
(c) Textile - Amylase
(d) Detergents - Lipase *(2009)*

38. Which of the following is not used as a biopesticide?
(a) *Trichoderma harzianum*
(b) *Nucleopolyhedrovirus* (NPV)
(c) *Xanthomonas campestris*
(d) *Bacillus thuringiensis* *(2009)*

39. *Trichoderma harzianum* has proved a useful microorganism for
(a) gene transfer in higher plants
(b) biological control of soil-borne plant pathogens
(c) bioremediation of contaminated soils
(d) reclamation of wastelands. *(2008)*

40. Nitrogen fixation in root nodules of *Alnus* is brought about by
(a) *Frankia* (b) *Azorhizobium*
(c) *Bradyrhizobium* (d) *Clostridium*. *(2008)*

41. Which one of the following proved effective for biological control of nematodal diseases in plants?
(a) *Gliocladium virens*
(b) *Paecilomyces lilacinus*
(c) *Pisolithus tinctorius*
(d) *Pseudomonas cepacia* *(2008)*

42. Probiotics are
(a) cancer inducing microbes
(b) new kind of food allergens
(c) live microbial food supplement
(d) safe antibiotics. *(2007)*

43. Which one of the following pairs is wrongly matched?
(a) Yeast - Ethanol
(b) *Streptomycetes* - Antibiotic
(c) Coliforms - Vinegar
(d) Methanogens - Gobar gas *(2007)*

44. Dough kept overnight in warm weather becomes soft and spongy because of
(a) absorption of carbon dioxide from atmosphere
(b) fermentation
(c) cohesion (d) osmosis. *(2004)*

45. Which one of the following pairs is not correctly matched?
(a) *Streptomyces* - Antibiotic
(b) *Serratia* - Drug addiction
(c) *Spirulina* - Single cell protein
(d) *Rhizobium* - Biofertilizer
(2004)

46. The most thoroughly studied of the known bacteria-plant interactions is the
(a) cyanobacterial symbiosis with some aquatic ferns
(b) gall formation on certain angiosperms by *Agrobacterium*
(c) nodulation of *Sesbania* stems by nitrogen fixing bacteria
(d) plant growth stimulation by phosphate-solubilising bacteria. *(2004)*

47. A major component of gobar gas is
(a) ammonia (b) methane
(c) ethane (d) butane. *(2004)*

48. During anaerobic digestion of organic waste, such as in producing biogas, which one of the following is left undegraded ?
(a) Lipids (b) Lignin
(c) Hemi-cellulose (d) Cellulose *(2003)*

49. Which bacteria is utilized in gobar gas plant?
(a) Methanogens
(b) Nitrifying bacteria
(c) Ammonifying bacteria
(d) Denitrifying bacteria *(2002)*

50. During the formation of bread it becomes porous due to release of CO_2 by the action of
(a) yeast (b) bacteria
(c) virus (d) protozoans.
(2002)

51. Which of the following is the pair of biofertilizers?
(a) *Azolla* and BGA
(b) *Nostoc* and legume
(c) *Rhizobium* and grasses
(d) *Salmonella* and *E.coli* *(2001)*

52. Spoilage of oil can be detected by which fatty acid
(a) oleic acid (b) linolenic acid
(c) linoleic acid (d) erucic acid.
(2001)

53. Which aquatic fern is used to increase the yield in paddy crop?
(a) *Azolla* (b) *Salvinia*
(c) *Marsilea* (d) *Isoetes* *(2000)*

54. Which of the following is used to manufacture ethanol from starch?
(a) *Penicillin* (b) *Saccharomyces*
(c) *Azotobactor* (d) *Lactobacillus*
(2000)

55. Which of the following fern is an excellent biofertilizer?
(a) *Marsilia* (b) *Pteridium*
(c) *Azolla* (d) *Salvinia* *(1999)*

56. Which of the following is non-symbiotic biofertilizer?
(a) *Anabaena* (b) *Rhizobium*
(c) VAM (d) *Azotobacter*
(1998)

57. Yeast (*Saccharomyces cerevisiae*) is used in the industrial production of
(a) tetracyline (b) ethanol
(c) butanol (d) citric acid. *(1998)*

58. Farmers have reported over 50% higher yields of rice by using which of the following biofertilizer?
(a) *Cyanobacteria*
(b) legume-*Rhizobium* symbiosis
(c) *Mycorrhiza*
(d) *Azolla pinnata* *(1998)*

59. Which of the following microorganisms is used for production of citric acid in industries?
(a) *Aspergillus niger*
(b) *Rhizopus nigricans*
(c) *Lactobacillus bulgaris*
(d) *Penicillium citrinum* *(1998)*

60. Biological control component is central to advanced agricultural production. Which of the following is used as a third generation pesticide?
(a) Insect repellants
(b) Organophosphate and carbamates

(c) Pathogens
(d) Pheromones *(1998)*

61. The biofertilizers are
(a) *Anabaena* and *Azolla*
(b) cow dung, manure and farmyard waste
(c) quick growing crop ploughed under soil
(d) none of these. *(1997)*

62. Gobar gas contains mainly
(a) $CO_2 + H_2$ (b) $CO_2 + H_2O$
(c) CH_4 only (d) $CH_4 + CO_2$.
(1997)

63. Cochineal insects have proved very useful for
(a) *Cactus* prevention
(b) *Eicchornia* prevention
(c) weeds control
(d) *Parthenium* contol. *(1996)*

64. When a natural predator (living being) is applied on the other pathogen organism to control them, this process is called
(a) artificial control
(b) confusion technique
(c) biological control
(d) genetic engineering. *(1996)*

65. The citric acid is produced by
(a) *Candida utilis*
(b) *Azotobacter suboxydans*
(c) *Aspergillus niger*
(d) *Streptococcus lactis*. *(1995)*

66. The rotenone is
(a) a natural herbicide
(b) a natural insecticide
(c) an insect hormone
(d) a bioherbicide. *(1995)*

67. The organism, used for alcohol fermentation, is
(a) *Aspergillus* (b) *Saccharomyces*
(c) *Pseudomonas* (d) *Penicillium*.
(1995)

68. One of the major difficulties in the biological control of insect pest is that
(a) the method is less effective as compared with the use of insecticides
(b) the practical difficulty of introducing the predator to specific areas
(c) the predator develops a preference to other diets and may itself become a pest
(d) the predator does not always survive when transferred to a new environment.
(1995)

69. Biological control of agricultural pests, unlike chemical control, is
(a) self perpetuating (b) polluting
(c) very expensive (d) toxic. *(1994)*

70. In cheese manufacture, the microorganisms are important for
(a) the ripening only
(b) the souring of milk only
(c) the development of resistance to spoilage only
(d) both the souring and the ripening processes.
(1994)

71. Which of the following species does not have the ability to fix atmospheric nitrogen?
(a) *Azotobactor* (b) *Anabaena*
(c) *Nostoc* (d) *Spirogyra*
(1994)

72. Which one of the following statements is correct?
(a) Legumes fix nitrogen only through the specialized bacteria that live in their roots.
(b) Legumes fix nitrogen independently of the specialized bacteria that live in their roots.
(c) Legumes fix nitrogen only through specialized bacteria that live in their leaves.
(d) Legumes are incapable of fixing nitrogen.
(1994)

Answer Key

1.	(a)	**2.**	(b)	**3.**	(c)	**4.**	(b)	**5.**	(b)	**6.**	(c)	**7.**	(a)	**8.**	(b)	**9.**	(b)	**10.**	(b)
11.	(c)	**12.**	(b)	**13.**	(d)	**14.**	(b)	**15.**	(b)	**16.**	(a)	**17.**	(b)	**18.**	(b)	**19.**	(b)	**20.**	(d)
21.	(d)	**22.**	(a)	**23.**	(d)	**24.**	(d)	**25.**	(c)	**26.**	(a)	**27.**	(b)	**28.**	(b)	**29.**	(b)	**30.**	(c)
31.	(c)	**32.**	(d)	**33.**	(d)	**34.**	(b)	**35.**	(d)	**36.**	(b)	**37.**	(a)	**38.**	(c)	**39.**	(b)	**40.**	(a)
41.	(b)	**42.**	(c)	**43.**	(c)	**44.**	(b)	**45.**	(b)	**46.**	(b)	**47.**	(b)	**48.**	(b)	**49.**	(a)	**50.**	(a)
51.	(a)	**52.**	(d)	**53.**	(a)	**54.**	(b)	**55.**	(c)	**56.**	(d)	**57.**	(b)	**58.**	(d)	**59.**	(a)	**60.**	(d)
61.	(a)	**62.**	(d)	**63.**	(a)	**64.**	(c)	**65.**	(c)	**66.**	(b)	**67.**	(b)	**68.**	(d)	**69.**	(a)	**70.**	(d)
71.	(d)	**72.**	(a)																

EXPLANATIONS

1. (a) : *Rhodospirillum* is a free-living nitrogen fixing bacteria. Mycorrhiza is the symbiotic association between fungi and roots of higher plants. The most common fungal partners of mycorrhiza are *Glomus* species.

2. (b) : Primary or physical treatment is the process of removal of small and large, floating and suspended solids from sewage through two processes of filtration and sedimentation.

3. (c) : *Methanobacterium* is useful in the production of biogas. *Penicillium notatum* is used to produce penicillin, an antibiotic. *Acetobacter aceti* is used to obtain acetic acid.

4. (b)

5. (b) : *Clostridium butylicum* helps in the production of butyric acid. *Candida lipolytica* and *Geotrichum candidum* help in production of lipases that are added in detergents for removing oily stains from laundry.

6. (c)

7. (a) : Methanogens like *Methanobacterium* are found in the rumen (a part of the stomach) of cattle. A lot of cellulosic material is also available in the rumen. In rumen, these bacteria help in the breakdown of cellulose and play an important role in nutrition of cattle.

8. (b) : *Amanita muscaria* is a member of Class Basidiomycetes. It is a poisonous mushroom and has hallucinogenic properties. It produces a toxic alkaloid, muscarine, which mimics the effects of acetylcholine and binds to muscarinic receptors as well as ibotenic acid which also binds to different receptors. This leads to excitation of neurons bearing these receptors and hence hallucinations.

9. (b) : *Chlorella* is a single celled chlorophycean alga with rich protein content. It is considered as a source of SCP (single cell protein) and also as food source during long space travels.

10. (b) : The type of gases produced by microbial activity depend upon the microbes and the organic substrates they utilise. Certain bacteria, called methanogens, grow anaerobically on cellulosic material and produce large amount of methane along with carbon dioxide. These bacteria are commonly found in the anaerobic sludge during sewage treatment. Other anaerobic bacteria, involved in the process of anaerobic digestion produce other gases like ammonia and hydrogen sulphide.

11. (c) : *Aspergillus niger* produces citric acid, *Clostridium butylicum* produces butyric acid, *Saccharomyces* is used for commercial production of ethanol, *Pseudomonas* produces alkaline proteases.

12. (b) : Biopesticides are those biological agents that are used for control of weeds, insects and pathogens. The microorganisms used as biopesticides are viruses, bacteria, protozoa, fungi and mites. Some of the biopesticides are being used at a commercial scale. Most important example is the soil bacterium, *Bacillus thuringiensis* (Bt). Spores of this bacterium produce the insecticidal cry protein. Therefore, spores of this bacterium kill larvae of insects which eat them.

13. (d) : Statins are produced by the yeast *Monascus purpureus* which have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

14. (b) : Streptokinase (Tissue Plasminogen Activator or TPA) is an enzyme obtained from the culture of some haemolytic bacterium *Streptococcus* which is modified genetically to function as clot buster. Therefore, it helps in clearing blood clots inside the blood vessels through dissolution of intravascular fibrin during myocardial infarction.

15. (b) : *Azolla* plays a very important role in rice production. *Azolla* and its nitrogen-fixing partner, *Anabaena*, have been used as green manure to fertilise rice paddies and increase production. With the help of *Azolla*, rice can be grown year after year, several crops a year, with little or no decline in productivity; hence no rotation of crops is necessary.

16. (a) : A biological control being developed for use in the treatment of plant disease is the fungus *Trichoderma*. *Trichoderma* species are free living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

17. (b) : Biogas or gobar gas is a methane rich fuel gas produced by anaerobic breakdown or digestion of biomass with the help of methanogenic bacteria. It is made up of methane (50 -70%), carbon dioxide (30 -40%) with traces of nitrogen, hydrogen sulphide and hydrogen.

18. (b) : Chikungunya is caused by Chikungunya virus. Colostrum is the first breast milk of mother which contains antibodies (especially IgA) which protect the infant by the age of three months. Beer is manufactured by fermentation of barley malt by yeast species.

19. (b) : Sewage water can be purified by passing it through sewage treatment plants with the action of heterotrophic microorganisms. There are three stages

of this treatment – primary, secondary and tertiary. Primary treatment removes floating and suspended solids from sewage through two processes of filtration and sedimentation. First floating matter is removed through sequential filtration. The filtrate is kept in large open settling tanks where grit settles down. The sediment is called primary sludge while the supernatant is called effluent. The primary sludge traps a lot of microbes and debris. In secondary treatment, the primary effluent is taken to aeration tanks. A large number of aerobic heterotrophic microbes grow in the aeration tank. They form flocs. Flocs are masses of bacteria held together by slime and fungal filaments to form mesh like structures. The microbes digest a lot of organic matter, converting it into microbial biomass and releasing a lot of minerals. As the BOD of the waste matter is reduced to 10-15% of raw sewage, it is passed into settling tank. Thus secondary treatment is more or less biological. The sediment of settling tank is called activated sludge. The remaining is passed into a large tank called anaerobic sludge digester. It is designed for continuous operation. The aerobic microbes present in the sludge get killed. Anaerobic microbes digest the organic mass as well as aerobic microbes of the sludge. They are of two types, nonmethanogenic and methanogenic. Methanogenic bacteria produce a mixture of gases containing methane, H_2S and CO_2.

20. (d) **21. (d)**

22. (a) : Biofertilizers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilizers are bacteria, fungi and cyanobacteria. *Rhizobium* bacteria is found in the nodules on the roots of leguminous plants by symbiotic association. These bacteria fix atmospheric nitrogen into organic forms, which is used by the plants as nutrient. Fungi are also known to form symbiotic associations with plants called mycorrhiza. Cyanobacteria are autotrophic microbes widely distributed in an aquatic and terrestrial environments. Many of which can fix atmospheric nitrogen, *e.g.*, *Anabaena*, *Nostoc*, *Oscillatoria* etc. But *Agrobacterium tumefaciens* is a pathogen of several dicot plants. It causes gall tumor in the plants.

23. (d)

24. (d) : Marsh gas or methane gas is mainly produced by the activities of anaerobic bacteria on sewage. Sewage contains large amounts of organic matter and microbes, many of which are pathogenic. These microbes (bacteria and fungi) are digested during secondary treatment process of sewage by anaerobic bacteria. During digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbon dioxide. These gases are called biogas and can be easily used as a source of energy as it is inflammable.

25. (c) : *Rhizobium* is used as a biofertilizer for raising crop. *Rhizobium japonicum* forms symbiotic association in the roots of the leguminous plant, soyabean.

26. (a) : Ethanol is commercially produced through a particular species of yeast *Saccharomyces* (*Saccharomyces cerevisiae*).

27. (b)

28. (b) : Methanogens are any of various archaebacteria that produce methane; they include genera such as *Methanobacillus* and *Methanothrix*. Methanogens are obligate anaerobes found in oxygen-deficient environments, such as marshes, swamps, sludge and the digestive systems of ruminants. They are also utilised in gobar gas plants.

29. (b) : Cyclosporin A used as an immuno-suppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*.

30. (c) : Organic farming is the form of agriculture that relies on techniques such as crop rotation, green manure, compost and biological pest control to maintain soil productivity and control pest on a farm. Organic farming excludes or strictly limited the use of manufactured fertilizers, pesticides (which include herbicides, insecticides and fungicides), plant growth regulators such as hormones, food additives and genetically modified organisms.

31. (c) : Microbes are used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes. Examples of acid producers are *Aspergillus niger* (a fungus) of citric acid, *Acetobacter aceti* (a bacterium) of acetic acid; *Clostridium butylicum* (a bacterium) of butyric acid and *Lactobacillus* (a bacterium) of lactic acid.

32. (d) : *Refer to answer 19.*

33. (d) : The natural method of pest and pathogen control involving use of viruses, bacteria and other insects (which are their natural predators and pests) is called biocontrol or biological control. For example, free living fungus *Trichoderma* exerts biocontrol over several plant pathogens for the control of plant diseases. Baculoviruses (mostly of genus *Nucleo-polyhedrovirus*) are also used as biocontrol agents but they are used for the control of insects and arthropods. *Bacillus thuringiensis* is a soil bacterium which is used as biopesticide. *Glomus* species are the most common fungal partners of mycorrhiza residing in the roots of higher plants.

34. (b) : *Azospirillum* is an anaerobic nitrogen fixing bacteria which forms loose association with roots of some plants. Inoculation of paddy fields with

these bacteria helps in increasing yield and saving of nitrogen fertilizers.

35. (d) : Organic farming is a method of farming system which primarily aimed to keep the soil alive and in good health by use of organic wastes and other biological material alongwith beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an ecofriendly, pollution free environment.

Basic components of organic farming are green manures, farm yard manure, vermicompost, crop rotation, biopesticides and biofertilizers. *Glomus* being a mycorrhizal component, earthworm being a vermicompost and *Oscillatoria* being a nitrogen fixing blue green algae can be used in organic farming. Snail cannot be a component of organic farming.

36. (b) : The genus *Glomus* form endomycorrhiza, a symbiotic associations with plants. The fungal symbiont in these associations absorbs phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and drought, and an overall increase in plant growth and development.

Nostoc is a blue green algae, *Agaricus* is a basidiomycetes, *Rhizobium* is a eubacteria.

37. (a) : Yeast species are used in alcoholic fermentation due to the presence of zymase enzyme. It was known that the yeast extract contained an enzyme zymase, which is nondialyzable and a coenzyme which is dialyzable. It is now well known that the zymase is a complex mixture of many enzymes and that several coezymes are necessary for their function. The activity of this enzyme was lost because the main enzyme was separated from its coezyme during dialyzation. Thus, it was established later that extracellular enzyme zymase, secreted by yeast cells, carry out the process of fermentation.

38. (c) : *Refer to answer 33.*

39. (b) : *Refer to answer 33.*

40. (a) : The most common symbiotic association of legume and bacteria on roots is as nodules, which are small outgrowth on the roots. The microbe *Frankia* is symbiont in root nodules of several non-legume plants like *Casurina* and *Alnus*. Both *Rhizobium* and *Frankia* are free living in soil but as symbiont can fix atmospheric nitrogen.

41. (b) : *Paecilomyces lilacinus* proved effective for biological control of nematodal diseases in plant.

42. (c) : Probiotics are dietary supplements containing potentially beneficial bacteria or yeast, with lactic acid bacteria (LAB) as the most common microbes used. LAB have been used in the food industry for many years, because they are able to convert sugars (including lactose) and other carbohydrates into lactic acid. They not only provides the characteristic sour taste of fermented dairy foods such as yogurt, but acts as a preservative, by lowering the pH and creating fewer opportunities for spoilage organisms to grow.

43. (c) : Coliform bacteria are a commonly used bacterial indicator of sanitary quality of foods and water. It is not involved in the production of vinegar.

44. (b)

45. (b) : *Serratia marcescens* is considered a harmful human pathogen which has been known to cause urinary tract infections, wound infections and pneumonia. *Serratia* bacteria also have many antibiotic resistance properties which may become important if the incidence of *Serratia* infections dramatically increases.

46. (b) : *Agrobacterium tumefaciens* is the causative agent of crown gall, an important disease of many commercial crops. This disease has come to be recognized in recent years as being caused by a DNA plasmid (Ti plasmid) carried by bacterium and transferred to the plant cells.

47. (b) : *Refer to answer 17.*

48. (b) : Lignin is a complex polymer of phenylpropane units, which are cross-linked to each other with a variety of different chemical bonds. This complexity has thus far proven as resistant to microbial degradation.

49. (a) : *Refer to answer 28.*

50. (a) : *Saccharomyces* converts starch or sugars to pyruvic acid through EMP pathway. Then this pyruvic acid is converted to acetaldehyde and finally to ethyl alcohol in the absence of oxygen. This entire process is called fermentation.

$$C_6H_{12}O_6 \rightarrow 2CH_2COCOOH \rightarrow 2C_2H_5OH + 2CO_2$$

This released carbon dioxide makes the dough to rise and gives spongy nature to bread.

51. (a)

52. (d) : *Erucic acid* is an unsaturated fatty acid belonging to the oleic acid series, occurring as glycerides in rape seed oil and other vegetable oils. It is the *cis*-isomer, the *trans*-isomer being brassidic acid. Erucic acid is used as a binder for oil paints. It is useful in manufacture of emulsions to coat photographic films and papers. Oleic acid is found in various animal and vegetable sources. It is widely used in industries including textile, chemical, medicine, leather, stationary, paper making, etc. Linolenic acids is used in making soaps, emulsifiers and quick-drying

oils, in beauty products. It helps in acne reduction, moisture retention, etc. Linoleic aicd is an important fatty acid especially for growth and development of infants. Commercially it is used in margarine, animal feeds, soaps and drugs.

53. (a) : *Refer to answer 15.*

54. (b) : *Refer to answer 50.*

55. (c) : *Refer to answer 15.*

56. (d) : Biofertilizers are organisms which bring about nutrient enrichment of the soil. *Azotobacter* is a free living, aerobic, nitrogen fixing bacteria. *Anabena* is a nitrogen fixing cyanobacteria that occurs in both free living and symbiotc associations with *Azolla*, *Cycas* roots, etc. *Rhizobium* lives symbiotically in root nodules of legumes and non-legumes. Vesicular-arbuscular mycorrhiza (VAM) is an example of endomycorrhiza in which fungal hyphae penetrate the cortical cells of grasses to form vesicles.

57. (b) : *Refer to answer 50.*

58. (d) : *Refer to answer 15.*

59. (a) : Citric acid is obtained through the fermentation carried out by *Aspergillus niger* on sugary syrups. Citric acid is employed in dyeing, engraving, medicines, inks, flavouring and preservation of food and candies.

60. (d) : Pheromones are volatile chemicals produced by a given species to communicate with other individuals of the same species to change their behaviour. The synthetic versions of lepidopteran pheromones can be used as pesticides. Sometimes the relative amount of several pheromone chemicals in a pesticide product determine which specific pests are controlled when the pesticide product releases pheromone into the air where males are looking for females, the males become confused and cannot easily locate the females. As a result, many of the females do not mate and lay eggs and there are many fewer offspring than usual. These insect pheromones are third generation pesticides. Other third generation pesticides are insect growth regulators, chitin synthesis inhibitors and juvenile hormones.

61. (a) : *Refer to answer 56.*

62. (d) : *Refer to answer 17.*

63. (a) : Extensive growth of *Opuntia* (Cactus) in Australia was checked through introduction of its natural herbivore, cochineal insect (*Cactoblastis cactorum*).

64. (c) : The control of insect pests by the introduction, encouragment and artificial increase of biological agencies like predaceous and parasitic insects, other animals and diseases is termed as biological control. It is basically a natural control in which man plays significant role of making the biological agencies more effective. Of these agencies, insect enemies play important role in nature for managing the phytophagous insect pests and keep a balance *e.g*., lady bugs or praying mantis, frog, toads, lizard and birds are employed by man to eat up the insect pests like aphids. It is a self perpetuating method.

65. (c) : *Refer to answer 59.*

66. (b) : Natural insecticides are those which are obtained from microorganisms and plants. The first natural insecticide used by man is azadirachtin obtained from *Azadirachta indica*.

Rotenone is another natural insecticide which is obtained from the roots of *Derris* and *Lonchocarpers*. It is harmless to warm blooded animals.

67. (b) : *Refer to answer 50.*

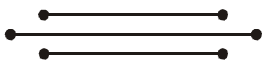
68. (d) : Insect enemies play important role in nature for managing the phytophagous insect pests and keep a balance. It is just possible that predators of a particular plant pest are unable to get established and multiply in a particular environment. In such cases, the predators are reared in the laboratory and let off at a particular time when the pests are about to threaten the crops. And then this practice become expensive.

69. (a) : *Refer to answer 64.*

70. (d) : Cheese is a protein rich nutritive preparation obtained after fermentation and curding of milk. Cheese contains proteins (20-35%), fats (20-30%), minerals, vitamins and water. Milk is first curdled (soured) with the help of a lactic acid bacterium. Curd is gently heated to separate cheese from liquid called whey. Curd is placed in cloth-lined porous containers for draining out whey. The left out solidified material is called cottage cheese. For preservation and ripening, blocks of cottage cheese are salted and placed in brine solution. Salt solution is drained out. Cheese blocks are wiped and placed in sterilised rooms for ripening with the help of microorganisms.

71. (d) : Members of Kingdom Monera - bacteria and cyanobacteria (blue green algae) have the ability to fix nitrogen. *Azotobacter* is a N_2-fixing bacteria. *Anabaena* and *Nostoc* are heterocystous blue-green algae. The heterocysts are the sites of N_2-fixation. *Spirogyra* is one of the commonest green algae. It has no function in nitrogen fixation.

72. (a) : The nitrogen-fixing ability of leguminous plants is not a property of the plants as such but results from infection of their roots by bacteria in the soil, infection leading to the formation of nodules. These organisms are Gram-negative motile rods that are classified in the genus *Rhizobium*.



Chapter
33

Biotechnology: Principles and Processes

1. The DNA fragments separated on an agarose gel can be visualised after staining with
(a) acetocarmine (b) aniline blue
(c) ethidium bromide
(d) bromophenol blue. *(NEET 2017)*

2. DNA fragments are
(a) negatively charged
(b) neutral
(c) either positively or negatively charged depending on their size
(d) positively charged. *(NEET 2017)*

3. A gene whose expression helps to identify transformed cell is known as
(a) vector (b) plasmid
(c) structural gene
(d) selectable marker. *(NEET 2017)*

4. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis ?
(a) The smaller the fragment size, the farther it moves.
(b) Positively charged fragments move to farther end.
(c) Negatively charged fragments do not move.
(d) The larger the fragment size, the farther it moves. *(NEET 2017)*

5. The process of separation and purification of expressed protein before marketing is called
(a) downstream processing
(b) bioprocessing
(c) postproduction processing
(d) upstream processing. *(NEET 2017)*

6. Stirred-tank bioreactors have been designed for
(a) purification of product
(b) addition of preservatives to the product
(c) availability of oxygen throughout the process
(d) ensuring anaerobic conditions in the culture vessel. *(NEET-II 2016)*

7. A foreign DNA and plasmid cut by the same restriction endonuclease can be joined to form a recombinant plasmid using
(a) *Eco*RI (b) *Taq* polymerase
(c) polymerase III (d) ligase.
(NEET-II 2016)

8. Which of the following is not a component of downstream processing?
(a) Separation (b) Purification
(c) Preservation (d) Expression
(NEET-II 2016)

9. Which of the following restriction enzymes produces blunt ends?
(a) *Sal*I (b) *Eco*RV
(c) *Xho*I (d) *Hin*dIII
(NEET-II 2016)

10. Which of the following is not a feature of the plasmids?
(a) Transferable (b) Single-stranded
(c) Independent replication
(d) Circular structure (*NEET-I 2016)*

11. The *Taq* polymerase enzyme is obtained from
(a) *Bacillus subtilis*
(b) *Pseudomonas putida*
(c) *Thermus aquaticus*
(d) *Thiobacillus ferroxidans*.*(NEET-I 2016)*

12. Which of the following is a restriction endonuclease?
(a) DNase I (b) RNase
(c) *Hin*d II (d) Protease
(NEET-I 2016)

13. Which of the following is not required for any of the techniques of DNA fingerprinting available at present?
(a) Restriction enzymes
(b) DNA-DNA hybridisation
(c) Polymerase chain reaction
(d) Zinc finger analysis *(NEET-I 2016)*

14. The DNA molecule to which the gene of interest is integrated for cloning is called

(a) template (b) carrier
(c) transformer (d) vector. *(2015)*

15. The cutting of DNA at specific locations became possible with the discovery of
(a) selectable markers (b) ligases
(c) restriction enzymes
(d) probes. *(2015)*

16. An analysis of chromosomal DNA using the Southern hybridization technique does not use
(a) electrophoresis (b) blotting
(c) autoradiography (d) PCR. *(2014)*

17. Which vector can clone only a small fragment of DNA?
(a) Bacterial artificial chromosome
(b) Yeast artificial chromosome
(c) Plasmid
(d) Cosmid *(2014)*

18. Commonly used vectors for human genome sequencing are
(a) T - DNA
(b) BAC and YAC
(c) expression vectors
(d) T/A cloning vectors. *(2014)*

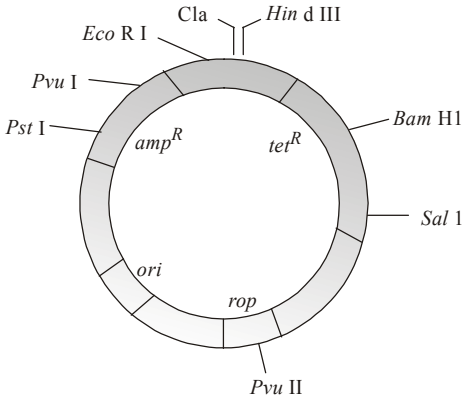
19. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bacteria because of
(a) insertional inactivation of alpha galactosidase in recombinant bacteria.
(b) inactivation of glycosidase enzyme in recombinant bacteria.
(c) non-recombinant bacteria containing beta galactosidase.
(d) insertional inactivation of alpha galactosidase in non-recombinant bacteria. *(NEET 2013)*

20. DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by
(a) electrophoresis
(b) restriction mapping
(c) centrifugation
(d) polymerase chain reaction. *(NEET 2013)*

21. Which of the following is not correctly matched for the organism and its cell wall degrading enzyme?
(a) Algae - Methylase
(b) Fungi - Chitinase
(c) Bacteria - Lysozyme
(d) Plant cells - Cellulase *(NEET 2013)*

22. During the process of isolation of DNA, chilled ethanol is added to
(a) precipitate DNA
(b) break open the cell to release DNA
(c) facilitate action of restriction enzymes
(d) remove proteins such as histones. *(Karnataka NEET 2013)*

23. The given figure is the diagrammatic representation of the *E. coli* vector pBR322. Which one of the given options correctly identifies its certain component(s)?



(a) *ori*-original restriction enzyme
(b) *rop*-reduced osmotic pressure
(c) *Hin*dIII, *Eco*RI - selectable markers
(d) amp^R, tet^R–antibiotic resistance genes *(2012)*

24. PCR and restriction fragment length polymorphism are the methods for
(a) study of enzymes
(b) genetic transformation
(c) DNA sequencing
(d) genetic fingerprinting. *(2012)*

25. A single strand of nucleic acid tagged with a radioactive molecule is called
(a) vector
(b) selectable marker
(c) plasmid
(d) probe. *(2012)*

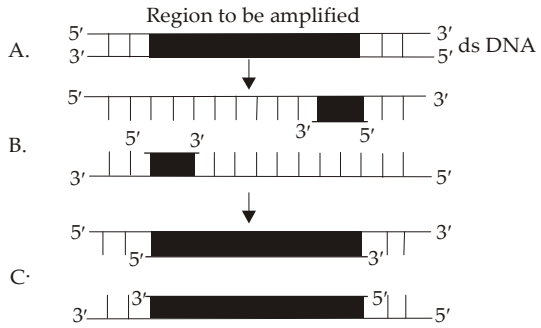
26. Which one is a true statement regarding DNA polymerase used in PCR?
(a) It is used to ligate introduced DNA in recipient cells.
(b) It serves as a selectable marker.
(c) It is isolated from a virus.
(d) It remains active at high temperature. *(2012)*

27. For transformation, micro-particles coated with DNA to be bombarded with gene gun are made up of
(a) silver or platinum
(b) platinum or zinc
(c) silicon or platinum
(d) gold or tungsten.
(2012)

28. Biolistics (gene-gun) is suitable for
(a) disarming pathogen vectors
(b) transformation of plant cells
(c) constructing recombinant DNA by joining with vectors
(d) DNA fingerprinting. *(Mains 2012)*

29. In genetic engineering, the antibiotics are used
(a) as selectable markers
(b) to select healthy vectors
(c) as sequences from where replication starts
(d) to keep the cultures free of infection.
(Mains 2012)

30. The figure below shows three steps (A, B, C) of Polymerase Chain Reaction (PCR). Select the option giving correct identification together with what it represents?



(a) B - denaturation at a temperature of about 98°C separating the two DNA strands
(b) A - denaturation at a temperature of about 50°C
(c) C - extension in the presence of heat stable DNA polymerase
(d) A - annealing with two sets of primers
(Mains 2012)

31. Which one of the following represents a palindromic sequence in DNA?
(a) 5′ - GAATTC - 3′ (b) 5′ - CCAATG - 3′
3′ - CTTAAG - 5′ 3′ - GAATCC - 5′
(c) 5′ - CATTAG - 3′ (d) 5′ - GATACC - 3′
3′ - GATAAC - 5′ 3′ - CCTAAG - 5′
(Mains 2012)

32. Given below is a sample of a portion of DNA strand giving the base sequence on the opposite strands. What is so special shown in it?
5′_____ GAATTC′ _____ 3′
3′_____ CTTAAG _____ 5′
(a) Replication completed
(b) Deletion mutation
(c) Start codon at the 5′ end
(d) Palindromic sequence of base pairs *(2011)*

33. There is a restriction endonuclease called *Eco*RI. What does "co" part in it stand for?
(a) colon (b) coelom
(c) coenzyme (d) *coli* *(2011)*

34. Agarose extracted from sea weeds is used in
(a) spectrophotometry
(b) tissue culture
(c) PCR
(d) gel electrophoresis. *(2011)*

35. Which one of the following techniques made it possible to genetically engineer living organisms?
(a) Recombinant DNA techniques
(b) X-ray diffraction
(c) Heavier isotope labelling
(d) Hybridization *(Mains 2011)*

36. Which one of the following is used as vector for cloning genes into higher organisms?
(a) Baculovirus
(b) *Salmonella typhimurium*
(c) *Rhizopus nigricans*
(d) Retrovirus *(2010)*

37. DNA or RNA segment tagged with a radioactive molecule is called
(a) vector (b) probe
(c) clone (d) plasmid. *(2010)*

38. Restriction endonucleases are enzymes which
(a) make cuts at specific positions within the DNA molecule
(b) recognize a specific nucleotide sequence for binding of DNA ligase
(c) restrict the action of the enzyme DNA polymerase
(d) remove nucleotides from the ends of the DNA molecule. *(2010)*

39. Stirred-tank bioreactors have been designed for
(a) addition of preservatives to the product
(b) purification of the product
(c) ensuring anaerobic conditions in the culture vessel
(d) availability of oxygen throughout the process. *(2010)*

40. Which of the following are used in gene cloning?
(a) Nucleoids (b) Lomasomes
(c) Mesosomes (d) Plasmids *(2010)*

41. In genetic engineering, a DNA segment (gene) of interest, is transferred to the host cell through a vector. Consider the following four agents (i-iv) in this regard and select the correct option about which one or more of these can be used as a vector/vectors.
(i) Bacterium (ii) Plasmid
(iii) *Plasmodium* (iv) Bacteriophage
(a) (i), (ii) & (iv) (b) (i) only
(c) (i) & (iii) (d) (ii) & (iv)
(Mains 2010)

42. Which one of the following is commonly used in transfer of foreign DNA into crop plants?
(a) *Meloidogyne incognita*
(b) *Agrobacterium tumefaciens*
(c) *Penicillium expansum*
(d) *Trichoderma harzianum* *(2009)*

43. Gel electrophoresis is used for
(a) construction of recombinant DNA by joining with cloning vectors
(b) isolation of DNA molecules
(c) cutting of DNA into fragments
(d) separation of DNA fragments according to their size. *(2008)*

44. The linking of antibiotic resistance gene with the plasmid vector became possible with
(a) DNA polymerase (b) exonucleases
(c) DNA ligase (d) endonucleases.
(2008)

45. Restriction endonuclease
(a) synthesizes DNA
(b) cuts the DNA molecule randomly
(c) cuts the DNA molecule at specific sites
(d) restricts the synthesis of DNA inside the nucleus. *(2006)*

46. Two microbes found to be very useful in genetic engineering are
(a) crown gall bacterium and *Caenorhabditis elegans*
(b) *Escherichia coli* and *Agrobacterium tumefaciens*
(c) *Vibrio cholerae* and a tailed bacteriophage
(d) *Diplococcus* sp. and *Pseudomonas* sp.
(2006)

47. Restriction endonucleases
(a) are present in mammalian cells for degradation of DNA when the cell dies
(b) are used in genetic engineering for ligating two DNA molecules
(c) are used for *in vitro* DNA synthesis
(d) are synthesized by bacteria as part of their defense mechanism. *(2004)*

48. In transgenics, expression of transgene in target tissue is determined by
(a) enhancer (b) transgene
(c) promoter (d) reporter. *(2004)*

49. In recent years, DNA sequences (nucleotide sequence) of *mt*DNA and Y chromosomes were considered for the study of human evolution, because
(a) they are small and therefore, easy to study
(b) they are uniparental in origin and do not take part in recombination
(c) their structure is known in greater detail
(d) they can be studied from the samples of fossil remains. *(2003)*

50. Which one of the following bacteria has found extensive use in genetic engineering work in plants ?
(a) *Clostridium septicum*
(b) *Xanthomonas citri*
(c) *Bacillus coagulens*
(d) *Agrobacterium tumefaciens* *(2003)*

51. Manipulation of DNA in genetic engineering became possible due to the discovery of
(a) restriction endonuclease
(b) DNA ligase (c) transcriptase
(d) primase. *(2002)*

52. A mutant strain of T4 - Bacteriophage, R-II, fails to lyse the *E. coli* but when two strains R-IIX and R-IIY are mixed then they lyse the *E. coli*. What may be the possible reason?
(a) Bacteriophage transforms in wild.
(b) It is not mutated.
(c) Both strains have similar cistrons.
(d) Both strains have different cistrons.
(2001)

53. In Lederberg's replica plating experiment what shall be used to obtain streptomycin resistant strain
(a) minimal medium and streptomycin
(b) complete medium and streptomycin
(c) only minimal medium
(d) only complete medium. *(2001)*

54. Which of the following cut the DNA from specific places?
(a) *E.coli* restriction endonuclease I

(b) Ligase
(c) Exonuclease
(d) Alkaline phosphate *(2001)*

55. Maximum number of bases in plasmids discovered so far
(a) 50 kilo base (b) 500 kilo base
(c) 5000 kilo base (d) 5 kilo base.
(2001)

56. The bacteria generally used for genetic engineering is
(a) *Agrobacterium* (b) *Bacillus*
(c) *Pseudomonas* (d) *Clostridium*.
(2000)

57. Plasmid has been used as vector because
(a) it is circular DNA which have capacity to join to eukaryotic DNA
(b) it can move between prokaryotic and eukaryotic cells
(c) both ends show replication
(d) it has antibiotic resistance gene. *(2000)*

58. The process of replication in plasmid DNA, other than initiation, is controlled by
(a) mitochondrial gene (b) plasmid gene
(c) bacterial gene (d) none of these.
(1999)

59. Which of the following is related to genetic engineering?
(a) Heterosis (b) Mutation
(c) Plastid (d) Plasmid *(1999)*

60. Recombinant DNA is achieved by cleaving the pro-DNAs by
(a) ligase
(b) restriction endonulcease
(c) primase
(d) exonucleases. *(1998)*

61. Two bacteria found to be very useful in genetic engineering experiments are
(a) *Nitrobacter* and *Azotobacter*
(b) *Rhizobium* and *Diplococcus*
(c) *Nitrosomonas* and *Kliebsiella*
(d) *Escherichia* and *Agrobacterium*.
(1998)

62. Restriction endonucleases are
(a) used for *in vitro* DNA synthesis
(b) used in genetic engineering
(c) synthesized by bacteria
(d) present in mammalian cells for degradation of DNA.
(1998)

63. Genetic engineering is possible, because
(a) we can cut DNA at specific sites by endonucleases like DNase I
(b) restriction endonucleases purified from bacteria can be used *in vitro*
(c) the phenomenon of transduction in bacteria is well underwood
(d) we can see DNA by electron microscope.
(1998)

64. The restriction enzymes are used in genetic engineering, because
(a) they can cut DNA at specific base sequence
(b) they are nucleases that cut DNA at variable sites
(c) they can degrade harmful proteins
(d) they can join different DNA fragments.
(1995)

65. Which of the following organelles is related with genetic engineering?
(a) Mitochondria (b) Plasmids
(c) Golgi bodies (d) Lysosomes
(1994)

Answer Key

1.	(c)	**2.**	(a)	**3.**	(d)	**4.**	(a)	**5.**	(a)	**6.**	(c)	**7.**	(d)	**8.**	(d)	**9.**	(b)	**10.**	(b)
11.	(c)	**12.**	(c)	**13.**	(d)	**14.**	(d)	**15.**	(c)	**16.**	(d)	**17.**	(c)	**18.**	(b)	**19.**	(c)	**20.**	(a)
21.	(a)	**22.**	(a)	**23.**	(d)	**24.**	(d)	**25.**	(d)	**26.**	(d)	**27.**	(d)	**28.**	(b)	**29.**	(a)	**30.**	(c)
31.	(a)	**32.**	(d)	**33.**	(d)	**34.**	(d)	**35.**	(a)	**36.**	(d)	**37.**	(b)	**38.**	(a)	**39.**	(d)	**40.**	(d)
41.	(d)	**42.**	(b)	**43.**	(d)	**44.**	(c)	**45.**	(c)	**46.**	(b)	**47.**	(d)	**48.**	(d)	**49.**	(b)	**50.**	(d)
51.	(a)	**52.**	(d)	**53.**	(a)	**54.**	(a)	**55.**	(b)	**56.**	(a)	**57.**	(a)	**58.**	(c)	**59.**	(d)	**60.**	(b)
61.	(d)	**62.**	(b)	**63.**	(b)	**64.**	(a)	**65.**	(b)										

EXPLANATIONS

1. (c) : The separated DNA fragments can be seen only after staining them with a compound known as ethidium bromide (EtBr) followed by exposure to UV radiation as bright orange coloured bands.

2. (a)

3. (d) : Some genes called "selectable markers" help in selecting those host cells which contain the vectors (transformants) and eliminating the non-transformants.

4. (a) : Electrophoresis is a technique used for the separation of substances of different ionic properties. Since the DNA fragments are negatively charged molecules, they can be separated by allowing them to move towards the anode. DNA fragments move towards the anode according to their molecules size through the pores of agarose gel. Thus, the smaller fragments move farther away as compared to larger fragments.

5. (a) : After the formation of the product in the bioreactor it undergoes some processes before a finished product is ready for marketing. The process includes separation and purification of products which are collectively called downstream processing.

6. (c) : A stirred-tank reactor is usually cylindrical or with a curved base to facilitate the mixing of the reactor contents. The stirrer facilitates, even mixing and oxygen availability throughout the bioreactor.

7. (d) : Ligase is a class of enzymes that catalyse the formation of covalent bonds using the energy released by the cleavage of ATP. Ligases are important in the synthesis and repair of many biological molecules, including DNA ligase and used in genetic engineering to insert foreign DNA into cloning vectors.

8. (d) : After the formation of the product in bioreactor, it undergoes through some processes before a finished product to be ready for marketing. Downstream processing includes separation and purification process. The product obtained is subjected to quality control, testing and kept in suitable preservatives.

9. (b) : *Eco*RV is a type II restriction endonuclease isolated from certain strains of *E.coli*. It creates blunt ends. It recognises the palindromic sequence of 6 bases as shown here:
*Sal*I, *Xho*I and *Hin*dIII restriction enzymes produce sticky ends.

10. (b) : Plasmids are extra-chromosomal, self-replicating, usually circular, double-stranded DNA molecules that serve as vectors which carry foreign DNA segment and replicate inside host cell.

11. (c) : *Taq* polymerase, generally used in PCR is isolated from thermophilic bacterium *Thermus aquaticus*.

12. (c) : *Hin*d II is the first restriction endonuclease. It was isolated from *Haemophilus influenzae* Rd. It always cut DNA at specific position producing blunt ends. DNase I is an endonuclease that cleaves DNA preferentially at phosphodiester linkages adjacent to a pyrimidine nucleotide non-specially. RNase is a type of nuclease that catalyses the degradation of RNA into smaller components. It can be endoribonuclease or exoribonuclease. A protease is an enzyme that perform proteolysis, *i.e.,* protein catabolism by hydrolysis of the peptide bonds.

13. (d) : Any small, functional, freely folded domain in which coordination of one or more zinc ions is required to stabilise its structure is known as zinc finger. The zinc finger domains are widely dispersed in eukaryotic genomes and are actively involved in sequence specific binding to DNA/RNA and contribute in protein-protein recognitions.

14. (d) : Vector is a DNA molecule that carries a foreign DNA segment and replicates inside a host cell. The vector DNA and foreign DNA carrying gene of interest are cut by the same restriction endonuclease enzyme to produce complementary sticky ends. With the help of DNA ligase enzyme, the complementary sticky ends of the two DNAs are joined to produce a recombinant DNA (rDNA), which is then introduced into the host cell.

15. (c) : Restriction enzymes recognise specific base sequences in a DNA molecule and cut its strands, *e.g., Eco*RI cuts DNA strands in the base sequence GAATTC.

16. (d) : PCR is used only for amplification of DNA. It is not directly involved in Southern hybridisation technique.

17. (c) : Plasmids have been modified to be used as vectors. They can clone DNA fragments of about 10 kbp size while cosmid can carry upto 45 kbp, YAC can carry upto 1000-2500 kbp and BAC can carry around 300 – 350 Kbp long DNA fragments.

18. (b) : Bacterial artificial chromosome (BAC) vectors are based on natural, extra-chromosomal plasmid of *E. coli*. BAC vector contains genes for replication and maintenance of the F-factor, a selectable marker and cloning site. These vectors can accommodate upto 300-350 kb of foreign DNA and are also being used in genome sequencing project. Yeast artificial chromosome (YAC) vectors are used to clone DNA fragments of more than 1Mb in size. Therefore, they have been exploited extensively in mapping the large genomes, *e.g.,* in the Human Genome Project. These vectors contain the telomeric sequence, the centromere and the autonomously replicating sequence from yeast chromosomes.

19. (c) : The presence of restriction sites within the markers tet^r and amp^r of plasmid permits an easy selection for cells transformed with recombinant plasmid. Insertion of the DNA fragment into the plasmid makes antibiotic resistance genes nonfunctional, for example, insertion of the DNA fragment into the plasmid (pBR322) using *Pst* I or *Pvu* I makes amp^r nonfunctional. Bacterial cells containing such a recombinant pBR322 will be unable to grow in the presence of ampicillin, but will grow on tetracycline. This process, however, becomes burdensome because it requires simultaneous plating on two plates having different antibiotics. Thus, alternative selectable marker is developed to differentiate recombinants and non-recombinants on the basis of their ability to produce colour in the presence of a chromogenic substance. Here, a recombinant DNA is inserted in the coding sequence of an enzyme β-galactosidase. pUC 18 plasmid contains this gene which allows it to produce β-galactosidase which degrades certain sugars and produces a blue pigment when exposed to specific substrate analog. If the plasmid in the bacterium does not have an insert, *i.e.*, is non-recombinant, the presence of chromogenic substrate gives blue coloured colonies. Presence of insert in the plasmid in recombinant bacterium does not produce any colour, such bacterial colonies are marked as recombinant colonies.

20. (a) : *Refer to answer 4.*

21. (a) : Cell wall of algae is made up of cellulose, pectin and mucilage. These substances cannot be degraded by methylase. Methylase is a type of transferase enzyme that transfers a methyl group from a donor to an acceptor.

22. (a) : Ethanol is much less polar than water. Adding it to the solution disrupts the screening charges exerted by water. The electrical attraction between phosphate and any positive ions (Na^+) present in solution becomes strong enough to form a stable ionic bond and DNA precipitates. Ethanol precipitation is a widely used technique to purify, or concentrate nucleic acid.

23. (d) : In pBR322,
ori-represents site or origin of replication
rop-codes for proteins that take part in the replication of plasmid.
Hin d III, *Eco* RI- recognition sites of restriction endonucleases.
amp^R and tet^R - antibiotic resistance genes.

24. (d) : Polymerase chain reaction (PCR) is used to amplify a small DNA fragment to obtain its large quantity. PCR is very helpful in DNA fingerprinting in such cases where the culprit has to be identified from a very small blood, semen or other cell sample from a crime scene.

25. (d) : Probes are single stranded, radiolabelled molecules of nucleic acids with known sequence. The probes having sequence complementary to the gene to be identified are supplied. They bind with the particular gene segment. Radiation imaging identifies the location of that particular segment which bind with probe. Probes are used as identification tool.

26. (d) : In PCR, *Taq* polymerase is used which is obtained from *Thermus aquaticus* bacteria. It is a relatively thermostable enzyme thus used in PCR as during the process the step involving denaturation of DNA strands requires high temperature.

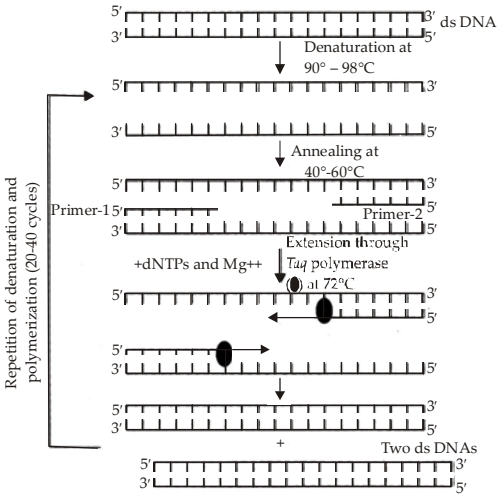
27. (d) : A gene or a biolistic particle delivery system, originally designed for plant transformation, is a device for injecting cells with genetic information. The payload is an elemental particle of a heavy metal such as gold or tungsten coated with plasmid DNA. The device is used to transform almost any type of cell including plants, and is not limited to genetic material of the nucleus. It can also transform organelles, including plastids.

28. (b) : Biolistics is a technique for introducing genetic material into living cells, especially plant cells, in which DNA-coated microscopic particles (tungsten or gold particles) are bombarded with a very high velocity into the target cell using a special gun. The microprojectiles, typically 1mm in diameter, are accelerated to high velocity by a specially modified small calibre gun and penetrate the cell walls and plasma membrane with minimal damage. Hence, the novel DNA can be inserted into intact plant cells ultimately transforming it without using a vector.

29. (a) : Selectable markers are those genes which help in selecting those host cells which contain vectors (*i.e.*, transformants) and eliminating the non-transformants. The genes encoding resistance to antibiotics such as tetracycline, ampicillin, kanamycin etc., are useful selectable markers for *E.coli*. Plasmid pBR322 has two resistance genes – ampicillin resistance (amp^r) and tetracyclin resistance (tet^r) which are considered useful for selectable markers.

The presence of restriction sites within the markers tet^r and amp^r permits an easy selection for cells transformed with the recombinant pBR322. Insertion of the DNA fragment into the plasmid using enzyme *Pst* I or *Pvu* I places the DNA insert within the gene amp^r; this makes amp^r nonfunctional. Bacterial cells containing such a recombinant pBR322 will be unable to grow in the presence of ampicillin, but will grow on tetracycline. Similarly, when restriction enzyme *Bam* HI or *Sal* I is used, the DNA insert is placed within the gene tet^r making it nonfunctional. Bacterial cells possessing such a recombinant pBR322 will, therefore, grow on ampicillin but not on tetracyclin.

30. (c) : A schematic representation of PCR can be illustrated as follow.



31. (a) : Palindromes are groups of letters that form the same words when read both forward and backward, *e.g.*, "MALAYALAM". As against a word-palindrome where the same word is read in both directions, the palindrome in DNA is a sequence of base pairs that reads same on the two strands when orientation of reading is kept the same. For example, the following sequences read the same on the two strands in $5' \rightarrow 3'$ direction. This is also true if read in the $3' \rightarrow 5'$ direction. In this case, it is

$5'$ — GAATTC — $3'$

$3'$ — CTTAAG — $5'$.

32. (d) : *Refer to answer 31.*

33. (d) : The enzyme restriction endonuclease *Eco*RI is found in the colon bacteria *E. coli*. So, here 'co' stands for *coli*. According to nomenclature of restriction enzyme, the first letter used for the enzyme is the first letter of the genus name (in italics) of the bacterium, then comes the first two letters of its species (also in italics), next is the strain of the organism. At last is a Roman numeral signifying the order of discovery. Here, the enzyme *Eco*RI was isolated from the bacterium *Escherichia coli* (co), strain RY13(R) and it was first endonuclease (I) isolated from *E.coli*.

34. (d) : In gel electrophoresis DNA fragments separate (resolve) according to their size through sieving effect provided by the agarose gel. Agarose is a natural polymer extracted from sea weeds and is commonly used as a matrix.

35. (a)

36. (d) : Retroviruses in animals have the ability to transform normal cells into cancerous cells. We have transformed these pathogens into useful vectors for delivering genes of interest to humans. Retroviruses have been disarmed and are now used to deliver desirable genes into animal cells. So, once a gene or a DNA fragment has been ligated into a suitable retroviral vector it is transferred into a bacterial, plant or animal host (where it multiplies).

37. (b) : *Refer to answer 25.*

38. (a) : Restriction endonucleases were found by Arber in 1962 in bacteria. They act as "molecular scissors" or chemical scalpels. They recognize the specific base sequence at palindrome sites in DNA duplex and cut its strands. For example, restriction endonuclease *Eco*RI found in the colon bacteria *E. coli* reocgnizes the base sequence GAATTC in DNA duplex and cuts its strands between G and A.

39. (d) : A stirred-tank bioreactor is usually cylindrical or with a curved base to facilitate the mixing of the reaction contents. The stirrer facilitates even mixing and oxygen availability throughout the bioreactor. Alternatively air can be bubbled through the reactor.

40. (d) : Plasmid is a small circular double stranded DNA molecule present in the cytoplasm of the bacterial cell. It can replicate independently of

bacterial chromosome. Due to this characteristic of plasmid, it is used as the vector (vectors are for the transferring of a piece of DNA to target gene) in gene cloning.

41. (d) : Plasmid and bacteriophage are used as vectors in genetic engineering. Plasmid is an autonomously replicating circular extra chromosomal DNA found in bacteria. They can be transferred from cell to cell in a bacterial colony. This characteristic is being used in biotechnology for transferring desirable gene into target gene of the host. Bacteriophage is a bacterial virus which can infect it, quickly multiply within and destroy (lyse) their host (virus) cells. During infection bacteriophages inject their DNA into these cells. The injected DNA selectively replicate and are expressed in the host that results in a multiplication of phages that ultimately burst out of the cell (by lysis). This ability of transferring DNA from the phage genome to specific host during infection process gave scientists the idea that specially designed phage vectors could be used for gene cloning.

42. (b) : *Agrobacterium tumefaciens* has been extensively used in genetic engineering experiments. It is the causative agent of crown gall, an important disease of many commercial crops. This disease has come to be recognized in recent years as being caused by a DNA plasmid (Ti plasmid) carried by bacterium and transferred to the plant cells. Following the discovery of the relationship between crown gall and the Ti plasmid, this plasmid has come to be widely used in plant genetic engineering as a vector in order to inject a novel gene in host plant to form a transgenic plant.

43. (d) : *Refer to answer 4.*

44. (c) : The construction of the first recombinant DNA emerged from the possibility of linking a gene encoding antibiotic resistance with a native plasmid. The cutting of DNA at specific locations became possible with the discovery of the so-called 'molecular scissors' – restriction enzymes. The cut piece of DNA was then linked with the plasmid DNA. This plasmid DNA acts as vector to transfer the piece of DNA attached to it. The linking of antibiotic resistance gene with the plasmid vector became possible with the enzyme DNA ligase, which acts on cut DNA molecules and joins their ends. This makes a new combination of circular autonomously replicating DNA created *in vitro* and is known as recombinant DNA.

45. (c) : *Refer to answer 38.*

46. (b) : *E.coli* contains many important standard cloning vectors widely used in gene cloning experiments like pBR322 contains origin of replication (*ori*). Other cloning vectors like PACYC177, pBR324, PRK 64.6 contain ampicillin resistance gene they are also found in *E.coli*. Among higher plants, Ti plasmid of *Agrobacterium tumefaciens* and Ri plasmid of *A. rhizogenes* is the best known vector.

T-DNA from Ti or Ri plasmid of *Agrobacterium* is considered to be a very potential vector for cloning experiments with higher plants.

47. (d) : Restriction endonucleasses are enzymes that digest double stranded DNA following recognition of specific nucleotide sequences. This is achieved by cleaving the two phosphodiester bonds, one within each strand of the DNA duplex. They are found in bacteria and their function in bacteria is to cut up any invading virus as a part of its defense mechanism, thus restricting the multiplication of viruses in the bacterial cell. Different species of bacteria produce different restriction endonucleases.

48. (d) : The plants, in which a functional foreign gene has been incorporated by any biotechnological methods that generally is not present in plant, are called transgenic plants. When plant cell are transformed by any of the transformation methods it is necessary to isolate the transformed cells/tissue. There are certain selectable marker genes present in vectors that facilitate the selection process. In transformed cells the selectable marker genes or are introduced through vector. There is a number of marker genes which are commonly described as reporter genes screenable genes. Some of the reporter genes which are most commonly used in plant transformation are : cat, gus, lux, nptII., etc.

49. (b) : Sequence of both *mt*DNA and Y chromosomes are considered for the study of human evolution because they are uniparental in origin. *mt*DNA is inherited along with the maternal cytoplasm and Y chromosome is inherited from father. So they do not take part in recombination. In addition, *mt*DNA has a higher mutation rate then nuclear DNA so that it is more useful for short term evolutionary studies.

50. (d) : *Refer to answer 42.*

51. (a) : DNA restriction endonuclease are important class of restriction exonucleases, class

II, which cut double-stranded DNA molecules only at sites characterized by a specific nucleotide sequence. Restriction enzymes are isolated from bacterial cells, and are tools for molecular biologists. Several hundred restriction enzymes are now known, each with a specific sequence requirement dictating where it will cut DNA. Some, such as *Hin*d III, make staggered cuts leaving 'sticky ends', three nucleotides long protruding on one strand from each severed terminus; others make clean cuts in both strands at the same place and thus generate 'blunt ends'. Digesting DNA with a restriction enzyme therefore creates a characteristic set of fragments, which can be isolated by electrophoresis and subsequently analysed.

52. (d) : A mutant strain of T_4-bacteriophage, RII, fails to lyse the *E.coli* but when two strains R-II (X) and R-IIY are mixed then they lyse the *E.coli* because both strains have different cistrons.

53. (a) : If streptomycin resistant mutant are to be obtained, material should be allowed to grow on medium lacking streptomycin so that both mutant and wild types may grow. These colonies are imprinted on petriplates to form the master pattern and other plates having streptomycin can then be pressed on velveteen to get an impression. The plate now containing only mutants for streptomycin resistance will grow.

54. (a)

55. (b) : A plasmid is a DNA molecule separate from the chromosomal DNA and capable of autonomous replication. In many cases, it is typically circular and double-stranded. It usually occurs in bacteria, and is sometimes found in eukaryotic organisms. The size of plasmids varies from 1 to over 400 kilobase pairs (kbp). There may be one copy, for large plasmids, to hundreds of copies of the same plasmid in a single cell. The term plasmid was first introduced by the American molecular biologist Joshua Lederberg in 1952.

56. (a)

57. (a) : *Refer to answer 41.*

58. (c) : The DNA plasmid replicates in a semi-conservative manner. The initiation of replication is controlled by plasmid gene and elongation and termination are controlled by bacterial genes.

59. (d)

60. (b) : Recombinant DNA is the product obtained after isolating a specific DNA segment and then inserting it into another DNA molecule at a desired position. Restriction endonucleases are the enzymes that digest DNA at specific sites to isolate a specific DNA segment. Thus they are required for producing recombinant DNA.

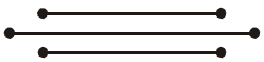
61. (d) : *Refer to answer 46.*

62. (b) : *Refer to answer 38.*

63. (b) : *Refer to answer 51.*

64. (a) : *Refer to answer 51.*

65. (b) : Plasmids are extrachromosomal genetic element found in many bacteria and in a few eukaryotic cells. Plasmids are closed circles of double-stranded DNA. ranging in size from one to 200 kilobases. They frequently carry genes conferring antibiotic resistance. Plasmids are becoming important tools for genetic engineering since they have the ability to replicate and migrate to daughter cells. Plasmids are widely used as carriers of cloned genes, as for example the *E. coli* plasmid pBR322. When plasmids are used as cloning vectors and carry a novel DNA sequence they are referred to as chimeric plasmids.



Chapter 34

Biotechnology and Its Applications

1. Which kind of therapy was given in 1990 to a four-year-old girl with adenosine deaminase (ADA) deficiency?
(a) Gene therapy (b) Chemotherapy
(c) Immunotherapy (d) Radiation therapy
(NEET-II 2016)

2. The two polypeptides of human insulin are linked together by
(a) covalent bond
(b) disulphide bridges
(c) hydrogen bonds
(d) phosphodiester bond. *(NEET-I 2016)*

3. Which part of the tobacco plant is infected by *Meloidogyne incognita*?
(a) Stem (b) Root
(c) Flower (d) Leaf
(NEET-I 2016)

4. Golden rice is a genetically modified crop plant where the incorporated gene is meant for biosynthesis of
(a) omega 3 (b) vitamin A
(c) vitamin B (d) vitamin C.
(2015)

5. The introduction of T-DNA into plants involves
(a) exposing the plants to cold for a brief period
(b) allowing the plant roots to stand in water
(c) infection of the plant by *Agrobacterium tumefaciens*
(d) altering the pH of the soil, then heat-shocking the plants. *(2015)*

6. In Bt cotton, the Bt toxin present in plant tissue as protoxin is converted into active toxin due to
(a) action of gut microorganisms
(b) presence of conversion factors in insect gut
(c) alkaline pH of the insect gut
(d) acidic pH of the insect gut.
(2015 Cancelled)

7. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services?
(a) Genetic Engineering Approval Committee
(b) Research Committee on Genetic Manipulation
(c) Bio-safety committee
(d) Indian Council of Agricultural Research
(2015 Cancelled)

8. The crops engineered for glyphosate are resistant/tolerant to
(a) insects (b) herbicides
(c) fungi (d) bacteria.
(2015 Cancelled)

9. The first human hormone produced by recombinant DNA technology is
(a) insulin (b) estrogen
(c) thyroxin (d) progesterone.
(2014)

10. Which of the following Bt crops is being grown in India by the farmers?
(a) Brinjal (b) Soybean
(c) Maize (d) Cotton
(NEET 2013)

11. RNA interference involves
(a) synthesis of cDNA and RNA using reverse transcriptase
(b) silencing of specific *m*RNA due to complementary RNA
(c) interference of RNA in synthesis of DNA
(d) synthesis of *m*RNA from DNA.
(Karnataka NEET 2013)

12. Which one of the following vectors is used to replace the defective gene in gene therapy?
(a) Adenovirus
(b) Cosmid
(c) Ri plasmid
(d) Ti plasmid
(Karnataka NEET 2013)

13. Consumption of which one of the following foods can prevent the kind of blindness associated with vitamin 'A' deficiency?
(a) 'Flavr Savr' tomato
(b) Canolla
(c) Golden rice
(d) Bt-Brinjal *(2012)*

14. Tobacco plants resistant to a nematode have been developed by the introduction of DNA that produces (in the host cells)
(a) both sense and anti-sense RNA
(b) a particular hormone
(c) an antifeedant
(d) a toxic protein. *(Mains 2012)*

15. What is it that forms the basis of DNA fingerprinting?
(a) The relative proportions of purines and pyrimidines in DNA.
(b) The relative difference in the DNA occurrence in blood, skin and saliva.
(c) The relative amount of DNA in the ridges and grooves of the fingerprints.
(d) Satellite DNA occurring as highly repeated short DNA segments. *(Mains 2012)*

16. The first clinical gene therapy was given for treating
(a) diabetes mellitus
(b) chicken pox
(c) rheumatoid arthritis
(d) adenosine deaminase deficiency. *(Mains 2012)*

17. Maximum number of existing transgenic animals is of
(a) fish (b) mice
(c) cow (d) pig. *(2011)*

18. The process of RNA interference (RNAi) has been used in the development of plants resistant to
(a) nematodes (b) fungi
(c) viruses (d) insects. *(2011)*

19. *Bacillus thuringiensis* forms protein crystals which contain insectidical protein. This protein
(a) binds with epithelial cells of midgut of the insect pest ultimately killing it.
(b) is coded by several genes including the gene *cry*.
(c) is activated by acid pH of the foregut of the insect pest.
(d) does not kill the carrier bacterium which is itself resistant to this toxin. *(Mains 2011)*

20. Silencing of *m*RNA has been used in producing transgenic plants resistant to
(a) bollworms (b) nematodes
(c) white rusts (d) bacterial blights. *(Mains 2011)*

21. Read the following four statements (A-D) about certain mistakes in two of them.
(A) The first transgenic buffalo, Rosie produced milk which was human alpha-lactalbumin enriched.
(B) Restriction enzymes are used in isolation of DNA from other macromolecules.
(C) Downstream processing is one of the steps of rDNA technology.
(D) Disarmed pathogen vectors are also used in transfer of rDNA into the host.
Which of the two statements have mistakes?
(a) B and C (b) C and D
(c) A and C (d) A and B *(Mains 2011)*

22. The genetically-modified (GM) brinjal in India has been developed for
(a) insect-resistance
(b) enhancing shelf life
(c) enhancing mineral content
(d) drought-resistance. *(2010)*

23. Genetic engineering has been successfully used for producing
(a) transgenic mice for testing safety of polio vaccine before use in humans
(b) transgenic models for studying new treatments for certain cardiac diseases
(c) transgenic cow-Rosie which produces high fat milk for making ghee
(d) animals like bulls for farm work as they have super power. *(2010)*

24. Some of the characteristics of Bt cotton are
(a) long fibre and resistance to aphids
(b) medium yield, long fibre and resistance to beetle pests
(c) high yield and production of toxic protein crystals which kill dipteran pests
(d) high yield and resistance to bollworms. *(2010)*

25. An improved variety of transgenic basmati rice
(a) does not require chemical fertilizers and growth hormones
(b) gives high yield and is rich in vitamin A
(c) is completely resistant to all insect pests and diseases of paddy
(d) gives high yield but has no characteristic aroma. *(2010)*

26. Which one of the following is now being commercially produced by biotechnological procedures?
(a) Nicotine (b) Morphine
(c) Quinine (d) Insulin
(Mains 2010)

27. What is true about Bt toxin?
(a) Bt protein exists as active toxin in the *Bacillus*.
(b) The activated toxin enters the ovaries of the pest to sterilise it and thus prevent its multiplication.
(c) The concerned Bacillus has antitoxins.
(d) The inactive protoxin gets converted into active form in the insect gut. *(2009)*

28. Transgenic plants are the ones
(a) generated by introducing foreign DNA into a cell and regenerating a plant from that cell
(b) produced after protoplast fusion in artificial medium
(c) grown in artificial medium after hybridization in the field
(d) produced by a somatic embryo in artificial medium. *(2009)*

29. The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as
(a) insecticide
(b) agent for production of dairy products
(c) source of industrial enzyme
(d) indicator of water pollution. *(2009)*

30. What is antisense technology?
(a) When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene
(b) RNA polymerase producing DNA
(c) A cell displaying a foreign antigen used for synthesis of antigens
(d) Production of somaclonal variants in tissue cultures *(2009)*

31. *Cry I* endotoxins obtained from *Bacillus thuringiensis* are effective against
(a) nematodes (b) boll worms
(c) mosquitoes (d) flies. *(2008)*

32. A transgenic food crop which may help in solving the problem of night blindness in developing countries is
(a) Bt soybean
(b) Golden rice
(c) Flavr Savr tomatoes
(d) Starlink maize. *(2008)*

33. Main objective of production/use of herbicide resistant GM crops is to
(a) encourage eco-friendly herbicides
(b) reduce herbicide accumulation in food articles for health safety
(c) eliminate weeds from the field without the use of manual labour
(d) eliminate weeds from the field without the use of herbicides. *(2008)*

34. Human insulin is being commercially produced from a transgenic species of
(a) *Rhizobium* (b) *Saccharomyces*
(c) *Escherichia* (d) *Mycobacterium*.
(2008)

35. A genetically engineered micro-organism used successfully in bioremediation of oil spills is a species of
(a) *Trichoderma* (b) *Xanthomonas*
(c) *Bacillus* (d) *Pseudomonas*.
(2007)

36. Golden rice is a promising transgenic crop. When released for cultivation, it will help in
(a) producing a petrol-like fuel from rice
(b) alleviation of vitamin A deficiency
(c) pest resistance
(d) herbicide tolerance. *(2006)*

37. *Bacillus thuringiensis* (Bt) strains have been used for designing novel
(a) biofertilizers
(b) bio-metallurgical techniques
(c) bio-mineralization processes
(d) bioinsecticidal plants. *(2005)*

38. Production of a human protein in bacteria by genetic engineering is possible because
(a) the human chromosome can replicate in bacterial cell
(b) the mechanism of gene regulation is identical in humans and bacteria
(c) bacterial cell can carry out the RNA splicing reactions
(d) the genetic code is universal.
(2005)

39. Golden rice is a transgenic crop of the future with the following improved trait
(a) insect resistance
(b) high lysine (essential amino acid) content
(c) high protein content
(d) high vitamin-A content.
(2005)

40. DNA fingerprinting refer to
(a) molecular analysis of profiles of DNA samples
(b) analysis of DNA samples using imprinting devices
(c) techniques used for molecular analysis of different specimens of DNA
(d) techniques used for identification of fingerprints of individuals.
(2004)

41. The *Ti* plasmid, is often used for making transgenic plants. The plasmid is found in
(a) *Azotobacter*
(b) *Rhizobium* of the roots of leguminous plants
(c) *Agrobacterium*
(d) Yeast as a 2 mm plasmid. *(2004)*

42. ELISA is used to detect viruses where the key reagent is
(a) alkaline phosphatase
(b) catalase
(c) DNA probe
(d) RNase. *(2004, 2003)*

43. The term 'humulin' is used for
(a) hydrolytic enzyme
(b) powerful antibiotic
(c) human insulin
(d) isoenzyme. *(1999)*

44. The first transgenic crop was
(a) tobacco (b) cotton
(c) pea (d) flax. *(1999)*

45. The transgenic animals are those which have
(a) foreign RNA in all its cells
(b) foreign DNA in some of its cells
(c) foreign DNA in all its cells
(d) both (a) and (b). *(1995)*

Answer Key

1.	(a)	**2.**	(b)	**3.**	(b)	**4.**	(b)	**5.**	(c)	**6.**	(c)	**7.**	(a)	**8.**	(b)	**9.**	(a)	**10.**	(d)
11.	(b)	**12.**	(a)	**13.**	(c)	**14.**	(a)	**15.**	(d)	**16.**	(d)	**17.**	(b)	**18.**	(a)	**19.**	(a)	**20.**	(b)
21.	(d)	**22.**	(a)	**23.**	(a)	**24.**	(d)	**25.**	(b)	**26.**	(d)	**27.**	(d)	**28.**	(a)	**29.**	(a)	**30.**	(a)
31.	(b)	**32.**	(b)	**33.**	(c)	**34.**	(c)	**35.**	(d)	**36.**	(b)	**37.**	(d)	**38.**	(d)	**39.**	(d)	**40.**	(a)
41.	(c)	**42.**	(a)	**43.**	(c)	**44.**	(a)	**45.**	(c)										

EXPLANATIONS

1. (a) : Gene therapy is a technique of genetic engineering which involves replacement of a faulty/ disease causing gene by a normal healthy functional gene. The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency. This enzyme is very important for the immune system to function. The deficiency of this enzyme can lead to severe combined immune deficiency (SCID).

2. (b) : Human insulin is made up of 51 amino acids arranged in two polypeptide chains. Chain A has 21 amino acids and chain B has 30 amino acids. The two polypeptide chains are interconnected by disulphide bridges or S-S-linkages.

3. (b) : *Meloidogyne incognita* is a nematode which infects the roots of the tobacco plants and causes a great reduction in the yield.

4. (b) : Golden rice is a transgenic variety of rice (*Oryza sativa*) which contains good quantities of β-carotene (provitamin A - inactive state of vitamin A). β-carotene is a principal source of vitamin A. Since the grains of this rice is yellow in colour due to β-carotene and commonly called golden rice.

5. (c) : Ti plasmid (tumor inducing) from the soil bacterium *Agrobacterium tumefaciens* is effectively used as vector for gene transfer to plant cells. The part of Ti plasmid transferred into plant cell DNA, is called the T-DNA. This T-DNA with desired DNA spliced into it, is inserted into the chromosomes of the host plant where it produces copies of itself, by migrating from one chromosomal position to another at random. Such plant cells are then cultured, induced to multiply and differentiate to form plantlets. Transferred into soil, the plantlets grow into mature plants, carrying the foreign gene, expressed throughout the new plant.

6. (c) : Soil bacterium *Bacillus thuringiensis* produces proteins that kill certain insects like lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes). *B. thuringiensis* forms some protein crystals. These crystals contain a toxic insecticidal protein. This toxin does not kill the *Bacillus* (bacterium) because it exists as inactive protoxins in them. But, once an insect ingests it, it is converted into an active form of toxin due to the alkaline pH of the alimentary canal. The activated toxin binds to the surface of midgut epithelial cells and create pores that cause swelling and lysis and finally cause death of the insect.

7. (a) : Genetic modification of organisms can have unpredictable results, when such organisms are introduced into the ecosystem. Therefore, the Indian Government has set up organizations such as GEAC (Genetic Engineering Approval Committee), which makes decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.

8. (b) : Glyphosate is a broad spectrum herbicide which especially kills broad leaved herbs. Crop plants may also get affected by the herbicide, thus now crop plants are genetically engineered for glyphosate resistance. So, when glyphosate herbicide is applied, only weeds and no crop plants get harmed.

9. (a) : The recombinant DNA technological processes have made great impact in the area of health care by mass production of safe and more effective therapeutic drugs. In 1983, Eli Lily, an American company, first prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *Escherichia coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin (humulin).

10. (d) : Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton. The choice of genes depends upon the crop and targeted pest, as most Bt toxins are insect-group specific. The toxin is coded by a gene named *cry*. These are numerous genes. Two *cry* genes *cry* I Ac and *cry* II Ab have been incorporated in cotton. The genetically modified crop is called Bt cotton as it contains Bt toxin genes against cotton bollworms.

11. (b) : RNA interference (RNAi) is the phenomenon of inhibiting activity of a gene through production of both sense and antisense RNA. RNAi takes place in all eukaryotic organisms as a method of cellular defense. This method involves a specific *m*RNA silencing. It is due to a complementary dsRNA molecule which binds to

and prevents translation of the *m*RNA causing its silencing.

12. (a) : Gene therapy is a corrective therapy that is given to patients of diseases caused by some gene defects. Here, genes are inserted into a person's cells and tissues to treat disease by replacing the defective gene. The normal gene delivered into the individual or embryo takes over the function and compensate for the normal gene. Viral vectors like adenovirus are generally used to deliver the normal gene.

13. (c) : *Refer to answer 4.*

14. (a) : Many nematodes live in plants and animals including human beings. A nematode *Meloidogyne incognita* infests the roots of tobacco plants and causes a great reduction in yield. A novel strategy was adopted to prevent this infection that was based on the process of RNA interference (RNAi). RNA interference (RNAi) is the phenomenon of inhibiting activity of a gene by synthesis of RNA molecules complementary to the *m*RNA. The normal (*in vivo* synthesized) *m*RNA of a gene is said to be "sense" because it carries the codons that are "read" during translation. Normally, the complement to the *m*RNA "sense" strand will not contain a sequence of codons that can be translated to produce a functional protein; thus, this complementary strand is called "anti-sense RNA". The anti-sense RNA and *m*RNA molecules will anneal to form duplex RNA molecules (or double stranded RNA) and the duplex RNA molecules can not be translated. Thus, the presence of anti-sense RNA will block translation of the *m*RNA of the affected gene. In fact, recent evidence indicates that these RNA duplexes are often rapidly degraded *in vivo*.

15. (d) : DNA fingerprinting is a technique of determining nucleotide sequences of certain areas of DNA which are unique to each individual. The difference of about 0.1% or 3×10^6 base pairs (out of 3×10^9 bp) provides individuality to each human being. Human genome possesses numerous small noncoding but inheritable sequences of bases which are repeated many times. These sequences occur near telomere, centromeres, Y chromosome and heterochromatic area. The area with same sequence of bases repeated several times is called repetitive DNA. It is separated as satellite from the bulk DNA during density gradient centrifugation and hence called satellite DNA where, repetition of bases is in tandem. Satellite DNAs show polymorphism (the occurrence of mutations in a population at high frequency), which is the basis of genetic mapping of human genome as well as DNA fingerprinting. While mutations in genes produce alleles with different expressions, mutations in noncoding repetitive DNA have no immediate impact. These mutations which have piled up with time form the basis of polymorphism.

16. (d) : Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo. Here genes are inserted into a person's cells and tissues to treat a disease. Correction of a genetic defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for the non-functional gene. The first clinical gene therapy was given in 1990 to a 4 - year old girl with adenosine deaminase (ADA) deficiency. This enzyme is very important for the immune system to function. SCID is caused due to defect in the gene for the enzyme adenosine deaminase. In some children ADA deficiency can be cured by bone marrow transplantation. Here, the isolated gene from bone marrow cells producing ADA is introduced into cells at early embryonic stages; it can be a permanent cure.

17. (b)

18. (a) : *Refer to answer 14.*

19. (a) : *Refer to answer 6.*

20. (b)

21. (d) : In 1997, the first transgenic cow, Rosie, produced human protein enriched milk. The milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk. Isolation of DNA from other macromolecule is achieved by treating the bacterial cells/plant or animal tissue with enzymes such as lysozyme (bacteria), cellulase (plant cells), chitinase (fungus).

22. (a) : The genetically modified (GM) Bt brinjal in India has been developed mainly for insect resistance. Through genetic engineering Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton, brinjal.

23. (a) : Many transgenic animals are designed to increase our understanding of how genes contribute to the development of diseases. These are specially made to serve as models for human

diseases so that investigation of new treatments for diseases is made possible. Today transgenic models exist for many human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's. Transgenic mice are being developed for use in testing the safety of vaccines before they are used on humans. Transgenic mice are being used to test the safety of the polio vaccine.

24. (d) : Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into cotton plant. The genetically modified crop is called Bt cotton. Bt cotton has the following useful characteristics: pest resistance, herbicide tolerance, high yield and resistance to bollworm infestation.

25. (b)

26. (d) : Insulin is now being commercially produced by genetic engineering. Insulin consists of two short polypeptide chains: chain A and chain B, that are linked together by disulphide bonds. Insulin, in mammal is synthesised as a prohormone which contains an extra stretch called the C-peptide. During maturation this
C-peptide is removed. The production of insulin could only have been commercially possible if somehow the maturation process of C-peptide been skipped.
This problem was solved in 1988 by Eli Lilly, an American company which prepared functionable insulin from two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E.coli* to produce insulin chains. In this way, chains A and B were produced separately which was extracted, combined by creating disulfide bonds to get human insulin.

27. (d) : *Refer to answer 6.*

28. (a) : The plants produced through genetic engineering contain gene or genes usually from an unrelated organism. Such genes are called transgenes and the plants having transgenes are called transgenic plants. Recombinant DNA techniques are being used to improve crop plants by increasing their productivity, by making them more nutritious, and by developing disease resistance. Transgenic plants have a natural resistance to herbicides and pests. In the future, plants may have an ability to fix atmospheric nitrogen and an increased ability to grow in arid and salty soils.

29. (a) : *Refer to answer 6.*

30. (a) : *Refer to answer 14.*

31. (b) **32. (b)**

33. (c) : Genetic engineering has helped to develop such transgenic crop plants which are resistant to herbicides so that they are not damaged when farmers spray herbicides in the fields. Herbicide resistant plants have been developed in such a way that they continue to produce normal crop yield and at the same time remain unaffected by the activity of herbicides. These plants also reduces the use of weeding labour, farmer's cost and increases yield.

34. (c) : *Refer to answer 26.*

35. (d) : Bioremediation is the process of using living micro-organisms to clean up a contaminated site. Micro-organisms do this by removing toxins from materials. They decompose these compounds by using enzymes, specific proteins that control reactions in living cells. Organisms that produce enzymes capable of degrading petroleum are useful in cleaning up oil spills. Some common ones that break down oil are genetically engineered species of *Pseudomonas* and *Azotobacter*. Bioremediation accounts for 5 to 10 percent of all pollution treatment and has been used successfully in cleaning up leaking underground gasoline storage tanks. Bioremediation has many applications, from the ordinary garden compost to the removal of selenium and other toxic metals from waste. The best agents for bioremediation are the ones that can break down contaminants without becoming contaminated or harmful themselves.

36. (b) : *Refer to answer 4.*

37. (d) : *Bacillus thuringiensis* strains have been used for designing bioinsecticidal plants. A gene from this bacteria have insecticidal property which is transferred to cotton plants to produce Bt cotton which is resistant to bollworm insect which is a major pest of cotton. Similarly insects affecting maize; cabbage, sunflower etc., are also controlled by mutant strains of *Bacillus thuringiensis* bacteria.

38. (d) : Genetic code may be defined as the sequence of nucleotides in polynucleotide chain which determines the sequence of amino acids in a polypeptide chain. Thus the genetic code is universal. These is no ambiguity regarding genetic code. It means that each codon codes for the same amino acid in all organisms including bacteria, plants and animals.

39. (d) : Golden rice is a transgenic crop rice with high vitamin A content. It has been developed by transferring beta carotene synthesizing gene into the transgenic rice. Beta carotene is the precursor of vitamin A. This transgenic rice has been crossed with the already adapted varieties of rice to make them grow well in a particular area. It is very useful for the people suffering from vision impairment due to vitamin A deficiency.

40. (a) : *Refer to answer 15.*

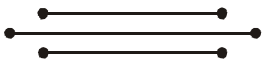
41. (c) : *Refer to answer 5.*

42. (a) : ELISA (enzyme linked immunosorbent assay) screening test is the initial test to diagnose AIDS. The test works by detecting anitibodies/ substances or protein which are produced in the blood when virus is present.
Alkaline phosphatase and peroxidases are commonly used enzymes as key reagent to perform the ELISA test. These enzymes are used to provide antibody-antigen complex in a specialised ELISA plate or tray. In ELISA test for detecting a particular antigen, its antibody is buffered and a drop of serum (supernatant of centrifuged blood) poured over it. If the latter contains antigen, it will produce antigen-antibody complex. A second enzyme labelled antibody is added. It forms enzyme-antigen-antibody complex, if the antigen is present. Substrate is now added. It produces a stain if the antigen is present.

43. (c) : Human insulin (humulin) is the first therapeutic product produced by means of recombinant technology by Eli lilly and Co. on July 5, 1983.

44. (a) : Transgenic plants are those plants in which a foreign gene has been introduced and stably integrated into host DNA. The first transgenic plants were produced in tobacco (*Nicotiana tabacum*). A gene resistant to PPT (L-phosphinothricin), an active ingredient of herbicide 'Basta', was isolated from *Medicago sativa*. It inhibits the enzyme GS (glutamine synthase) which is involved in ammonia assimilation. This gene resistant to PPT was incorporated into tobacco, as a result of which transgenic tobacco was produced which was resistant to PPT.

45. (c) : Transgenic organism is one that has become transformed following the introduction of novel genes into its genome. It is most frequently achieved by integration of cloned DNA sequences following their injection into the fertilized egg. This fertilized egg divides mitotically to form the whole organism so that all the cells of the organism will carry the transferred gene. The transferred genes are known as transgenes. Transgenesis can be done by pronuclear microinjection and somatic cell nuclear transfer or cloning. Transgenic animals produced by this technology include mice, *Drosophila*, *Xenopus* and some of the fish species.



Chapter
35

Organisms and Populations

1. Asymptote in a logistic growth curve is obtained when
(a) K = N (b) K > N
(c) K < N
(d) the value of '*r*' approaches zero.
(NEET 2017)

2. Plants which produce characteristic pneumatophores and show vivipary belong to
(a) halophytes (b) psammophytes
(c) hydrophytes (d) mesophytes.
(NEET 2017)

3. Presence of plants arranged into well defined vertical layers depending on their height can be seen best in
(a) tropical rainforest (b) grassland
(c) temperate forest
(d) tropical savannah. *(NEET 2017)*

4. Mycorrhizae are the example of
(a) amensalism (b) antibiosis
(c) mutualism (d) fungistasis.
(NEET 2017)

5. Which of the following is correct for *r*-selected species?
(a) Large number of progeny with small size
(b) Large number of progeny with large size
(c) Small number of progeny with small size
(d) Small number of progeny with large size
(NEET-II 2016)

6. If '+' sign is assigned to beneficial interaction, '–' sign to detrimental and 'O' sign to neutral interaction, then the population interaction represented by '+' '–' refers to
(a) mutualism (b) amensalism
(c) commensalism (d) parasitism.
(NEET-II 2016)

7. The principle of competitive exclusion was stated by
(a) C. Darwin (b) G.F. Gause
(c) Mac Arthur (d) Verhulst and Pearl.
(NEET-II 2016)

8. It is much easier for a small animal to run uphill than for a large animal, because
(a) small animals have a lower O_2 requirement
(b) the efficiency of muscles in large animals is less than in the small animals
(c) it is easier to carry a small body weight
(d) smaller animals have a higher metabolic rate.
(NEET-I 2016)

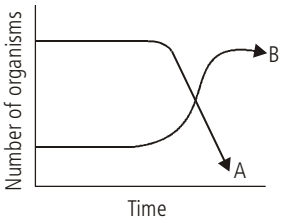
9. When does the growth rate of a population following the logistic model equal zero? The logistic model is given as dN/dt = rN(1–N/K)
(a) when N/K equals zero
(b) when death rate is greater than birth rate
(c) when N/K is exactly one
(d) when N nears the carrying capacity of the habitat. *(NEET-I 2016)*

10. Gause's principle of competitive exclusion states that
(a) no two species can occupy the same niche indefinitely for the same limiting resources
(b) larger organisms exclude smaller ones through competition
(c) more abundant species will exclude the less abundant species through competition
(d) competition for the same resources exclude species having different food preferences.
(NEET-I 2016)

11. In which of the following interactions both partners are adversely affected?
(a) Parasitism (b) Mutualism
(c) Competition (d) Predation
(2015)

12. An association of individuals of different species living in the same habitat and having functional interactions is
(a) ecosystem (b) population
(c) ecological niche (d) biotic community.
(2015)

13. The following graph depicts changes in two populations (A and B) of herbivores in a grassy field. A possible reason for these changes is that



(a) population A produced more offspring than population B
(b) population A consumed the members of population B
(c) both plant populations in this habitat decreased
(d) population B competed more successfully for food than population A.

(2015 Cancelled)

14. Just as a person moving from Delhi to Shimla to escape the heat for the duration of hot summer, thousands of migratory birds from Siberia and other extremely cold northern regions move to
(a) Western Ghat (b) Meghalaya
(c) Corbett National Park
(d) Keolado National Park. *(2014)*

15. Besides paddy fields, cyanobacteria are also found inside vegetative part of
(a) *Equisetum* (b) *Psilotum*
(c) *Pinus* (d) *Cycas*.

(NEET 2013)

16. A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is
(a) commensalism (b) amensalism
(c) ectoparasitism (d) symbiosis.

(NEET 2013)

17. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is
(a) 05 (b) zero
(c) 10 (d) 15. *(NEET 2013)*

18. The age pyramid with broad base indicates
(a) high percentage of old individuals
(b) low percentage of young individuals
(c) a stable population
(d) high percentage of young individuals.

(Karnataka NEET 2013)

19. Which one of the following is not a parasitic adaptation?
(a) Development of adhesive organs
(b) Loss of digestive organs
(c) Loss of reproductive capacity
(d) Loss of unnecessary sense organs

(Karnataka NEET 2013)

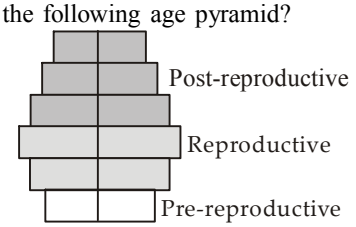
20. Benthic organisms are affected the most by
(a) light reaching the forest floor
(b) surface turbulence of water
(c) sediment characteristics of aquatic ecosystems
(d) water-holding capacity of soil.

(Karnataka NEET 2013)

21. *Cuscuta* is an example of
(a) ectoparasitism (b) brood parasitism
(c) predation (d) endoparasitism.

(Mains 2012)

22. What type of human population is represented by the following age pyramid?



(a) Vanishing population
(b) Stable population
(c) Declining population
(d) Expanding population *(2011)*

23. Large woody vines are more commonly found in
(a) temperate forests (b) mangroves
(c) tropical rainforests (d) alpine forests.

(2011)

24. Consider the following four conditions (1 - 4) and select a correct pair of them as adaptations to environment in desert lizards.
Conditions:
1. Burrowing in soil to escape high temperature.
2. Losing heat rapidly from the body during high temperature.
3. Bask in sun when temperature is low.
4. Insulating body due to thick fatty dermis.

(a) 3, 4 (b) 1, 3
(c) 2, 4 (d) 1, 2

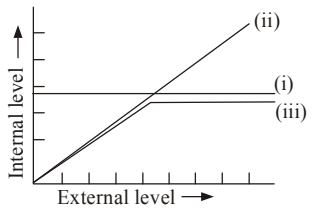
(2011)

25. Which one of the following is categorised as a parasite in true sense?
(a) The female *Anopheles* bites and sucks blood from humans
(b) Human foetus developing inside the uterus draws nourishment from the mother
(c) Head louse living on the human scalp as well as laying eggs on human hair
(d) The cuckoo (koel) lays its eggs in crow's nest.

(2011)

26. The logistic population growth is expressed by the equation
(a) $dt / dN = Nr\left(\frac{K - N}{K}\right)$
(b) $dN / dt = rN\left(\frac{K - N}{K}\right)$
(c) $dN / dt = rN$
(d) $dN / dt = rN\left(\frac{N - K}{N}\right)$. *(Mains 2011)*

27. The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do (i), (ii) and (iii) represent respectively?



	(i)	(ii)	(iii)
(a)	conformer	regulator	partial regulator
(b)	regulator	partial regulator	conformer
(c)	partial regulator	regulator	conformer
(d)	regulator	conformer	partial regulator

(2010)

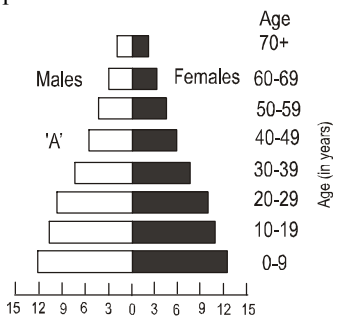
28. Which one of the following is one of the characteristics of a biological community?
(a) Stratification (b) Natality
(c) Mortality (d) Sex-ratio

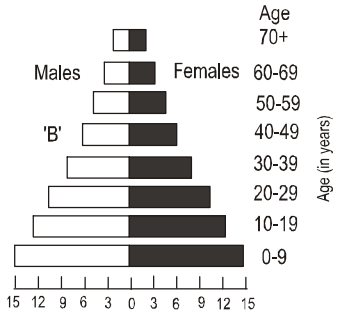
(2010)

29. Which one of the following is most appropriately defined?
(a) Host is an organism which provides food to another organism.
(b) Amensalism is a relationship in which one species is benefitted whereas the other is unaffected.
(c) Predator is an organism that catches and kills other organism for food.
(d) Parasite is an organism which always lives inside the body of other organism and may kill it.

(Mains 2010)

30. A country with a high rate of population growth took measures to reduce it. The figure below shows age-sex pyramids of populations A and B twenty years apart. Select the correct interpretation about them.





Interpretations:
(a) "B" is earlier pyramid and shows stabilized growth rate.
(b) "B" is more recent showing that population is very young.
(c) "A" is the earlier pyramid and no change has occurred in the growth rate.
(d) "A" is more recent and shows slight reduction in the growth rate.

(2009)

31. Reduction in vascular tissue, mechanical tissue and cuticle is characteristic of
(a) mesophytes (b) epiphytes
(c) hydrophytes (d) xerophytes. *(2009)*

32. Consider the following four statements (1-4) about certain desert animals such as kangaroo rat.
(1) They have dark colour and high rate of reproduction and excrete solid urine.
(2) They do not drink water, breathe at a slow rate to conserve water and have their body covered with thick hairs.
(3) They feed on dry seeds and do not require drinking water.
(4) They excrete very concentrated urine and do not use water to regulate body temperature.

Which two of the above statements for such animals are true?
(a) 3 and 1 (b) 1 and 2
(c) 3 and 4 (d) 2 and 3 *(2008)*

33. *Quercus* species are the dominant component in
(a) scrub forests
(b) tropical rain forests
(c) temperate deciduous forests
(d) alpine forests. *(2008)*

34. Geometric representation of age structure is a characteristic of
(a) population (b) landscape
(c) ecosystem (d) biotic community. *(2007)*

35. The population of an insect species shows an explosive increase in numbers during rainy season followed by its disappearance at the end of the season. What does this show?
(a) The food plants mature and die at the end of the rainy season.
(b) Its population growth curve is of J-type.
(c) The population of its predators increases enormously.
(d) S-shaped or sigmoid growth of this insect. *(2007)*

36. If the mean and the median pertaining to a certain character of a population are of the same value, the following is most likely to occur
(a) a bi-modal distribution
(b) a T-shaped curve
(c) a skewed curve
(d) a normal distribution. *(2007)*

37. A high density of elephant population in an area can result in
(a) intraspecific competition
(b) interspecific competition
(c) predation on one another
(d) mutualism. *(2007)*

38. Niche overlap indicates
(a) mutualism between two species
(b) active cooperation between two species
(c) two different parasites on the same host
(d) sharing of one or more resources between the two species. *(2006)*

39. More than 70% of world's freshwater is contained in
(a) polar ice
(b) glaciers and mountains
(c) Antarctica
(d) Greenland. *(2005)*

40. At which latitude, heat gain through insolation approximately equals heat loss through terrestrial radiation?
(a) $22\frac{1}{2}^{\circ}$ North and South
(b) 40° North and South
(c) $42\frac{1}{2}^{\circ}$ North and South
(d) 66° North and South *(2005)*

41. Animals have the innate ability to escape from predation. Examples for the same are given below. Select the incorrect example.
(a) Colour change in *Chamaeleon*
(b) Enlargement of body size by swallowing air in puffer fish
(c) Poison fangs in snakes
(d) Melanism in moths *(2005)*

42. Which one of the following pairs is mismatched?
(a) Tundra - permafrost
(b) Savanna - *Acacia* trees
(c) Prairie - Epiphytes
(d) Coniferous forest - Evergreen trees *(2005)*

43. Certain characteristic demographic features of developing countries are
(a) high fertility, low or rapidly falling mortality rate, rapid population growth and a very young age distribution
(b) high fertility, high density, rapidly rising mortality rate and a very young age distribution

(c) high infant mortality, low fertility, uneven population growth and a very young age distribution
(d) high mortality, high density, uneven population growth and a very old age distribution. *(2004)*

44. What is a keystone species?
(a) A species which makes up only a small proportion of the total biomass of a community, yet has a huge impact on the community's organization and survival
(b) A common species that has plenty of biomass, yet has a fairly low impact on the community's organization
(c) A rare species that has minimal impact on the biomass and on other species in the community
(d) A dominant species that constitutes a large proportion of the biomass and which affects many other species. *(2004)*

45. In which one of the following pairs is the specific characteristic of a soil not correctly matched?
(a) Laterite - contains aluminium compound
(b) Terra rosa - most suitable for roses
(c) Chernozems - richest soil in the world
(d) black soil - rich in calcium carbonate *(2004)*

46. The maximum growth rate occurs in
(a) stationary phase (b) senescent phase
(c) lag phase (d) exponential phase. *(2004)*

47. In which one of the following habitats does the diurnal temperature of soil surface vary most?
(a) Shrub land (b) Forest
(c) Desert (d) Grassland *(2004)*

48. Mycorrhiza is an example of
(a) symbiotic relationship
(b) ectoparasitism (c) endoparasitism
(d) decomposers. *(2003)*

49. What is true for individuals of same species?
(a) Live in same niche
(b) Live in same habitat
(c) Interbreeding
(d) Live in different habitat *(2002)*

50. Which type of association is found in between entomophilous flower and pollinating agent?
(a) Mutualism (b) Commensalism
(c) Cooperation (d) Co-evolution *(2002)*

51. Two different species cannot live for long duration in the same niche or habitat. This law is
(a) Allen's law
(b) Gause's hypothesis
(c) Dollo's rule
(d) Weisman's theory. *(2002)*

52. Which part of the world has a high density of organisms?
(a) Deciduous forests
(b) Tropical rain forests
(c) Grasslands
(d) Savannahs *(1999)*

53. In desert grasslands, which type of animals are relatively more abundant?
(a) Aquatic (b) Fossorial
(c) Diurnal (d) Arboreal *(1998)*

54. Plants such as *Prosopis*, *Acacia* and *Capparis* represent examples of tropical
(a) deciduous forests (b) evergreen forests
(c) grass lands (d) thorn forests. *(1998)*

55. Which of the following communities is more vulnerable to invasion by outside animals and plants?
(a) Temperate forests
(b) Oceanic island communities
(c) Mangroves
(d) Tropical evergreen forests *(1998)*

56. During adverse season, therophytes survive by
(a) rhizomes (b) seeds
(c) bulbs (d) corms. *(1997)*

57. Benthoic animals are those, which
(a) are submerged in area
(b) float on the sea surface
(c) are deep dweller in sea
(d) are floating (free) organisms. *(1996)*

58. The 'niche' of a species is meant for
(a) habitat and specific functions of a species
(b) specific place where an organism lives

(c) specific species function and its competitive power
(d) none of these. *(1996)*

59. The abundance of a species population, within its habitat, is called
(a) relative density (b) regional density
(c) absolute density (d) niche density.
(1995)

60. Which one of the following pairs is correctly matched?
(a) Parasitism - intraspecific relationship
(b) Uricotelism - aquatic habitat
(c) Excessive perspiration - xeric adaptation
(d) Streamlined body - aquatic adaptation
(1995)

61. Study of inter-relationships between organisms and their environment is
(a) ecology (b) ecosystem
(c) phytogeography (d) ethology. *(1993)*

62. The sum total of the populations of the same kind of organisms constitute
(a) colony (b) genus
(c) community (d) species. *(1993)*

63. Association of animals when both partners are benefitted
(a) colony (b) mutualism
(c) commensalism (d) ammensalism.
(1993)

64. Fertility of soil is measured by its ability to
(a) retain nutrients
(b) hold organic materials
(c) hold water (d) support life.
(1992)

65. Soil particles determine its
(a) texture (b) field capacity
(c) water holding capacity
(d) soil flora. *(1992)*

66. Homeostasis is
(a) tendency of biological systems to change with change in environment
(b) tendency of biological systems to resist change
(c) disturbance of self regulatory system and natural controls
(d) biotic materials used in homeopathic medicines.
(1991)

67. Deep black soil is productive due to high proportion of
(a) sand and zinc (b) gravel and calcium
(c) clay and humus (d) silt and earthworm.
(1991)

68. Which one is true?
(a) Commensalism when none of the interacting populations affect each other.
(b) Symbiosis when the interaction is useful to both the populations.
(c) Symbiosis when neither populations affects each other.
(d) Commensalism when the interaction is useful to both the populations.
(1991)

69. The relation between algae and fungi in a lichen is
(a) symbiosis (b) parasitism
(c) commenalism (d) protocooperation.
(1989)

70. Competition for light, nutrients and space is most severe between
(a) closely related organism growing in different niches
(b) closely related organisms growing in the same area/niche
(c) distantly related organisms growing in the same habitat
(d) distantly related organisms growing in different niches.
(1988)

71. A mutually beneficial association necessary for survival of both partners is
(a) mutualism/symbiosis
(b) commensalism
(c) amensalism
(d) both a and b. *(1988)*

Answer Key

1.	(a)	**2.**	(a)	**3.**	(a)	**4.**	(c)	**5.**	(a)	**6.**	(d)	**7.**	(b)	**8.**	(b)	**9.**	(c)	**10.**	(a)
11.	(c)	**12.**	(d)	**13.**	(d)	**14.**	(d)	**15.**	(d)	**16.**	(d)	**17.**	(b)	**18.**	(d)	**19.**	(c)	**20.**	(c)
21.	(a)	**22.**	(c)	**23.**	(c)	**24.**	(b)	**25.**	(c)	**26.**	(b)	**27.**	(d)	**28.**	(a)	**29.**	(c)	**30.**	(d)
31.	(c)	**32.**	(c)	**33.**	(c)	**34.**	(a)	**35.**	(b)	**36.**	(d)	**37.**	(a)	**38.**	(d)	**39.**	(a)	**40.**	(b)
41.	(c)	**42.**	(c)	**43.**	(a)	**44.**	(a)	**45.**	(d)	**46.**	(d)	**47.**	(c)	**48.**	(a)	**49.**	(c)	**50.**	(d)
51.	(b)	**52.**	(b)	**53.**	(b)	**54.**	(d)	**55.**	(d)	**56.**	(b)	**57.**	(c)	**58.**	(a)	**59.**	(d)	**60.**	(d)
61.	(a)	**62.**	(d)	**63.**	(b)	**64.**	(d)	**65.**	(a)	**66.**	(b)	**67.**	(c)	**68.**	(b)	**69.**	(a)	**70.**	(b)
71.	(a)																		

EXPLANATIONS

1. (a) : Asymptote in a logistic growth curve is obtained when population density (N) reaches the carrying capacity (K) *i.e.,* N = K.

2. (a) : Presence of pneumatophores, *i.e.,* small negatively geotropic vertical roots and vivipary or seed germination while attached to plant are adaptations of halophytes, *i.e.,* plants growing in saline habitat.

3. (a)

4. (c) : Mycorrhiza is a mutualistic interaction between a fungus and roots of higher plants.

5. (a) : Organisms that are *r*-selected (*r*-strategists) able to colonise a habitat rapidly, utilising the food and other resources before other organisms are established and begin to compete. The *r*-strategists tend to be relatively small organisms with short life spans (*e.g.*, bacteria) and often live in temporary or unstable environments; characteristically their survival depends on their ability to produce large numbers of offspring rather than on their ability to compete.

6. (d) : Parasitism is an association in which one organism (the parasite) lives on (ectoparasitism) or in (endoparasitism) the body of another organism (host), from which it obtains its nutrients. This association is beneficial for the parasites as they get continuous supply of nutrients from their host and are able to rapidly multiply their numbers. But it is detrimental for the host organism as parasitic infection leads to various complications and diseases in the host body may also be fatal to him under certain circumstances.

7. (b) : Two or more species with closely similar niche requirements cannot exist indefinitely in the same area as sooner or later they come into competition for possession of it. This is called as Gause's competitive exclusion principle, which states that an ecological niche cannot be simultaneously and completely occupied by established populations of more than one species. Two species can live in same habitat but not in the same niche. More similar the two niches are, severe the competition is.

8. (b) : The small animals have smaller surface area to body volume ratio. They have higher metabolic rates than larger animals. Therefore, it is much easier for small animals to move uphill than large animals.

9. (c)

10. (a) : *Refer to answer 7.*

11. (c) : Competition is the rivalry between two or more organisms for obtaining the same resources such as food, light, water, space, shelter, mate etc. Competitors adversely affect each other.

12. (d) : Biological or biotic community is an assemblage of populations of different species of plants, animals, bacteria and fungi which live in a particular area and interact with one another through competition, predation, mutualism, etc. Each biotic community has a specific composition and structure, *e.g.*, pond community.

13. (d) : Both the populations are herbivorous, thus they cannot affect each other. If the food sources for these populations A and B have decreased, then both the populations A and B would have declined. If population A have produced more offspring then the graph A should have increased. Based on the graph, population B is more successful in competing with population A, that is why number of organisms in population B increased while that in population A decreased, as they get access to limited resources.

14. (d)

15. (d) : Coralloid roots of *Cycas* have symbiotic association with blue-green algae like *Nostoc* and *Anabaena*. Coralloid roots are irregular, negatively geotropic, dichotomously branched coral like roots which do not possess root hairs and root caps.

16. (d) : Sea anemone gets associated to the shell of hermit crab. It provides camouflage and protection to the crab due to presence of stinging cells in sea anemone. In turn, sea anemone is transported to new places reaching new food sources. This is symbiosis as both the organisms are benefitted.

17. (b) : Natality and immigration positively contribute to the population growth while mortality and emigration are negative factors. In the given question,

The net increase in population is
natality + immigration = 250 + 20 = 270
The net decrease in population is
mortality + emigration = 240 + 30 = 270
Thus, net increase in population = 270 – 270 = 0

18. (d) : Age pyramid is a graphic representation of abundance of individuals of different age groups with pre-reproductive individuals at the base,

reproductive individuals in the middle and post-reproductive individuals at the top.

Triangular age pyramid has high proportion of pre-reproductive individuals, moderate number of reproductive individuals and fewer post-reproductive individuals. It represents young or rapidly growing population. In bell-shaped age pyramid, the number of pre-reproductive and reproductive individuals is almost equal. Post - reproductive individuals are comparatively fewer. It represents stable or stationary population where growth rate is nearly zero. In urn-shaped age pyramid, the number of reproductive individuals is higher than the number of pre-reproductive individuals. It represents declining or diminishing population.

19. (c) : Parasitism is a relationship between two living organisms of different species in which one organism called parasite obtains its food directly from another living organism called host. The parasite spends a part or whole of its life either on or inside the body of the host.

The general parasitic adaptations are (i) anaerobic respiration in internal parasites, (ii) loss of certain organs, (iii) presence of adhesive organs, (iv) excessive multiplication, (v) resistant cysts and eggs for safe transfer of their progeny to new hosts and (vi) well developed and complicated reproductive organs.

20. (c) : Benthic organisms are bottom dwelling forms found crawling or attached to the bottom. The sediment characteristics often determine the type of benthic animals that can thrive there.

21. (a) : *Cuscuta* is a total stem parasite which is a good example of ectoparasitism. It is commonly found growing on hedge plants. It has lost chlorophyll and leaves in the course of evolution. It attaches and wraps itself around the stem of host plant and produces haustoria that gets inserted into the vascular system of host. The parasitic plant sucks all the nutrients from the host plant with the help of haustoria. *Cuscuta* is known to receive even the flower inducing hormone or florigen from the host.

22. (c) : *Refer to answer 18.*

23. (c) : Lianas are large climbing woody vines that drape tropical rainforest trees. They have adapted to life in rainforest by having their roots in the ground and climbing high onto the tree canopy to reach available sunlight. Many lianas start life in the rainforest canopy and send roots down to the ground.

24. (b) : Desert lizards lack the physiological ability that mammals have to deal with the high temperatures of their habitat, but manage to keep their body temperature fairly constant by behavioural means. They bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing. Some species are capable of borrowing into the soil to hide and escape from the above-ground heat.

25. (c) : Parasitism is an association in which one organism (the parasite) lives on (ectoparasitism) or in (endoparasitism) the body of another (the host), from which it obtains its nutrients. They also produce vast numbers of eggs there *e.g.*, head louse living on the human scalp.

26. (b) : Logistic population growth is expressed by following equation:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

Where, N = population density at time t

r = intrinsic rate of natural increase

K = carrying capacity

27. (d) : Some organisms are able to maintain homeostasis by physiological (sometimes behavioural also) means which ensures constant body temperature, constant osmotic concentration, etc. They are known as regulators. A majority of animals and plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature. These animals and plants are simply conformers. During the course of evolution, the costs and benefits of maintaining a constant internal environment are taken into consideration. Some species have evolved the ability to regulate, but only over a limited range of environmental conditions, beyond which they simply conform. They are known as partial regulators.

28. (a) : The characteristics of biological community are dominance, species diversity, trophic organisation, stratification, dynamism and stability. Organisms are not uniformly distributed throughout a community. They usually occur in definite zones. This spatial arrangement of populations is called stratification. Structurally a community may be divided horizontally into subcommunities. This horizontal division constitutes the zonation in the community. Natality, mortality, age structure and sex ratio are the basic characteristics of a population.

29. (c) : Predation is an interaction between members of two species in which members of one species capture, kill and eat up members of other species. Host is a term which is specifically related to parasitism. Amensalism is an interspecies interaction in which one species is harmed whereas the other one is unaffected. Parasitic organism can live both over the surface of their host or inside their body.

30. (d) : "A" is more recent and shows slight reduction in growth rate.

31. (c) : In hydrophytes mechanical tissue *i.e.*, sclerenchyma, conducting tissue xylem, absorbing tissues are in reduced form or absent. Cuticle is either completely absent or if present it is thin and poorly developed.

32. (c) : Kangaroo rat (*Dipodomys merriami*) feeds on dry seeds. It seldom drinks water. The requirement of water is met by food (10%) and metabolic water (90%). Water loss is prevented by living in burrows during the day, concentration of urine and solidification of faeces. It has a thick coat to minimise evaporative desiccation.

33. (c) : Temperate broad leaf (deciduous) forests have warm summer and moderately cool winter. Rainfall is 100 – 250 cm. Dominant trees are oak, elm, birch, maple ash, chestnut, hickory, beech, poplar and *Magnolia*. Indian temperate broad leaves forests are dominated by oak like *Quercus semecarpifolia* (Brown oak of Himalayas, Khrsu oak), *Q. floribunda* (Tilonaj oak), *Q. lanuginose* (Rianj oak) and *Q. leucotrichophora* (Banj oak). Fauna of latitudinal temperate broad leaf forests consists of deer, fox, beaver, wild cat, racoon etc.

34. (a) : Population has several characteristics or attributes which are a function of the whole group and not of an individual. Age distribution is one of them that is the number or the percentage of individuals in a population in different age groups. This is represented geometrically in the form of age pyramid.

35. (b) : J-shape of growth pattern can be easily observed in algae blooms, some insects, annual plants and the lemmings of Tundra. In the beginning density of the population increases rapidly in compound interest fashion and then stops abruptly as the environmental resistance or other limiting factors become effective. These factors may be food, space, seasonal (frost, excessive rain etc.) or the termination of reproduction session.

36. (d) : If the mean and the median pertaining to a certain character of a population are of the same value, a normal distribution is most likely to occur.

37. (a) : Competition is rivalry for obtaining the same resource. Competition is of two types, intraspecific and interspecific. Intraspecific competition is the competition amongst members of the same species for a common resource. It may be for food, space, and mate. So if the density of elephant population in an area increases, it will lead to intraspecific competition. This will lead to the establishment of territories in elephants which will result in pushing out of the extra number securing shelter, mate and food for the rest.

38. (d) : Niche/ecological niche is specific part of habitat occupied by individuals of a species which is circumscribed by its range of tolerance, range of movement, microclimate, type of food and its availability, shelter, type of predator and timing of activity. A habitat has several ecological niches and supports a number of species. An ecological niche is used by a single species. Two or more species cannot use the same niche despite having a mutualistic association. Organisms or populations in competition have a niche overlap of a limited resource for which they compete. Both owl and cat feed on shrews and mice. They occupy the same niche because of being ecological equivalents though their habitats are different.

39. (a) : Nearly about 97% of the earth's water is saline in the oceans and seas. 3% of the earth's water is locked up on the polar ice caps. 85% of the frozen freshwater is in the Antarctic is ice cap, 15% of the frozen freshwater is in the northern polar ice cap and glaciers.

40. (b) : Earth does not receive equal radiation at all points. The East West rotation of earth provides equal exposure to sunlight but latitude and dispersion do affect the amount of radiation received. The poles receive far less radiation than equator. This uneven heating is called differential insolation. At 40º North and South, approximately the heat gain is equal to heat loss through terrestrial radiation.

41. (c) : Colour change in *Chameleon* and melanism in moths are examples of camouflage in animals adapted to prevent predation from prey. As a defence mechanism puffers have the ability to inflate rapidly, filling their extremely elastic stomach with water (or air) until they are almost spherical. This prevents them from being identified by the predator. But poison fangs in snakes are a method adopted for preying and not escaping predation.

42. (c) : A biome is a major terrestrial community characterized by a distinct climate and inhabited by a particular species of plants and animals.

Tundra is characterized by precipitation of less than 25 cm annually. Permafrost or permanent ice is found about a meter down from the surface, it never melts and is impenetrable to both water and roots.

Savannahs are open grasslands with scattered shrubs and trees. Coniferous forest contain evergreen trees. In these forests all plants do not shed their leaves at the same time hence forest remains always evergreen. But Paiaries is a grassland and epiphytes and ephemerals are found in deserts.

43. (a) : In developing countries the conditions are becoming better for survival of human beings. So the mortality rate or the number of individuals dying per unit of time is low.

Mortality or the average number of individuals produced by a population in a unit of time is high. So that there is rapid population growth and there are more individuals in the pre-reproductive age group. So there is young age distribution.

44. (a) : Keystone species are those species which has significant and disproportionately large influence on the community structure and characteristics. It has often considerably low abundance and biomass as compared to dominant species. Removal of such species causes serious disruption in structure and function of community.

45. (d) : Black soil forms the largest group. It is developed mainly on the Deccan traps of Maharashtra, Madhya Pradesh and Kathiawar. Because of its hydrology and climatic conditions of the environment, the medium and deep black soils are very suitable for cotton cultivation. Laterite soil is rich in insoluble iron oxides and aluminium compounds, which gives laterites a reddish appearance. Chernozems are rich in nutrients (due to abundant organic rich compounds) and consequently the most fertile in the world.

46. (d) : Maximum growth rate occurs in exponential or acceleration or log phase. The point at which the exponential growth begins to slow down is known as inflexion point.

47. (c) : Deserts are places where the diurnal temperatures vary greatly. It is extremely hot during the day time and very cold at night. This change in temperature also affects the temperature condition of the soil.

48. (a) : In mutalism or symbosis both the organisms in association are mutually benefitted and further this association is obligatory, *i.e.*, necessary for existence of both organisms. Mycorrhiza is a example of symbiosis.

It is association between roots of higher plants and fungal hyphae. The fungal hyphae supply water and nutrients to the plant and in turn get food form the plant. So both the organism are mutually benefitted.

49. (c) : Species may be defined as the uniform interbreeding population of individuals which freely interbreed among themselves. Niche represents the habitat and functions of a species. Habitat is a specific place where an organisms lives.

50. (d) : Co-evolution can occur in any interspecific relationship like symbiosis or mutualism. The relation between an entomophilous flower and pollinating insect shows co-evolved mutualism. In this the plant depends exclusively on the insect for pollination and the insect relies on the plant for food.

51. (b) : Interspecific competition is rivalry amongst members of different species. The severity of competition depends upon similarity in the requirement of food and shelter. Every type of organism has a particular niche, no two organisms can live in same niche. One of the two is eliminated. This phenomenon is called Gause hypothesis of competitive exclusion.

52. (b) : Trophical forests are found in trophical zone of the world and are characterized by very high temperature with rainfall in abundance. The flora of trophical rain forest is very rich and highly diversified. The trophical forests have a very rich fauna both in density as well as in varieties. The reason for this high diversity and variety of flora and fauna is the occurrence of suitable conditions in these forests.

53. (b) : Desert animals prefer to live under the surface. The animal residing either permanently or for most of life inside the burrows or under the earth surface are known as burrowing or fossorial animals and their mode of existence is described as subterranean or underground.

54. (d) : Tropical shrubs or thorn forests are found in places where moisture conditions are intermediate between desert and savanna on one hand and seasonal or rain forests on the other hand. *Acacia* and *Prosopis* are non-succulent perennial plants and *Capparis* is a xerophytic shrub.

55. (d) : Tropical forests are found in tropical zone of the world and are characterised by very high temperature with rainfall in abundance. The flora of tropical rain forest is very rich and highly diversified. The tropical forests have a very rich fauna both in density as well as in varieties. The reason for this high diversity and variety of flora and fauna is the occurrence of suitable conditions in these forests. So these are more vulnerable to invasion by outside plants and animals.

56. (b) : Therophytes are those plants that survive the winter as a seed and complete their life cycle between the spring and autumn.

57. (c) : Benthoic organisms are attached or rest on the bottom sediments. Benthic animal may be divided into filter feeders, *e.g.,* clams and deposit feeders *e.g*., snails.

58. (a) : *Refer to answer 38.*

59. (d)

60. (d) : Streamline body is a secondary aquatic adaption. It is found in animals that live permanently in water but most of them are amphibious in nature. The streamlined body consists of compression of head, body and tail into a curved streamlined form. There is no protruberance over the body so that the animal can move easily through water. Parasitism is a relationship between two organisms of different species in which one organism called parasite obtains its food directly from another living organism called host.
In xeric adaptation perspiration is reduced to conserve water. Uricotelism is characteristic of terrestrial animals which excrete uric acid.

61. (a) : Ecology is the branch of science which deals with the study of inter-relationship between organisms and their environment. The scope of ecology is very vast as it treats the organisms at the level of population, community and ecosystem.

62. (d) : The sum total of the populations of the same kind of organisms constitute species. A species is a group of individuals of same kind of phenotypic characters and can interbreed.

63. (b) : *Refer to answer 48.*

64. (d) : Soil fertility is the characteristic of soil that supports abundant plant life. In particular the term is used to describe agricultural and garden soil.

65. (a) : Soil particles determines its texture. The soil particles enclose living spaces in between them called pore space. In coarse textured soils, the pore space is wide but pore frequency is low. But in fine textured soil, the pore space is narrow but pore frequency is high.

66. (b) : The ability to maintain a steady state within constantly changing environment is essential for the survival of living systems. The maintenance of a constant internal environment is called homeostasis.

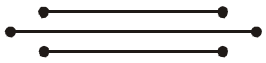
67. (c) : Deep black soil is productive due to high proportion of clay and humus. The organic matter present in the soil is contributed by the death and decay of living organisms. These are the richest in nutrients and therefore these soils are the most fertile.

68. (b) : *Refer to answer 48.*

69. (a) : Algae and fungi in a lichen show symbiotic relationship. Fungi give support to the algae, give protection and help in absorption of water while algae provide food to fungi which is achlorophyllous. No one is harmed but both are benefitted by each other.

70. (b) : *Refer to answer 37.*

71. (a) : *Refer to answer 48.*



Chapter
36

Ecosystem

1. Which ecosystem has the maximum biomass?
(a) Grassland ecosystem
(b) Pond ecosystem
(c) Lake ecosystem
(d) Forest ecosystem *(NEET 2017)*

2. The primary producers of the deep-sea hydrothermal vent ecosystem are
(a) green algae
(b) chemosynthetic bacteria
(c) blue-green algae (d) coral reefs.
(NEET-II 2016)

3. Which of the following would appear as the pioneer organisms on bare rocks?
(a) Mosses (b) Green algae
(c) Lichens (d) Liverworts
(NEET-I 2016)

4. Which one of the following is a characteristic feature of cropland ecosystem?
(a) Absence of weeds
(b) Ecological succession
(c) Absence of soil organisms
(d) Least genetic diversity *(NEET-I 2016)*

5. The term ecosystem was coined by
(a) E. Haeckel (b) E.Warming
(c) E.P. Odum (d) A. G. Tansley.
(NEET-I 2016)

6. Most animals that live in deep oceanic waters are
(a) tertiary consumers (b) detritivores
(c) primary consumers
(d) secondary consumers. *(2015)*

7. During ecological succession
(a) the numbers and types of animals remain constant
(b) the changes lead to a community that is in near equilibrium with the environment and is called pioneer community
(c) the gradual and predictable change in species composition occurs in a given area
(d) the establishment of a new biotic community is very fast in its primary phase. *(2015)*

8. In which of the following both pairs have correct combination?

(a)	Gaseous nutrient cycle Sedimentary nutrient cycle	Nitrogen and Sulphur Carbon and Phosphorus
(b)	Gaseous nutrient cycle Sedimentary nutrient cycle	Sulphur and Phosphorus Carbon and Nitrogen
(c)	Gaseous nutrient cycle Sedimentary nutrient cycle	Carbon and Nitrogen Sulphur and Phosphorus
(d)	Gaseous nutrient cycle Sedimentary nutrient cycle	Carbon and Sulphur Nitrogen and Phosphorus

(2015)

9. The mass of living material at a trophic level at a particular time is called
(a) net primary productivity
(b) standing crop
(c) gross primary productivity
(d) standing state. *(2015 Cancelled)*

10. Vertical distribution of different species occupying different levels in a biotic community is known as
(a) zonation (b) pyramid
(c) divergence (d) stratification.
(2015 Cancelled)

11. Secondary succession takes place on/in
(a) newly created pond
(b) newly cooled lava

(c) bare rock (d) degraded forest.
(2015 Cancelled)

12. Most animals are tree dwellers in a
(a) temperate deciduous forest
(b) tropical rainforest
(c) coniferous forest
(d) thorn woodland. *(2015 Cancelled)*

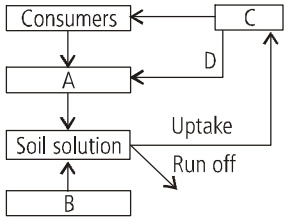
13. In an ecosystem the rate of production of organic matter during photosynthesis is termed as
(a) secondary productivity
(b) net productivity
(c) net primary productivity
(d) gross primary productivity.
(2015 Cancelled)

14. Match the following and select the correct option.

A.	Earthworm	(i)	Pioneer species
B.	Succession	(ii)	Detritivore
C.	Ecosystem service	(iii)	Natality
D.	Population growth	(iv)	Pollination

	A	B	C	D
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iv)	(i)	(iii)	(ii)
(c)	(iii)	(ii)	(iv)	(i)
(d)	(ii)	(i)	(iv)	(iii) *(2014)*

15. Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (A-D). Identify the blanks.



	A	B	C	D
(a)	Rock minerals	Detritus	Litter fall	Producers
(b)	Litter fall	Producers	Rock minerals	Detritus
(c)	Detritus	Rock minerals	Producers	Litter fall
(d)	Producers	Litter fall	Rock minerals	Detritus

(2014)

16. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?
Plant → Mice → Snake → Peacock
(a) 0.02 J (b) 0.002 J
(c) 0.2 J (d) 0.0002 J *(2014)*

17. Natural reservoir of phosphorus is
(a) rock (b) fossils
(c) sea water (d) animal bones.
(NEET 2013)

18. Secondary productivity is rate of formation of new organic matter by
(a) consumers (b) decomposers
(c) producers (d) parasites.
(NEET 2013)

19. Which one of the following processes during decomposition is correctly described?
(a) Catabolism – Last step in the decomposition under fully anaerobic condition
(b) Leaching – Water soluble inorganic nutrients rise to the top layers of soil
(c) Fragmentation – Carried out by organisms such as earthworm
(d) Humification – Leads to the accumulation of a dark coloured substance humus which undergoes microbial action at a very fast rate. *(NEET 2013)*

20. Which two distinct microbial processes are responsible for the release of fixed nitrogen as dinitrogen gas (N_2) to the atmosphere?
(a) Aerobic nitrate oxidation and nitrite reduction
(b) Decomposition of organic nitrogen and conversion of dinitrogen to ammonium compounds
(c) Enteric fermentation in cattle and nitrogen fixation by *Rhizobium* in root nodules of legumes
(d) Anaerobic ammonium oxidation and denitrification. *(Karnataka NEET 2013)*

21. Which of the following is a primary consumer in maize field ecosystem?
(a) Grasshopper (b) Wolf
(c) Phytoplankton (d) Lion
(Karnataka NEET 2013)

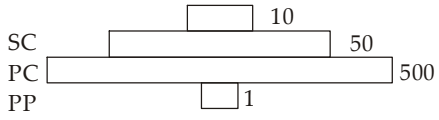
22. When man eats fish which feeds on zooplanktons which have eaten small plants, the producer in this chain is

(a) small plants (b) fish
(c) man (d) zooplankton.
(Karnataka NEET 2013)

23. Which one of the following is not a gaseous biogeochemical cycle in ecosystem?
(a) Sulphur cycle (b) Phosphorus cycle
(c) Nitrogen cycle (d) Carbon cycle
(2012)

24. Identify the possible link "A" in the following food chain.
Plant → Insect → Frog → "A" → Eagle
(a) Rabbit (b) Wolf
(c) Cobra (d) Parrot *(2012)*

25. Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels?



(a) Level PC is "insects" and level SC is "small insectivorous birds".
(b) Level PP is "phytoplanktons" in sea and "whale" on top level TC
(c) Level one PP is "*pipal* trees" and the level SC is "sheep".
(d) Level PC is "rats" and level SC is "cats".
(2012)

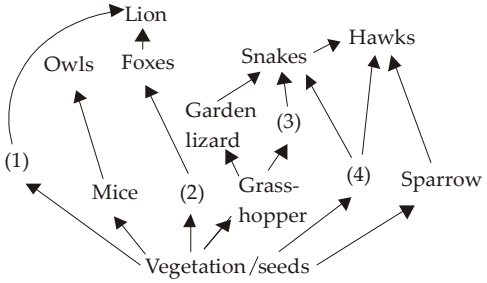
26. Which one of the following is not a functional unit of an ecosystem?
(a) Energy flow (b) Decomposition
(c) Productivity (d) Stratification
(2012)

27. The upright pyramid of number is absent in
(a) pond (b) forest
(c) lake (d) grassland. *(2012)*

28. The rate of formation of new organic matter by rabbit in a grassland, is called
(a) net productivity
(b) secondary productivity
(c) net primary productivity
(d) gross primary productivity. *(Mains 2012)*

29. The second stage of hydrosere is occupied by plants like
(a) *Azolla* (b) *Typha*
(c) *Salix* (d) *Vallisneria*.
(Mains 2012)

30. Identify the likely organisms (1), (2), (3) and (4) in the food web shown below.



	(1)	(2)	(3)	(4)
(a)	Deer	Rabbit	Frog	Rat
(b)	Dog	Squirrel	Bat	Deer
(c)	Rat	Dog	Tortoise	Crow
(d)	Squirrel	Cat	Rat	Pigeon

(Mains 2012)

31. Mass of living matter at a trophic level in an area at any time is called
(a) standing crop (b) detritus
(c) humus (d) standing state.
(2011)

32. Of the total incident solar radiation the proportion of PAR is
(a) about 70% (b) about 60%
(c) less than 50% (d) more than 80%.
(2011)

33. Which one of the following statements is correct for secondary succession?
(a) It begins on a bare rock.
(b) It occurs on a deforested site.
(c) It follows primary succession.
(d) It is similar to primary succession except that it has a relatively fast pace. *(2011)*

34. Which one of the following statements for the pyramid of energy is incorrect ?
(a) Its base is broad.
(b) It shows energy content of different trophic level organisms.
(c) It is inverted in shape.
(d) It is upright in shape. *(2011)*

35. Which one of the following animals may occupy more than one trophic levels in the same ecosystem at the same time?

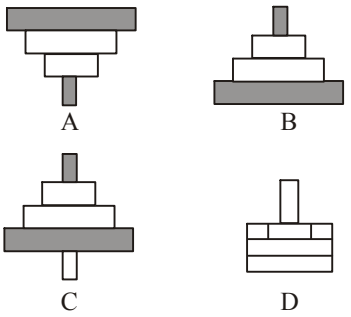
(a) Sparrow (b) Lion
(c) Goat (d) Frog *(Mains 2011)*

36. Both hydrarch and xerarch successions lead to
(a) medium water conditions
(b) xeric conditions
(c) highly dry conditions
(d) excessive wet conditions. *(Mains 2011)*

37. The breakdown of detritus into smaller particles by earthworm is a process called
(a) humification (b) fragmentation
(c) mineralisation (d) catabolism.
(Mains 2011)

38. The biomass available for consumption by the herbivores and the decomposers is called
(a) net primary productivity
(b) secondary productivity
(c) standing crop
(d) gross primary productivity. *(2010)*

39. Which of the following representations shows the pyramid of numbers in a forest ecosystem?



(a) D (b) A
(c) B (d) C *(Mains 2010)*

40. The correct sequence of plants in a hydrosere is
(a) *Volvox* → *Hydrilla* → *Pistia* → *Scirpus* → *Lantana* → Oak
(b) *Pistia* → *Volvox* → *Scirpus* → *Hydrilla* → Oak → *Lantana*
(c) Oak → *Lantana* → *Volvox* → *Hydrilla* → *Pistia* → *Scirpus*
(d) Oak → *Lantana* → *Scirpus* → *Pistia* → *Hydrilla* → *Volvox*. *(2009)*

41. Which one of the following types of organisms occupy more than one trophic level in a pond ecosystem?
(a) Fish (b) Zooplankton
(c) Frog (d) Phytoplankton
(2009)

42. Consider the following statements concerning food chains.
A. Removal of 80% tigers from an area resulted in greatly increased growth of vegetation.
B. Removal of most of the carnivores resulted in an increased population of deers.
C. The length of food chains is generally limited to 3-4 trophic levels due to energy loss.
D. The length of food chains may vary from 2 to 8 trophic levels.

Which two of the above statements are correct?
(a) A, D (b) A, B
(c) B, C (d) C, D *(2008)*

43. The slow rate of decomposition of fallen logs in nature is due to their
(a) anaerobic environment around them
(b) low cellulose content
(c) low moisture content
(d) poor nitrogen content. *(2008)*

44. About 70% of total global carbon is found in
(a) oceans (b) forests
(c) grasslands (d) agroecosystems.
(2008)

45. Which one of the following ecosystem types has the highest annual net primary productivity?
(a) Tropical deciduous forest
(b) Temperate evergreen forest
(c) Temperate deciduous forest
(d) Tropical rainforest *(2007)*

46. Which one of the following is not used for construction of ecological pyramids?
(a) Fresh weight (b) Dry weight
(c) Number of individuals
(d) Rate of energy flow *(2006)*

47. Which of the following is expected to have the highest value ($gm/m^2/yr$) in a grassland ecosystem?
(a) Secondary production
(b) Tertiary production
(c) Gross production (GP)
(d) Net production (NP) *(2004)*

48. An ecosystem which can be easily damaged but can recover after some time if damaging effect stops will be having
(a) low stability and high resilience
(b) high stability and low resilience
(c) low stability and low resilience
(d) high stability and high resilience. *(2004)*

49. Bamboo plant is growing in a fir forest then what will be the trophic level of it?
(a) First trophic level (T_1)
(b) Second trophic level (T_2)
(c) Third trophic level (T_3)
(d) Fourth trophic level (T_4) *(2002)*

50. Plant decomposers are
(a) monera and fungi (b) fungi and plants
(c) protista and animalia
(d) animalia and monera. *(2001)*

51. Which is the reason for highest biomass in aquatic ecosystem?
(a) Nano plankton, blue green algae and green algae
(b) Sea grass and slime moulds
(c) Benthoic and brown algae
(d) Diatoms *(2000)*

52. Energy transfer from one trophic level to other, in a food chain, is
(a) 10% (b) 20%
(c) 1% (d) 2%. *(1999)*

53. In a terrestrial ecosystem such as forest, maximum energy is in which trophic level?
(a) T_3 (b) T_4
(c) T_1 (d) T_2 *(1998)*

54. The rate at which light energy is converted into chemical energy of organic molecules is the ecosystem's
(a) net secondary productivity
(b) gross primary productivity
(c) net primary productivity
(d) gross secondary productivity. *(1998)*

55. Which of the following ecosystem has the highest gross primary productivity?
(a) Mangroves (b) Rainforest
(c) Grassland (d) Coral reef *(1997)*

56. Which of the following acts as "nature's scavengers"?
(a) Insects (b) Microorganisms
(c) Man (d) Animals *(1997)*

57. The 10% energy transfer law of food chain was given by
(a) Lindemann (b) Tansley
(c) Stanley (d) Weismann. *(1996)*

58. If we completely remove the decomposers from an ecosystem, its functioning will be adversely affected, because
(a) mineral movement will be blocked
(b) the rate of decomposition will be very high
(c) energy flow will be blocked
(d) herbivores will not receive solar energy. *(1995)*

59. In a biotic community, the primary consumers are
(a) detritivores (b) herbivores
(c) carnivores (d) omnivores. *(1995)*

60. Which of the following pairs is a sedimentary type of biogeochemical cycle?
(a) Phosphorus and nitrogen
(b) Phosphorus and sulphur
(c) Oxygen and nitrogen
(d) Phosphorus and carbon dioxide *(1995)*

61. Which of the following is the most stable ecosystem?
(a) Mountain (b) Ocean
(c) Forest (d) Desert *(1995)*

62. The primary succession refers to the development of communities on a
(a) forest clearing after devastating fire
(b) newly-exposed habitat with no record of earlier vegetation
(c) freshly cleared crop field
(d) pond, freshly filled with water after a dry phase. *(1995)*

63. The dominant second trophic level, in a lake ecosystem, is
(a) phytoplankton (b) zooplankton
(c) benthos (d) plankton. *(1994)*

64. Pyramid of numbers deals with number of
(a) species in an area
(b) individuals in a community
(c) individuals in a trophic-level
(d) subspecies in a community. *(1993)*

65. Pyramid of numbers in a pond ecosystem is
(a) irregular (b) inverted
(c) upright (d) spindle shaped. *(1993)*

66. Food chain in which microorganisms breakdown the food formed by primary producers is
(a) parasitic food chain
(b) detritus food chain
(c) consumer food chain
(d) predator food chain. *(1991)*

67. Pick up the correct food chain.
(a) Grass → Chameleon → Insect → Bird
(b) Grass → Fox → Rabbit → Bird
(c) Phytoplankton → Zooplankton → Fish
(d) Fallen leaves → Bacteria → Insect larvae *(1991)*

68. Pyramid of numbers in a grassland/tree ecosystem is
(a) always inverted (b) always upright
(c) both (a) and (b) (d) spindle-shaped. *(1991, 1990)*

69. Upper part of sea/aquatic ecosystem contains
(a) plankton (b) nekton
(c) plankton and nekton
(d) benthos. *(1988)*

70. What is true of ecosystem?
(a) Primary consumers are least dependent upon producers.
(b) Primary consumers out-number producers.
(c) Producers are more than primary consumers.
(d) Secondary consumers are the largest and most powerful. *(1988)*

71. In an ecosystem, which one shows one-way passage?
(a) Free energy (b) Carbon
(c) Nitrogen (d) Potassium *(1988)*

Answer Key

1.	(d)	**2.**	(b)	**3.**	(c)	**4.**	(d)	**5.**	(d)	**6.**	(b)	**7.**	(c)	**8.**	(c)	**9.**	(b)	**10.**	(d)
11.	(d)	**12.**	(b)	**13.**	(d)	**14.**	(d)	**15.**	(c)	**16.**	(a)	**17.**	(a)	**18.**	(a)	**19.**	(c)	**20.**	(d)
21.	(a)	**22.**	(a)	**23.**	(b)	**24.**	(c)	**25.**	(a)	**26.**	(d)	**27.**	(b)	**28.**	(b)	**29.**	(d)	**30.**	(a)
31.	(a)	**32.**	(c)	**33.**	(b)	**34.**	(c)	**35.**	(a)	**36.**	(a)	**37.**	(b)	**38.**	(a)	**39.**	(c)	**40.**	(a)
41.	(a)	**42.**	(c)	**43.**	(d)	**44.**	(a)	**45.**	(d)	**46.**	(a)	**47.**	(c)	**48.**	(a)	**49.**	(a)	**50.**	(a)
51.	(c)	**52.**	(a)	**53.**	(c)	**54.**	(b)	**55.**	(b)	**56.**	(b)	**57.**	(a)	**58.**	(a)	**59.**	(b)	**60.**	(b)
61.	(b)	**62.**	(b)	**63.**	(b)	**64.**	(c)	**65.**	(c)	**66.**	(b)	**67.**	(c)	**68.**	(b)	**69.**	(a)	**70.**	(c)
71.	(a)																		

EXPLANATIONS

1. (d)

2. (b) : Hydrothermal vents are cracks in the ocean floor that emit jets of hot water loaded with minerals and chemosynthetic bacteria. These bacteria are autotrophs that oxidise hydrogen sulphide in vent water to obtain energy which is used to produce organic material. These chemosynthetic bacteria are the primary producers and form the base of vent food webs. All vent animals ultimately depend on bacteria for food.

3. (c) : The bare rocky habitat is extremely hostile to living beings. There is no water, as the substratum does not absorb rain water. There is no nutrient holding mechanism. Plants cannot grow on these rocks. The first inhabitants or pioneers of such a habitat are usually lichens as they are resistant to desiccation and extreme temperatures.

4. (d) : Cropland ecosystem is an artificial or man-made terrestrial ecosystem which is created and maintained by human beings for their maximum benefits. Therefore, they will have least genetic diversity.

5. (d) : The term ecosystem was coined by A.G. Tansley in 1935.

6. (b) : Benthos is the community of organisms which live on, in, or near the sea bed, also known as the benthic zone. As no light is available at this zone of sea, the energy source for deep benthic ecosystems is often organic matter from higher up in the water column which drifts down to the depths. This dead and decaying matter sustains the benthic organisms, and therefore, most organisms in benthic zone *i.e.*, in deep oceanic waters, are scavengers or detritivores.

7. (c) : Biotic or ecological succession is the natural development of a series of biotic communities at the same site, one after the other till a climax community develops which does not change further because it is in perfect harmony with the environment of the area. The change is orderly and sequential. There is a parallel change in the physical environment.
During an ecological succession, the number and types of animals goes on increasing with time.
The community that is in near equilibrium with the environment is called climax community. The establishment of a new biotic community is slow in its primary phase but gradually becomes fast in its secondary phase.

8. (c) : Biogeochemical cycles are of two types: gaseous and sedimentary. In gaseous nutrient cycles, the materials involved in circulation between biotic and abiotic components of biosphere are gases or vapours and the reservoir pool is atmosphere or hydrosphere, *e.g.,* carbon, hydrogen, oxygen, nitrogen, water. In sedimentary nutrient cycles, materials involved in circulation between biotic and abiotic components of biosphere are non-gaseous and the reservoir pool is lithosphere, *e.g.*,phosphorus, calcium, magnesium. Sulphur has both sedimentary and gaseous nutrient cycles.

9. (b) : Standing crop is the total amount of living material in a specified population at a particular time, expressed as biomass (standing biomass) or its equivalent in terms of energy. The standing crop may vary at different times of the year; for example, in a population of deciduous trees between summer and winter.

10. (d)

11. (d) : Secondary succession (subsere) is the biotic succession that occurs in an area which become secondarily bare due to the destruction of community previously present there. Secondary succession starts from previously built up substrata with already existing living matter. The action of any external force, such as a sudden change in climatic factors, biotic intervention, fire, etc., had resulted in the destruction of previous community. Thus, area became devoid of living matter but its substratum, is built up. It has organic matter, so is biologically fertile and thus the successions are comparatively more rapid.

12. (b) : Tropical rainforests have a very dense plant cover. They also experience a large amount of precipitation, thus the forest floor is always damp. Thus, the conditions there have led animals to get adapted to arboreal habitats. Most animals found there are tree dwellers as almost every space on the forest floor is occupied by the vegetation.

13. (d) : The amount of energy accumulation in green plants as biomass or organic matter per unit area over a time period is known as primary productivity. The rate of total capture of energy, or the rate of total production of organic material (biomass), is known as gross primary productivity.

14. (d)

15. (c)

16. (a) : Herbivores are eaten by primary carnivores. Only 10% of the herbivores productivity is utilized for raising productivity of primary carnivores. The rest is consumed in ingestion, respiration, maintenance of body heat and other activities. Higher carnivores similarly are able to retain only 10% of energy present in primary carnivores. It is called 10% law which was proposed by Lindemann. Accordingly, if plant trapped 20 J of energy, mice will have 2 J, snake will have 0.2 J and hence, peacock will have 0.02 J of energy.

17. (a) : The reservoir pool of phosphorus is in phosphate rocks while the cycling pool is soil and water for terrestrial and aquatic ecosystems respectively. Small amount of phosphate is always being added to the cycling pool through weathering of rocks. Phosphate is generally found in soil in combination with calcium, iron and aluminium. Atmosphere or gaseous cycle is absent. Phosphate circulates in the abiotic environment in lithosphere as well as hydrosphere.

18. (a) : The rate of photosynthesis of organic matter by the consumers is known as secondary productivity. It depends upon the loss while transferring energy containing organic matter from the previous trophic level plus the consumption due to respiration and predation. Therefore, net productivity decreases with each trophic level.

19. (c) : Decomposition is the process in which decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients. The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation. Detritivores (*e.g.*, earthworm) break down detritus into smaller particles. This process is called fragmentation. By the process of leaching, water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts. Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism. Humification and mineralisation occur during decomposition in the soil. Humification leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.

20. (d) : Denitrification is a chemical process in which nitrates in the soil are reduced to molecular nitrogen (N_2) which is released into the atmosphere. It is done by denitrifying bacteria like *Pseudomonas denitrificans*. Anaerobic oxidation of ammonium (NH_4) also releases nitrogen in the atmosphere.

21. (a) : Primary consumers are herbivorous organisms that feed on producers. Carnivores are termed secondary, tertiary etc., consumers depending upon their position in food chain. In food chain on land, grasshopper is a herbivore (primary consumer) while wolf and lion are carnivores. Phytoplanktons are producers in aquatic food chains.

22. (a) : The transfer of food energy from producers to consumers through a series of organisms with repeated eating and being eaten is known as food chain. Green plants are always the first link of food chain because they alone are capable of synthesising organic food by using light energy by photosynthesis. The logical sequence of a food chain is :

Producer → Consumers → Decomposer

Small plants	→	Zooplanktons	→	Fish	→	Man
(Primary producer)		(Primary consumer)		(Secondary consumer)		(Tertiary consumer)

23. (b) : *Refer to answer 8.*

24. (c) **25. (a)**

26. (d) : Four important functional aspects of the ecosystem are productivity, decomposition, energy flow and nutrient cycling.

27. (b) : In forests, a single tree can support a large number of birds thus base showing producers in a pyramid of number will be narrower than the next slab showing primary consumers. Hence an upright pyramid of number is not formed in a forest ecosystem.

28. (b) : The rate of resynthesis of organic matter by consumers or the rate at which food energy is assimilated at the trophic level of consumers is called secondary productivity. In a grassland ecosystem, the rate of formation of new organic matter by rabbit is referred as secondary productivity.

29. (d) : Series of biotic communities that develop one after the other in a newly formed pond or lake is called hydrosere. It starts as soon as the muddy water becomes clear. The pioneer stage of hydrosere is plankton stage. Death and decomposition of planktons in the first seral stage of hydrosere produces organic matter which mixes up with clay and silt at the bottom to form soft mud which is favourable for growth of submerged hydrophytes in the next seral stage. Hence, the second stage of hydrosere is occupied by submerged hydrophytes like *Vallisneria*.

30. (a)

31. (a) : *Refer to answer 9.*

32. (c) : The source of energy in all ecosystem is solar energy. About 50% of the solar energy incident over earth is present in PAR (Photosynthetically active radiation). About 1–5% of incident solar radiation or 2 – 10% of PAR is captured by the photosynthetic organisms in the synthesis of organic matter (gross primary productivity). Roughly 20% of it is consumed in respiration so that net capture of energy (net primary productivity) is 0.8 – 4% of incident radiation or 1.6 – 8% of PAR.

33. (b) : Secondary succession begins in areas where natural biotic communities have been destroyed such as in abandoned farm lands, burned or cut forests (deforested site), lands that have been flooded etc.

34. (c) : Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.

35. (a) : Sparrow can be herbivorous (eating seeds and fruits) or carnivorous (eating insects).

36. (a) : Hydrarch succession takes place in wetter areas and the successional series progress from hydric to the mesic condition . Xerach succession takes place in dry areas and the series progress from xeric to mesic condition. Hence, both hydrach and xerach succession leads to medium water conditions (mesic).

37. (b) : *Refer to answer 19.*

38. (a) : The total organic matter synthesised by the producers in the process of photosynthesis per unit time and area is known as gross primary productivity. Net primary productivity is equal to the rate of organic matter created by photosynthesis minus the rate of respiration and other losses. It is actually the biomass available for consumption by the herbivores and the decomposers.

39. (c) : The representation of forest ecosystem in pyramid of numbers is always upright because higher trophic level comprising of tertiary consumers is generally smaller than that of the lower trophic levels (*i.e.*, secondary consumer, than primary consumer and primary producer).

The pyramid of number is inverted in case of single tree producer which can provide nourishment to several herbivores such as birds which can further support larger population of ectoparasites.

40. (a) : Hydrosere,originating in water (pond, pools, lakes etc.) and starts with the colonization of some phytoplanktons which form the pioneer plant community, and finally terminates into a forest, which is a climax community together with their chief components of vegetation.

The various stages together with their components of plant species of a hydrosere are phytoplankton stage,rooted submerged stage,rooted floating stage, reed swamp stage, marsh or sedge meadow stage, woodland stage and climax forest stage. *Volvox* is phytoplankton, *Hydrilla* is rooted submerged plant,*Pistia* is rooted floating plant,*Scirpus* is reed swamp plant, *Lantana* is sedge meadow plant and oak is woody tree.

41. (a) : A single species may occupy more than one trophic level. In pond, fish occupy more than one trophic level. Small fishes act as secondary consumer. They feed on primary consumer. Large fishes act as tertiary consumer. They feed on smaller fish.

42. (c) : Removal of 80% tigers (*i.e.*, tertiary consumer) from an area resulted in decreased growth of vegetation because there will be increased numbers of secondary or primary consumers which feeds on green plant. Removal of most of the carnivores resulted in an increased population of deers on which carnivores depends. The length of food chain is generally limited to 3-4 trophic level due to energy loss because all the food available at one level is neither eaten nor used by animals at the next level and a lot of the energy is lost in respiration to drive the organisms metabolism so less energy is left to support higher trophic level.

43. (d) : Decomposition is largely an oxygen-requiring process. The rate of decomposition is controlled by chemical composition of detritus and climatic factors. In a particular climatic condition, decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugar. Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes. Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.

44. (a) : Carbon constitutes 49% of dry weight of organism and is next only to water. Among the total quantity of global carbon 71% is found in oceans

in dissolved form whereas only 1% is found in atmosphere. Carbon cycling occurs through atmosphere, ocean and living or dead organism.

45. (d) : Net primary productivity is the total organic matter stored by producers per unit area per unit time. Gross primary productivity is the total organic matter synthesised by producers in the process of photosynthesis per unit area per unit time. So,

Net primary productivity = Gross productivity – Respiration and other losses

Tropical rainforests occur over equatorial/ subequatorial regions with abundant warmth and rainfall. Diversity and productivity are maximum as compared to other regions.

46. (a) : Ecological pyramids represents the trophic structure and trophic function of an ecosystem. In an ecological pyramid, the first trophic level forms the base and successive trophic levels the tiers which make up the apex. Ecological pyramids may be of three general types pyramid of number, pyramid of biomass and pyramid of energy. Pyramid of biomass *i.e.* the living weight of the organisms of the food chain present at any time in an ecosystem forms the pyramids of biomass. The pyramid of biomass indicates the decrease or the gradual reduction in biomass at each trophic levels from base to apex. Fresh weight is not used in ecological pyramids.

47. (c) : Productivity is rate of accumulation of energy containing organic matter by an ecosystem per unit area per unit time. It is of two types- primary and secondary.

Productivity at producers level is known as primary productivity. It is two types: Gross primary productivity is primary productivity including that amount which is utilized in respiration and other metabolic activities. Net primary productivity (NPP) is primary productivity in excess to that which is utilised in respiration and other metabolic activities.

$$NPP = GP - Respiration$$

Secondary productivity is productivity at consumers level. Since gross production includes total production including the amount utilized in respiration and other metabolic activities so it is more than other forms of productivity.

48. (a) : Stability can be defined as the power of a system to be in their state against unfavourable factors and resilience is the capability of regaining its original shape or position after being deformed. An ecosystem can be damaged easily and it must be having high resilience.

49. (a) : Trophic structure of ecosystem is a type of producer-consumer arrangement, in which each food level is called trophic level and the graphical representation of trophic structure of ecosystem constitutes ecological pyramids. The green plants are producers and represent the first trophic level (T_1). So bamboo plant is the first trophic level (T_1).

50. (a) : Microorganisms (bacteria and fungi) are decomposers of the ecosystem. They feed upon dead decaying living organisms (both plant and animals) and break them into simpler compounds. These are released free in the atmosphere and are utilized by producers for the synthesis of their food materials. They mainly belong to monera and fungi.

51. (c) : The benthic region includes all the sea floor from the wave-washed shore-line to the greatest depths. Depending upon the penetration of light it is subdivided into two main zones : the lighted or littoral zone and the deep sea system. Due to abundance of light, water, oxygen, carbon dioxide and less salinity of water, the tidal zone is characterized by exhorbitant growth of plants. The dense growth of vegetation, on the other hand, provides shelter and food for animals. A wide variety of algae, few grasses and animals of every phylum of animal kingdom are represented in this region.

52. (a) : *Refer to answer 16.*

53. (c) : In a terrestrial ecosystem maximum energy is in trophic level I because the organisms which trap solar energy are primary producers and they have got maximum energy. Only 10% energy is transferred from one trophic level to next trophic level.

54. (b)

55. (b) : Gross primary productivity is the total rate of photosynthesis, including the organic matter used up in respiration during the measurement period. Tropical evergreen/rainforests occur over equatorial/subequatorial regions with abundant warmth and rainfall (200–350 cm/yr) almost throughout the year. The forests are impenetrable (= jungle) with maximum diversity, *e.g.*, 200 types of trees in one hectare, 70–80% of all insects 80–85% of all birds. Productivity is maximum here, 12000 kcal/m^2/yr.

56. (b) : Microorganisms (bacteria and mould) are decomposers of the ecosystem. They feed upon dead decaying organisms (both plant and animals) and break them into simpler compounds. These are released free in the atmosphere and are utilized by producers for the synthesis of their food materials. They are called nature's scavengers as they are consumers of dead matter.

57. (a) : *Refer to answer 16.*

58. (a) : Decomposers are saprotrophs which decompose the organic remains by secreting extracellular digestive enzymes. They are also known as mineralisers as they release minerals trapped in organic remains. So in the absence of microorganisms the flow of minerals will stop.

59. (b)

60. (b) : *Refer to answer 8.*

61. (b) : Of all the ecosystems, ocean is the largest and most stable ecosystem. Aquatic life is protected from vigorous climates and weather that are climatic conditions, problem of water supply, food, fire and artificial forces such as industrialization, farming and grazing are lacking in the oceans. The sea is continuous and not separated as land and freshwater habitats.

62. (b) : When succession begins on an area which has not been previously being occupied by a community, *e.g.*, a new exposed rock area, sand dunes, new islands, deltas, shore or recent lava flow, it is known as primary succession. The first group of organisms (plants or animals) which become established in such an area is termed the pioneer community.

63. (b) : Trophic level is a step or division of food chain which is characterized by the method of obtaining its food. The two fundamental trophic levels are producers and consumers. Producers belong to the first trophic level. In a lake the producers are mainly some rooted or floating plants and phytoplanktons.

Primary consumers form the second trophic level. They feed on living plants or plant parts. The primary consumers are zooplanktons.

64. (c) : Pyramid of numbers is an ecological pyramid which employs the number of individuals per unit area at various trophic levels sequence wise with producers at the base and various consumers at successively higher levels. Pyramid of number assumes different shapes in different ecosystems. The pyramid of number in pond ecosystem is also upright. In forest ecosystem the pyramid of number is intermediate. Here, the number of primary consumers is more than producers as well as top consumers. In parasitic food chain the pyramid of number is inverted.

65. (c) : *Refer to answer 64.*

66. (b) : The dead organic matter of plants or animals is called as detritus. While a part of it remains on the soil surface as litter, the other part enters the soil. Many animals such as protozoans, nematodes, insects etc., depend on detritus and hence they are called as detritivores. Even the human beings are detritivores when they eat cooked food. From detritus, the chain proceeds to detritivores, then to carnivores and finally to top carnivores.

67. (c) : The process of transfer of energy from producers through a series of organisms, *i.e.*, from primary consumers to secondary consumers and from secondary consumers to tertiary consumers by process of eating and being eaten constitute a food chain. The correct food chain is :

Phytoplankton $\rightarrow$ Zooplankton $\rightarrow$ Fish

68. (b) : Pyramid of numbers in a grassland/tree ecosystem is always upright. It shows the number of individual organisms at each level. In a grassland, the producers, which are mainly grasses, are always maximum in number. This number then shows a decrease towards apex, primary consumers are lesser in number than the grasses; the secondary consumers are lesser in number than the primary consumers. Finally, the top consumers are least in number. Thus, the pyramid becomes upright.

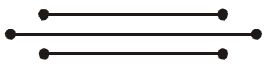
69. (a) : Planktons are passively floating in upper water, nektons are actively swimming while benthos lead sedentary life upon the sea bottom. Planktons are producers and are present in large number.

70. (c) : An ecosystem may be defined as a structural and functional unit of the biosphere comprising living organisms and their non-living environment that interact by means of food chains and chemical cycles resulting in energy flow, biotic diversity and material cycling to form a stable, self supporting system.

The organisms in an ecosystem are classified into 3 main categories-producers, consumers and decomposers. The consumers utilise materials and energy stored by the producers. Decomposers obtain their food molecules from the organic materials of dead producers and consumers. In a true ecosystem, producers are more than consumers (herbivores and carnivores).

71. (a) : The behaviour of energy in ecosystem can be termed energy flow due to unidirectional flow of energy. Flow of energy is only in one direction *i.e.*, from solar radiation $\rightarrow$ producers $\rightarrow$ herbivores $\rightarrow$ carnivores.

This energy cannot pass in the reverse direction. There is decrease in the content and flow of energy with rise in trophic level.



Chapter

37

Biodiversity and Conservation

1. Which one of the following is related to *ex situ* conservation of threatened animals and plants?
(a) Biodiversity hotspots
(b) Amazon rainforest
(c) Himalayan region
(d) Wildlife safari parks *(NEET 2017)*

2. Alexander von Humboldt described for the first time
(a) laws of limiting factor
(b) species area relationships
(c) population growth equation
(d) ecological biodiversity. *(NEET 2017)*

3. The region of biosphere reserve which is legally protected and where no human activity is allowed is known as
(a) buffer zone (b) transition zone
(c) restoration zone (d) core zone.
(NEET 2017)

4. How many hotspots of biodiversity in the world have been identified till date by Norman Myers?
(a) 17 (b) 25
(c) 34 (d) 43
(NEET-II 2016)

5. Which of the following is correctly matched?
(a) Aerenchyma – *Opuntia*
(b) Age pyramid – Biome
(c) *Parthenium hysterophorus* – Threat to biodiversity
(d) Stratification – Population
(NEET-II 2016)

6. Red list contains data or information on
(a) all economically important plants
(b) plants whose products are in international trade
(c) threatened species
(d) marine vertebrates only. *(NEET-II 2016)*

7. Which of the following national parks is home to the famous musk deer or hangul?
(a) Keibul Lamjao National Park, Manipur
(b) Bandhavgarh National Park, Madhya Pradesh
(c) Eaglenest Wildlife Sanctuary, Arunachal Pradesh
(d) Dachigam National Park, Jammu and Kashmir *(NEET-II 2016)*

8. Which is the national aquatic animal of India?
(a) Blue whale (b) Sea-horse
(c) Gangetic shark (d) River dolphin
(NEET-I 2016)

9. Which of the following is the most important cause of animals and plants being driven to extinction?
(a) Habitat loss and fragmentation
(b) Co-extinctions
(c) Over-exploitation
(d) Alien species invasion *(NEET-I 2016)*

10. The species confined to a particular region and not found elsewhere is termed as
(a) endemic (b) rare
(c) keystone (d) alien. *(2015)*

11. In which of the following, both pairs have correct combination?
(a) *In situ* conservation : Seed Bank
Ex situ conservation : National Park
(b) *In situ* conservation : Tissue culture
Ex situ conservation : Sacred groves
(c) *In situ* conservation : National Park
Ex situ conservation : Botanical Garden
(d) *In situ* conservation : Cryopreservation
Ex situ conservation : Wildlife Sanctuary
(2015 Cancelled)

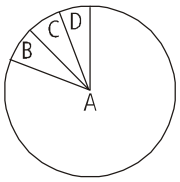
12. Cryopreservation of gametes of threatened species in viable and fertile condition can be referred to as
(a) *in situ* conservation by sacred groves
(b) *in situ* cryo-conservation of biodiversity
(c) *in situ* conservation of biodiversity
(d) advanced *ex situ* conservation of biodiversity.
(2015 Cancelled)

13. An example of *ex situ* conservation is
(a) national park (b) seed bank
(c) wildlife sanctuary (d) sacred grove.
(2014)

14. A species facing extremely high risk of extinction in the immediate future is called
(a) vulnerable (b) endemic
(c) critically endangered
(d) extinct. *(2014)*

15. The organization which publishes the Red list of species is
(a) ICFRE (b) IUCN
(c) UNEP (d) WWF. *(2014)*

16. Given below is the representation of the extent of global diversity of invertebrates. What groups the four portions (A-D) represent respectively?



	A	B	C	D
(a)	Insects	Crustaceans	Other animal groups	Molluscs
(b)	Crustaceans	Insects	Molluscs	Other animal groups
(c)	Molluscs	Other animal groups	Crustaceans	Insects
(d)	Insects	Molluscs	Crustaceans	Other animal groups

(2014)

17. Which one of the following is not used for *ex situ* plant conservation?
(a) Shifting cultivation (b) Botanical gardens
(c) Field gene banks (d) Seed banks
(NEET 2013)

18. Which of the following represent maximum number of species among global biodiversity?
(a) Fungi (b) Mosses and Ferns
(c) Algae (d) Lichens
(NEET 2013, 2012)

19. The largest tiger reserve in India is
(a) Valmiki
(b) Nagarjunasagar-Srisailam
(c) Periyar (d) Nagarhole.
(Karnataka NEET 2013)

20. Which of the following has maximum genetic diversity in India?
(a) Mango (b) Wheat
(c) Groundnut (d) Rice
(Karnataka NEET 2013, 2011)

21. Which organization publishes the 'Red Data Book'?
(a) IUCN (b) UNEP
(c) WWF (d) GEF
(Karnataka NEET 2013)

22. Which one of the following areas in India, is a hotspot of biodiversity?
(a) Eastern Ghats (b) Gangetic Plain
(c) Sunderbans (d) Western Ghats
(2012)

23. Select the correct statement about biodiversity.
(a) The desert areas of Rajasthan and Gujarat have a very high level of desert animal species as well as numerous rare animals.
(b) Large scale planting of Bt cotton has no adverse effect on biodiversity.
(c) Western ghats have a very high degree of species richness and endemism.
(d) Conservation of biodiversity is just a fad pursued by the developed countries.
(Mains 2012)

24. Sacred groves are specially useful in
(a) generating environmental awareness
(b) preventing soil erosion
(c) year-round flow of water in rivers
(d) conserving rare and threatened species.
(Mains 2012)

25. Which one of the following have the highest number of species in nature?
(a) Fungi (b) Insects
(c) Birds (d) Angiosperms
(2011)

26. Consider the following statements (A – D) each with one or two blanks.
(A) Bears go into (1) during winter to (2) cold weather.
(B) A conical age pyramid with a broad base represents (3) human population.
(C) A wasp pollinating a fig flower is an example of (4) .
(D) An area with high levels of species richness is known as (5) .

Which one of the following options, gives the correct fill ups for the respective blank numbers from (1) to (5) in the statements ?
(a) (3) - stable (4) - commensalism, (5) marsh
(b) (1) - aestivation, (2) - escape, (3) - stable, (4) - mutualism
(c) (3) - expanding, (4) - commensalism, (5) - biodiversity park
(d) (1) - hibernation, (2) - escape, (3) - expanding (5) - hotspot
(Mains 2011)

27. Biodiversity of a geographical region represents
(a) endangered species found in the region
(b) the diversity in the organisms living in the region
(c) genetic diversity in the dominant species of the region
(d) species endemic to the region.
(Mains 2011)

28. Study the four statements (i–iv) given below and select the two correct ones out of them.
(i) A lion eating a deer and a sparrow feeding on grains are ecologically similar in being consumers.
(ii) Predator star fish *Pisaster* helps in maintaining species diversity of some invertebrates.
(iii) Predators ultimately lead to the extinction of prey species.
(iv) Production of chemicals such as nicotine, strychnine by the plants are metabolic disorders.
The two correct statements are
(a) (ii) and (iii) (b) (iii) and (iv)
(c) (i) and (iv) (d) (i) and (ii).
(2010)

29. Which one of the following is an example of *ex situ* conservation?
(a) Wildlife sanctuary (b) Seed bank
(c) Sacred groves (d) National park
(2010)

30. The Indian rhinoceros is a natural inhabitant of which one of the Indian states?
(a) Uttarakhand (b) Uttar pradesh
(c) Himachal Pradesh (d) Assam
(Mains 2010)

31. Which one of the following has maximum genetic diversity in India?
(a) Mango (b) Wheat
(c) Tea (d) Teak
(2009)

32. Tiger is not a resident in which one of the following national parks?
(a) Sunderbans (b) Gir
(c) Jim Corbett (d) Ranthambhor
(2009)

33. The table below gives the populations (in thousands) of ten species (A-J) in four areas (p-s) consisting of the number of habitats given within brackets against each. Study the table and answer the question which follows.

Area and No. of habitats	Species, and their populations (in thousands) in the areas									
	A	B	C	D	E	F	G	H	I	J
p (11)	2.3	1.2	0.52	6.0	-	3.1	1.1	9.0	-	10.3
q (11)	10.2	-	0.62	-	1.5	3.0	-	8.2	1.1	11.2
r (13)	11.3	0.9	0.48	2.4	1.4	4.2	0.8	8.4	2.2	4.1
s (12)	3.2	10.2	11.1	4.8	0.4	3.3	0.8	7.3	11.3	2.1

Which area out of p - s shows maximum species diversity?
(a) s (b) p
(c) q (d) r *(2008)*

34. Which one of the following is not observed in biodiversity hotspots?
(a) Lesser inter-specific competition
(b) Species richness (c) Endemism
(d) Accelerated species loss *(2008)*

35. World Summit on Sustainable Development (2002) was held in
(a) Argentina (b) South Africa
(c) Brazil (d) Sweden. *(2008)*

36. Which one of the following pairs of organisms are exotic species introduced in India?
(a) *Lantana camara*, water hyacinth
(b) Water hyacinth, *Prosopis cinereria*
(c) Nile perch, *Ficus religiosa*
(d) *Ficus religiosa*, *Lantana camara* *(2007)*

37. Identify the odd combination of the habitat and the particular animal concerned.
(a) Sunderbans - Bengal Tiger
(b) Periyar - Elephant
(c) Rann of Kutch - Wild Ass
(d) Dachigam National Park - Snow Leopard
(2007)

38. One of the endangered species of Indian medicinal plants is that of
(a) *Ocimum* (b) garlic
(c) *Nepenthes* (d) *Podophyllum*.
(2007)

39. Which of the following is considered a hotspot of biodiversity in India?
(a) Aravalli hills (b) Western ghats
(c) Indo-gangetic plain (d) Eastern ghats
(2006)

40. Which of the following pairs of an animal and a plant represents endangered organisms in India?
(a) Banyan and black duck
(b) *Bentinckia nicobarica* and red panda
(c) Tamarind and rhesus monkey
(d) *Cinchona* and leopard *(2006)*

41. Which one of the following is not included under *insitu* conservation?
(a) National park (b) Sanctuary
(c) Botanical garden
(d) Biosphere reserve *(2006)*

42. Which one of the following is the correctly matched pair of an endangered animal and a national park?
(a) Great Indian bustard : Keoladeo National Park
(b) Lion : Corbett National Park
(c) Rhinoceros : Kaziranga National Park
(d) Wild ass : Dudhwa National Park *(2006)*

43. Biodiversity Act of India was passed by the Parliament in the year
(a) 1992 (b) 1996
(c) 2000 (d) 2002. *(2005)*

44. According to IUCN Red List, what is the status of Red Panda (*Ailurus fulgens*)?
(a) Critically endangered species
(b) Vulnerable species
(c) Extinct species
(d) Endangered species *(2005)*

45. In your opinion, which is the most effective way to conserve the plant diversity of an area?
(a) By tissue culture method
(b) By creating biosphere reserve
(c) By creating botanical garden
(d) By developing seed bank *(2004)*

46. Which group of vertebrates comprises the highest number of endangered species?
(a) Mammals (b) Fishes
(c) Reptiles (d) Birds *(2003)*

47. Which endangered animal is the source of the world's finest, lightest, warmest and most expensive wool – the shahtoosh ?
(a) Nilgai (b) Cheetal
(c) Kashmiri goat (d) Chiru *(2003)*

48. Wildlife is continuously decreasing. What is the main reason of this?
(a) Predation
(b) Cutting down of forest
(c) Destruction of habitat
(d) Hunting *(2002)*

49. Indri-indri lemur is found in
(a) Madagascar (b) Mauritius
(c) India (d) Sri Lanka. *(2000)*

50. Viable material of endangered species can be preserved by
(a) gene bank (b) gene library
(c) herbarium (d) gene pool. *(2000)*

51. Which of the following is mainly responsible for the extinction of wildlife?
(a) Pollution of air and water
(b) Hunting of flesh
(c) Destruction of habitats
(d) All of these *(1999)*

52. What is the major cause of diminishing wildlife number?
(a) Felling of trees
(b) Paucity of drinking water
(c) Cannibalism
(d) Habitat destruction *(1998)*

53. The breeding place of Flamingo (Hansawar) in India is most likely
(a) Runn of Kutch (b) Ghana Vihar
(c) Sambhar lake (d) Chilka lake. *(1996)*

54. The abundance of a species population, within its habitat, is called
(a) relative density (b) regional density
(c) absolute density (d) niche density. *(1995)*

55. Identify the correct match between tiger reserve and its state.
(a) Manas - Assam
(b) Corbett - Madhya Pradesh
(c) Bandipur - Tamil Nadu
(d) Palamu - Odisha *(1995)*

56. Which of the following is the matching pair of a sanctuary and its main protected wild animal?
(a) Kaziranga-Musk deer
(b) Gir-Lion
(c) Sunderban-Rhino
(d) All of these *(1995)*

57. The most important human activity, leading to the extinction of wildlife, is
(a) pollution of air and water
(b) hunting for valuable wildlife products
(c) introduction of alien species
(d) alteration and destruction of the natural habitats. *(1994)*

Answer Key

1.	(d)	**2.**	(b)	**3.**	(d)	**4.**	(c)	**5.**	(c)	**6.**	(c)	**7.**	(d)	**8.**	(d)	**9.**	(a)	**10.**	(a)
11.	(c)	**12.**	(d)	**13.**	(b)	**14.**	(c)	**15.**	(b)	**16.**	(d)	**17.**	(a)	**18.**	(a)	**19.**	(b)	**20.**	(d)
21.	(a)	**22.**	(d)	**23.**	(c)	**24.**	(d)	**25.**	(b)	**26.**	(d)	**27.**	(b)	**28.**	(d)	**29.**	(b)	**30.**	(d)
31.	(a)	**32.**	(b)	**33.**	(a)	**34.**	(a)	**35.**	(b)	**36.**	(a)	**37.**	(d)	**38.**	(d)	**39.**	(b)	**40.**	(b)
41.	(c)	**42.**	(c)	**43.**	(d)	**44.**	(d)	**45.**	(b)	**46.**	(a)	**47.**	(d)	**48.**	(c)	**49.**	(a)	**50.**	(a)
51.	(c)	**52.**	(d)	**53.**	(d)	**54.**	(d)	**55.**	(a)	**56.**	(b)	**57.**	(d)						

EXPLANATIONS

1. (d) : *Ex situ* conservation is conservation of selected rare or threatened animals and plants in places outside their natural homes. It includes offsite collections like botanical gardens, zoological parks, wildlife safari parks, etc., and gene banks.

2. (b) : Alexander von Humboldt described species area relationship for the first time. He observed that within a region, species richness increases with increasing explored area, but only upto a limit.

3. (d) : Core zone or Natural zone area of a biosphere reserve is undisturbed and legally protected ecosystem. No human activity is allowed in this zone. Little human activity is allowed in the buffer zone whereas in transition zone, an active cooperation is present between reserve management and local people for activities like settlements, cropping, etc. Restoration region is degraded area which is selected for restoration to near natural form.

4. (c) : Biodiversity hotspots are a method to identify those regions of the world where attention is needed to address biodiversity loss and to guide investments in conservation. The idea was first developed by Norman Myers in 1988 to identify tropical forests hotspots characterised both by exceptional levels of plant endemism and serious habitat loss which he then expanded to a more global scope. Currently 34 biodiversity hotspots have been identified most of which occur in tropical forests.

5. (c) : *Parthenium hysterophorus* is commonly known as congress grass or carrot weed. It is herbaceous annual plant of Family Asteraceae. It is a deadly invasive, noxious weed infesting cropped and non-cropped areas. It rapidly colonises area replacing the native vegetation and causes a number of human health related problems such as skin allergy, rhinitis and eye irritations. Also, being toxic and unpalatable it causes fodder scarcity. Hence, it is considered a threat to the biodiversity.

6. (c) : A red data book or red list is a catalogue of taxa facing risk of extinction. Red data book or red list was initiated in 1963.

7. (d)

8. (d) : River dolphin found in holy river Ganga, Brahmaputra, Indus and its tributaries is the National aquatic animal of India. Presence of river dolphin in Ganga indicates pure and freshwater.

9. (a) : Destruction of natural habitat causes the most serious threat to the biodiversity. Over-population, urbanisation and industrialisation lead to the destruction or fragmentation of natural habitats to fulfill the requirement of additional land. Loss of habitat results in annihilation of plants, microorganisms and forcing out of animals which in alien lands die out after some time. Fragmentation of habitats results in disruption of complex interactions amongst species, destruction of species in the cleared regions, annihilation of species restricted to deeper undisturbed parts of forests and decreased biodiversity in the habitat fragments.

10. (a)

11. (c) : *In situ* (on site) conservation is conservation and protection of the whole ecosystem and its biodiversity at all levels, in order to protect the threatened species. Two *in situ* methods are being used to save biodiversity *viz.*, hotspots and protected areas. Protected areas include national parks, sanctuaries, biosphere reserves and sacred groves. *Ex situ* (off site) conservation is conservation of selected rare plants/animals in places outside their natural homes. *Ex situ* conservation includes offsite collections, seed banks, gene banks, *in vitro* fertilization, cryopreservation techniques and tissue culture.

12. (d) : Cryopreservation is an advanced method of *ex situ* conservation. It involves preservation at –196°C in liquid nitrogen. It can maintain tissue culture, embryos, animal cells/tissues, spermatozoa indefinitely. The cryopreserved material is revived through special technique, when required.

13. (b) : *Refer to answer 11.*

14. (c) : The taxon under critically endangered category are facing very high risk of extinction in the wild and can become extinct at any moment in the immediate future.

15. (b) : IUCN is International Union of Conservation of Nature and Natural Resources which is now called World Conservation Union (WCU). It has its headquarters at Morges, Switzerland. It maintains a red data book or red list which is a catalogue of taxa facing risk of extinction. Red data book or red list was initiated in 1963. The Red list of year 2000 has made assessment of 18,000 species.

16. (d)

17. (a) : *Ex situ* conservation is conservation of selected rare plants/animals in places outside their natural homes. It includes botanical gardens or zoological parks, seed banks, cryopreservation, field gene banks and sacred plants. Many wild and domesticated species are well managed and collected in botanical gardens, zoological parks, wildlife safari parks, arboreta etc. Most of these have capture breeding programmes to restore the decreasing number of animals and helping the survival of existing individuals of the species. Gene banks are institutes that maintain stocks of viable seeds (seed banks), live plants (orchards), tissue culture and frozen germplasm with the whole range of genetic viability.

18. (a) : Fungi is a large kingdom of over 72,000 species. They are achlorophyllous, heterotrophic, spore forming, non-vascular, eukaryotic organisms which contain chitin or fungal cellulose in their walls and possess glycogen as food reserve. They are major decomposers of many ecosystems and are associate of many organisms.

19. (b) : Nagarjunasagar - Srisailam Tiger Reserve is the largest tiger reserve in India. It is present in Andhra Pradesh with a total area of 3568 km^2. The core area of this reserve is 1200 km^2.

20. (d) : Genetic diversity is the diversity in the numbers and types of genes as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. *Oryza sativa* (rice) has 32,000-50,000 genes.

21. (a) : *Refer to answer 15.*

22. (d) : Hotspots are areas with high density of biodiversity or megadiversity which are also the most threatened ones. Ecologically hotspots are determined by four factors – number of species/ species diversity, degree of endemism, degree of threat to habitat due to its degradation and fragmentation, and degree of exploitation. India has three hotspots : Indo-Burma, Himalayas and Western Ghats - Sri Lanka. India is even otherwise a country of megadiversity with 2.4% of land area and having 8.1% of global diversity. Major centres of biodiversity are Agasthyamalai hills, Silent valley and Amambalam reserve. There is high degree of endemism as well as richness of species of flowering plants, amphibians, reptiles, some mammals and butterflies.

23. (c) : *Refer to answer 22.*

24. (d) : Sacred grove is an example of *in situ* conservation of forests and wildlife especially rare and threatened species. These forest patches are found around places of worship which are held in high esteem by tribal communities. They are the most undisturbed forest patches which are often surrounded by highly degraded landscapes. Not a single branch is allowed to be cut from these forests. As a result many endemic species which are rare or have become extinct elsewhere can be seen to flourish here. Such sacred groves are found in Khasi and Jaintia hills of Meghalaya, Aravalli hills of Rajasthan, Western ghat regions of Karnataka, Maharashtra, Sarguja, Chanda and Bastar areas of Madhya Pradesh.

25. (b) : Insects have highest number of species found in nature. The insecta is the largest class of animals. It has over 7,00,000 species. The insects are the most successful land invertebrates and the only major competitors with humans for dominance in the world.

26. (d)

27. (b) : Biodiversity (biological diversity) is the existence of a wide variety of species (species diversity) or other taxa of plants, animals and microorganisms in a natural community or habitat, or of communities within a particular environment (ecological diversity), or of genetic variation within a species (genetic diversity). The maintenance of a high level of biodiversity is important for the stability of ecosystems.

28. (d) : Predator and prey evolve together. The prey is part of the predator's environment, and the predator dies if it does to get food, so it evolves whatever is necessary in order to eat the prey. Likewise, the predator is part of the prey's environment, and the prey dies if it is eaten by the predator, so it evolves whatever is necessary to avoid being eaten. So, predators cannot lead to the extinction of prey species.

Nicotine is an alkaloid found in the night shade family of plants (Solanaceae) that constitutes approximately 0.6–3.0% of dry weight of tobacco, with biosynthesis taking place in the roots and accumulation occurring in the leaves. Strychnine is an alkaloid plant toxin extracted chiefly from *Nux vomica*; formerly used as a stimulant. These are not metabolic disorder products but are metabolic wastes.

29. (b) : *Refer to answer 17.*

30. (d) : The Indian rhinoceros is a endemic of north-east region of India. Kaziranga National Park (Assam) is famous for rhinoceros.

31. (a)

32. (b) : Gir National Park is situated in district Junagarh of Gujarat. This national park is famous for Asiatic lion. Beside lion, panther, striped hyaena, sambhar, nilgai, cheetal are also conserved.

33. (a) : Species diversity is related to the variety in the number and richness of the species within a region and is measured at the level of 'species'. Thus, it is the product of species richness and species evenness. Species richness refers to the number of species per unit area. As the area of the site increases, the number of species also increases due to more availability of natural resources. Species evenness is the relative abundance with which each species is represented in an area. Thus, variation in the number of species, kinds of species as well as the number of individuals per species lead to greater diversity. In the given table, the area which shows maximum species diversity is 's'.

34. (a)

35. (b) : Conservation of biodiversity is a collective responsibility of all nations. The historic Convention on Biological Diversity ('The Earth Summit') held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits. In a follow-up, the World Summit on Sustainable Development held in 2002 in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant reduction in the current rate of biodiversity loss at global, regional and local levels.

36. (a) : In India, large variety of exotic animal and plant species have been introduced from other parts of the world through the ages. Some exotic plants have turned into weeds, multiplying fast and causing harm to the ecosystem, *e.g.* water hyacinth and *Lantana camara*.

37. (d) : Dachigam National Park is located only 22 kilometers from Srinagar, the capital city of the northern state of Jammu and Kashmir. Dachigam is considered home to some of the unique Himalayan range of flora and fauna. Primary amongst them is the hangul or Kashmiri stag, the most endangered species of red deer in the world. It was finally upgraded and declared a National Park in the year 1981.

38. (d) : An endangered species is a population of an organism which are at risk of becoming extinct because it is either a few in number or threatened by changing environmental or predation parameters. *Podophyllum* is such an endangered species of Indian medicinal plants. They contain, podophyllotoxin and podophyllin that is used as a purgative and as a cytostatic. They are also grown as ornamental plants for their attractive foliage and flowers. Extracts of plants are used for genital warts and some skin cancers.

39. (b) : *Refer to answer 22.*

40. (b) : An endangered species is a living organism in danger of disappearing from the face of the earth if it is not protected and its situation is not improved. Red panda (*Ailurus fulgens*) and *Bentinckia nicobarica* are endangered organisms of India. The red panda (*Ailurus fulgens*) faces problems with human encroachment into its habitat. *Bentinckia nicobarica* is a fast-growing, slender and elegant, pinnate palm from the Nicobar Islands in the Andaman Sea, North of Sumatra.

41. (c) : *In situ* conservation means "on-site conservation". *In situ* conservation is the protection and management of important components of biological diversity through a network of protected areas *e.g.*, National Park, sanctuary, biosphere reserve, etc. Botanical gardens come under *ex situ* conservation.

42. (c) : Kaziranga National Park of Assam is known for the conservation of rhinoceros.

43. (d) : Biodiversity Act of India provides for conservation of biological diversity, substainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected there with or incidental there to. The biodiversity act of India was passed in 2002. This act of parliament received the assent of President of India on the 5th February 2003.

44. (d) : According to IUCN Red list, the status of Red panda (*Ailurus fulgens*) is endangered species. Endangered species are those species that are facing a very high risk of extinction in the wild in the near future. This category is used when the species suffered a population reduction of 80% or more.

Vulnerable species have sufficient population at present but are depleting fast. *e.g.*, Golden langur, leopard cat. Extinct species no longer exist, *e.g.*, Dodo. Critically endangered species are threatened to a greater extent.

45. (b) : Biosphere reserves are multipurpose protected areas of different representative ecosystems which are meant for conservation of

biodiversity or wildlife, traditional life style of tribals and their domesticated animals and also plant resources. Each biosphere reserve has a core zone (where no human activity is allowed), a buffer zone (with limited human activity) and manipulation zone (where human activity is allowed without degradation of ecology. Thus, the biosphere reserves protect not just wild varieties but also domesticated varieties of plants of an area.

46. (a) : IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrate species, 359 invertebrate species and 87 plant species) in the last 500 years. On worldwide basis, more than 15,500 species are facing the threat of extinction. At present, 12% of the bird species, 23% of mammal species, 32% of amphibian species and 31% of gymnosperm species are facing the threat of extinction in the world. Several endangered mammalian species are *Panthera pandus* (Leopard), *Panthera leo persica* (Lion), *Presbytis pilaetus* (capped langur) etc.

47. (d) : Chiru or the Tibetan antelope (*Pantholops hodgsoni*) is medium-sized bovid which is about 1.2 m in height. Its coat is grey to reddish brown, with a white underside. The Chiru's wool, known as the shahtoosh, is worm, soft and fine. The wool can only be obtained by killing the animal. It is listed as endangered by the world conservation union and the United States Fish and Wildlife Service due to commercial poaching for its wool.

48. (c) : Wildlife refers to all living organisms (terrestrial, aquatic and aerial) living in all possible natural habitats of their own, other than the cultivated plants and domesticated animals. Thus "wildlife" does not exist only in jungles and are hunted down but wild life includes even the migrating birds, turtles, coral reefs, microorganisms, insects, fishes, etc.

Several hundred organisms are endangered or on the verge of extinction. The reasons are deforestation, pollution, killing, over exploitation etc. The most important among them is deforestation or destruction of their natural habitat because it will affect the species (flora and fauna) of complete area and not only the few organisms. The natural habitat may be destroyed by man for his settlements, grazing grounds, agriculture, mining, industries, dam building etc. As a consequence of this, the species must adapt to the changes, move elsewhere or may succumb to predation, starvation or disease, and eventually dies.

49. (a) : Indri-indri lemur is found in Madagascar. It is the largest of all surviving lemurs and is best known for its beautiful song which can carry for more than 2 km. Today, the Indri's number is small and dwindling due to habitat loss.

50. (a) : Viable material of endangered species can be preserved by gene bank. Gene bank is an institute that maintains stocks of viable seeds (seed banks), live growing plants (orchards), tissue culture and frozen germplasm with the whole range of genetic variability.

51. (c)

52. (d) : *Refer to answer 48.*

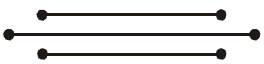
53. (d) : Flamingoes are protected in Chilka lake, Odisha. Other important birds protected are water fowls, ducks, cranes, golden plovers, sandpipers etc.

54. (d)

55. (a) : Manas biosphere reserve is located in Assam. Corbett National Park is located in district Nainital of Uttaranchal. Bandipur National Park is located in district Mysore of Karnataka. Palamu is located in Chhotanagpur, Jharkhand.

56. (b)

57. (d) : *Refer to answer 48.*



Chapter
38

Environmental Issues

1. Which one of the following statements is not valid for aerosols?
(a) They alter rainfall and monsoon patterns.
(b) They cause increased agricultural productivity.
(c) They have negative impact on agricultural land.
(d) They are harmful to human health.
(NEET 2017)

2. Biochemical Oxygen Demand (BOD) may not be a good index for pollution for water bodies receiving effluents from
(a) domestic sewage
(b) dairy industry
(c) petroleum industry
(d) sugar industry. *(NEET-II 2016)*

3. A lake which is rich in organic waste may result in
(a) increased population of aquatic organisms due to minerals
(b) drying of the lake due to algal bloom
(c) increased population of fish due to lots of nutrients
(d) mortality of fish due to lack of oxygen.
(NEET-II 2016)

4. The highest DDT concentration in aquatic food chain shall occur in
(a) phytoplankton (b) seagull
(c) crab (d) eel.
(NEET-II 2016)

5. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancers?
(a) Ammonia (b) Methane
(c) Nitrous oxide (d) Ozone
(NEET-I 2016)

6. Joint Forest Management Concept was introduced in India during
(a) 1980s (b) 1990s
(c) 1960s (d) 1970s.
(NEET-I 2016)

7. A river with an inflow of domestic sewage rich in organic waste may result in
(a) an increased production of fish due to biodegradable nutrients
(b) death of fish due to lack of oxygen
(c) drying of the river very soon due to algal bloom
(d) increased population of aquatic food web organisms. *(NEET-I 2016)*

8. Acid rain is caused by increase in the atmospheric concentration of
(a) CO_2 and CO (b) O_3 and dust
(c) SO_2 and NO_2 (d) SO_3 and CO.
(2015)

9. Eutrophication of water bodies leading to killing of fishes is mainly due to non-availability of
(a) essential minerals (b) oxygen
(c) food (d) light. *(2015)*

10. The UN Conference of Parties on climate change in the year 2012 was held at
(a) Lima (b) Warsaw
(c) Durban (d) Doha. *(2015)*

11. Which of the following are most suitable indicators of SO_2 pollution in the environment?
(a) Algae (b) Fungi
(c) Lichens (d) Conifers *(2015)*

12. Increase in concentration of the toxicant at successive trophic levels is known as
(a) biotransformation
(b) biogeochemical cycling
(c) biomagnification
(d) biodeterioration. *(2015)*

13. The UN Conference of Parties on climate change in the year 2011 was held in
(a) Peru (b) Qatar
(c) Poland (d) South Africa.
(2015 Cancelled)

14. Which of the following is not one of the prime health risks associated with greater UV radiations through the atmosphere due to depletion of stratospheric ozone?
(a) Damage to eyes
(b) Increased liver cancer
(c) Increased skin cancer
(d) Reduced Immune System
(2015 Cancelled)

15. High value of BOD (Biochemical Oxygen Demand) indicates that
(a) water is less polluted
(b) consumption of organic matter in the water is higher by the microbes
(c) water is pure
(d) water is highly polluted. *(2015 Cancelled)*

16. Rachel Carson's famous book "*Silent Spring*" is related to
(a) population explosion
(b) ecosystem management
(c) pesticide pollution
(d) noise pollution. *(2015 Cancelled)*

17. A location with luxuriant growth of lichens on the trees indicates that the
(a) trees are very healthy
(b) trees are heavily infested
(c) location is highly polluted
(d) location is not polluted. *(2014)*

18. The zone of atmosphere in which the ozone layer is present is called
(a) ionosphere (b) mesosphere
(c) stratosphere (d) troposphere. *(2014)*

19. A scrubber in the exhaust of a chemical industrial plant removes
(a) gases like sulphur dioxide
(b) particulate matter of the size 5 micrometer or above
(c) gases like ozone and methane
(d) particulate matter of the size 2.5 micrometer or less. *(2014)*

20. Kyoto protocol was endorsed at
(a) CoP - 6 (b) CoP - 4
(c) CoP - 3 (d) CoP - 5. *(NEET 2013)*

21. Global warming can be controlled by
(a) increasing deforestation, slowing down the growth of human population
(b) increasing deforestation, reducing efficiency of energy usage
(c) reducing deforestation, cutting down use of fossil fuel
(d) reducing reforestation, increasing the use of fossil fuel. *(NEET 2013)*

22. The Air Prevention and Control of Pollution Act came into force in
(a) 1985 (b) 1990
(c) 1975 (d) 1981. *(NEET 2013)*

23. The second commitment period for Kyoto Protocol was decided at
(a) Durban (b) Bali
(c) Doha (d) Cancun. *(Karnataka NEET 2013)*

24. Climate of the world is threatened by
(a) decreasing amount of atmospheric oxygen
(b) increasing amount of atmospheric carbon dioxide
(c) decreasing amount of atmospheric carbon dioxide
(d) increasing concentration of atmospheric oxygen. *(Karnataka NEET 2013)*

25. Which one of the following is not correct with regard to the harmful effects of particulate matter of the size 2.5 micrometer or less?
(a) It can cause respiratory problems.
(b) It can directly enter into our circulatory system.
(c) It can cause inflammation and damage to the lungs.
(d) It can be inhaled into the lungs. *(Karnataka NEET 2013)*

26. In an area where DDT had been used extensively, the population of birds declined significantly because
(a) birds stopped laying eggs
(b) earthworms in the area got eradicated
(c) cobras were feeding exclusively on birds
(d) many of the birds eggs laid, did not hatch. *(2012)*

27. Which one of the following is a wrong statement?
(a) Most of the forests have been lost in tropical areas.
(b) Ozone in upper part of atmosphere is harmful to animals.
(c) Greenhouse effect is a natural phenomenon.
(d) Eutrophication is a natural phenomenon in freshwater bodies. *(2012)*

28. Measuring Biochemical Oxygen Demand (BOD) is a method used for
(a) estimating the amount of organic matter in sewage water
(b) working out the efficiency of oil driven automobile engines
(c) measuring the activity of *Saccharomyces cerevisiae* in producing curd on a commercial scale
(d) working out the efficiency of RBCs about their capacity to carry oxygen. *(2012)*

29. Eutrophication is often seen in
(a) deserts (b) fresh water lakes
(c) ocean (d) mountains. *(2011)*

30. Which one of the following pairs of gases are the major cause of "greenhouse effect"?
(a) CO_2 and O_3 (b) CO_2 and CO
(c) CFCs and SO_2 (d) CO_2 and N_2O
(2011)

31. Which one of the following statements is incorrect in case of Bhopal tragedy?
(a) Methyl isocyanate gas leakage took place.
(b) Thousands of human beings died.
(c) Radioactive fall out engulfed Bhopal.
(d) It took place in the night of December 2/3, 1984. *(2011)*

32. Which one of the following is correct expanded form of the acronym?
(a) IPCC = International Panel for Climate Change
(b) UNEP = United Nations Environmental Policy
(c) EPA = Environmental Pollution Agency
(d) IUCN = International Union for Conservation of Nature and Natural Resources *(2011)*

33. "Good ozone" is found in the
(a) mesosphere (b) troposphere
(c) stratosphere (d) ionosphere.
(Mains 2011)

34. A renewable exhaustible natural resource is
(a) coal (b) petroleum
(c) minerals (d) forest. *(2010)*

35. dB is a standard abbreviation used for the quantitative expression of
(a) the density of bacteria in a medium
(b) a particular pollutant
(c) the dominant *Bacillus* in a culture
(d) a certain pesticide. *(2010)*

36. The two gases making highest relative contribution to the greenhouse gases are
(a) CO_2 and CH_4 (b) CH_4 and N_2O
(c) CFCs and N_2O (d) CO_2 and N_2O.
(2010)

37. When domestic sewage mixes with river water
(a) small animals like rats will die after drinking river water
(b) the increased microbial activity releases micronutrients such as iron
(c) the increased microbial activity uses up dissolved oxygen
(d) the river water is still suitable for drinking as impurities are only about 0.1%.
(Mains 2010)

38. Global agreement in specific control strategies to reduce the release of ozone depleting substances, was adopted by
(a) Montreal Protocol
(b) Kyoto Protocol
(c) Vienna Convention
(d) Rio de Janeiro Conference. *(2009)*

39. Biochemical oxygen demand (BOD) in a river water
(a) has no relationship with concentration of oxygen in the water
(b) gives a measure of *Salmonella* in the water
(c) increases when sewage gets mixed with river water
(d) remains unchanged when algal bloom occurs.
(2009)

40. Steps taken by the Government of India to control air pollution include
(a) compulsory PUC (Pollution under control) certification of petrol driven vehicles which tests for carbon monoxide and hydrocarbons
(b) permission to use only pure diesel with a maximum of 500 ppm sulphur as fuel for vehicles
(c) use of non-polluting compressed natural gas (CNG) only as fuel by all buses and trucks
(d) compulsory mixing of 20% ethyl alcohol with petrol and 20% biodiesel with diesel.
(2009)

41. Montreal Protocol aims at
(a) biodiversity conservation
(b) control of water pollution
(c) control of CO_2 emission
(d) reduction of ozone depleting substances.
(2009)

42. DDT residues are rapidly passed through food chain causing biomagnification because DDT is
(a) moderately toxic
(b) non-toxic to aquatic animals
(c) water soluble
(d) lipo soluble. *(2009)*

43. Chipko movement was launched for the protection of
(a) forests (b) livestock
(c) wetlands (d) grasslands. *(2009)*

44. A lake near a village suffered heavy mortality of fishes within a few days. Consider the following reasons for this.
A. Lots of urea and phosphate fertilizer were used in the crops in the vicinity.
B. The area was sprayed with DDT by an aircraft.
C. The lake water turned green and stinky.
D. Phytoplankton populations in the lake declined initially there by greatly reducing photosynthesis.

Which two of the above were the main causes of fish mortality in the lake?
(a) A, C (b) A, B
(c) B, C (d) C, D *(2008)*

45. According to Central Pollution Control Board (CPCB), which particulate size in diameter (in micrometers) of the air pollutants is responsible for greatest harm to human health?
(a) 1.0 or less (b) 5.2 - 2.5
(c) 2.5 or less (d) 1.5 or less *(2008)*

46. Which one of the following is the correct percentage of the two (out of the total of 4) green house gases that contribute to the total global warming?
(a) N_2O 6%, CO_2 86%
(b) methane 20%, N_2O 18%
(c) CFCs 14%, methane 20%
(d) CO_2 40%, CFCs 30% *(2008)*

47. In which one of the following the BOD (Biochemical Oxygen Demand) of sewage (S), distillery effluent (DE), paper mill effluent (PE) and sugar mill effluent (SE) have been arranged in ascending order?
(a) SE < PE < S < DE (b) PE < S < SE < DE
(c) S < DE < PE < SE (d) SE < S < PE < DE *(2007)*

48. In a coal fired power plant electrostatic precipitators are installed to control emission of
(a) NO_X (b) SPM
(c) CO (d) SO_2. *(2007)*

49. Which one of the following statements is correct?
(a) Both *Azotobacter* and *Rhizobium* fix atmospheric nitrogen in root nodules of plants.
(b) Cyanobacteria such as *Anabaena* and *Nostoc* are important mobilizers of phosphates and for plant nutrition in soil.
(c) At present it is not possible to grow maize without chemical fertilizers.
(d) Extensive use of chemical fertilizers may lead to eutrophication of nearby water bodies. *(2007)*

50. Which one of the following is not a bioindicator of water pollution?
(a) Blood-worms (b) Stone flies
(c) Sewage fungus (d) Sludge-worms *(2007)*

51. Limit of BOD prescribed by Central Pollution Control Board for the discharge of industrial and municipal waste waters into natural surface waters, is
(a) < 30 ppm (b) < 3.0 ppm
(c) < 10 ppm (d) < 100 ppm. *(2006)*

52. Photochemical smog pollution does not contain
(a) PAN (peroxyacyl nitrate)
(b) ozone
(c) nitrogen dioxide
(d) carbon dioxide. *(2006)*

53. Montreal protocol which calls for appropriate action to protect the ozone layer from human activities was passed in the year
(a) 1985 (b) 1986
(c) 1987 (d) 1988. *(2006)*

54. Prolonged liberal irrigation of agricultural fields is likely to create the problem of
(a) acidity (b) aridity
(c) salinity (d) metal toxicity. *(2005)*

55. Which one of the following is not used for disinfection of drinking water?
(a) Chlorine (b) Ozone
(c) Chloramine (d) Phenyl *(2005)*

56. Identify the correctly matched pair.
(a) Basal convention - Biodiversity conservation
(b) Kyoto protocol - Climatic change
(c) Montreal protocol - Global warming
(d) Ramsar convention - Ground water pollution *(2005)*

57. Which one of the following pairs is mismatched?
(a) Fossil fuel burning - release of CO_2
(b) Nuclear power - radioactive wastes
(c) Solar energy - greenhouse effect
(d) Biomass burning - release of CO_2 *(2005)*

58. In 1984, the Bhopal gas tragedy took place because methyl isocyanate
(a) reacted with DDT
(b) reacted with ammonia
(c) reacted with CO_2
(d) reacted with water. *(2004)*

59. Lead concentration in blood is considered alarming if it is
(a) 20 mg / 100 ml (b) 30 mg / 100 ml
(c) 4 - 6 mg / 100 ml (d) 10 mg / 100 ml. *(2004)*

60. Common indicator organism of water pollution is
(a) *Lemna pancicostata*
(b) *Eichhornia crassipes*
(c) *Escherichia coli*
(d) *Entamoeba histolytica*. *(2004)*

61. Fluoride pollution mainly affects
(a) brain (b) heart
(c) teeth (d) kidney. *(2003)*

62. *Escherichia coli* is used as an indicator organism to determine pollution of water with
(a) heavy metals (b) faecal matter
(c) industrial effluents
(d) pollen of aquatic plants. *(2003)*

63. Which of the following is absent in polluted water?
(a) *Hydrilla* (b) Water hyacinth
(c) Larva of stone fly (d) Blue green algae *(2002)*

64. Maximum green house gas released by which of the following country?
(a) India (b) France
(c) USA (d) Britain *(2002)*

65. What is B.O.D.?
(a) The amount of O_2 utilised by organisms in water.
(b) The amount of O_2 utilised by micro-organisms for decomposition.
(c) The total amount of O_2 present in water.
(d) All of the above *(2001)*

66. What is the intensity of sound in normal conversation?
(a) 10-20 dB (b) 30-60 dB
(c) 70-90 dB (d) 120-150 dB *(2001)*

67. Which is the result of damage to relative biological effectiveness?
(a) High temperature (b) Pollution
(c) Radiation (d) Low temperature *(2000)*

68. The Minamata disease in Japan was caused through the pollution of water by
(a) cyanide (b) methyl isocyanate
(c) lead (d) mercury. *(1999)*

69. D.D.T. is
(a) not a pollutant (b) an antibiotic
(c) a non-degradable pollutant
(d) a biodegradable pollutant. *(1999)*

70. Which of the following organism is likely to have more concentration of D.D.T. in its body?
(a) Top carnivores (b) Primary producers
(c) Herbivores (d) Carnivores *(1999)*

71. Which of the following is pollution related disorder?
(a) Silicosis (b) Pneumonicosis
(c) Fluorosis (d) Leprosis *(1999)*

72. In 1984, Bhopal gas tragedy was caused due to leakage of
(a) potassium isocyanate
(b) methyl isocyanate
(c) sodium monoxide
(d) none of these. *(1999)*

73. Which of the following is a secondary pollutant?
(a) PAN (b) Aerosol
(c) CO (d) CO_2 *(1999)*

74. The maximum biomagnification would be in which of the following in case of aquatic ecosystem?
(a) Zooplanktons (b) Phytoplanktons
(c) Fishes (d) Birds *(1999)*

75. Which of the following is the use of lichens in case of pollution?
(a) They promote pollution.
(b) Lichens are not related with pollution.
(c) They treat the polluted water.
(d) They act as bioindicators of pollutions. *(1999)*

76. The supersonic jets cause pollution by the thinning of
(a) O_2 layer (b) O_3 layer
(c) CO_2 layer (d) SO_2 layer. *(1998)*

77. Which one of the following organisms is used as indicator of water quality?
(a) *Azospirillum* (b) *Escherichia*
(c) *Biggiata* (d) *Chlorella* *(1998)*

78. If there was no CO_2 in the earth's atmosphere, the temperature of earth's surface would be
(a) higher than the present
(b) dependent on the amount of oxygen in the atmosphere
(c) same as present
(d) less than the present. *(1998)*

79. Carbon monoxide is a pollutant because
(a) reacts with haemoglobin
(b) makes nervous system inactive
(c) it reacts with O_2
(d) it inhibits glycolysis. *(1998)*

80. How carbon monoxide, emitted by automobiles, prevents transport of oxygen in the body tissues?
(a) By forming a stable compound with haemoglobin
(b) By obstructing the reaction of oxygen with haemoglobin
(c) By changing oxygen into carbon dioxide
(d) By destroying the haemoglobin *(1998)*

81. The most common indicator organism that represents polluted water is
(a) *C.vibrio*
(b) *Entamoeba histolytica*
(c) *E.coli*
(d) *P.typhi*. *(1997)*

82. In coming years, skin related disorders will be more common due to
(a) water pollution
(b) depletion of ozone layer
(c) pollutants in air
(d) use of detergents. *(1997)*

83. MAB stands for
(a) mammals and biosphere
(b) mammals and biology programme
(c) man and biology programme
(d) man and biosphere programme. *(1997)*

84. Formation of ozone hole is maximum over
(a) Europe (b) Africa
(c) India (d) Antarctica. *(1997)*

85. Phosphate pollution is caused by
(a) sewage and phosphate rock
(b) sewage and agricultural fertilizers
(c) phosphate rock only
(d) agricultural fertilizers only. *(1997)*

86. The true statement about 'green-house effect' is that it is
(a) caused by combination of many gases
(b) caused only by CO_2
(c) caused by CO_2, CFC, CH_4 and NO_2 gases
(d) none of these. *(1996)*

87. Which country has the greatest contribution for the hole formation in ozone layer?
(a) Russia (b) Japan
(c) USA (d) Germany *(1996)*

88. The two great industrial tragedies namely, MIC and Chernobyl tragedies respectively occurred where and at which time?
(a) Bhopal 1984, Ukrain 1986
(b) Bhopal 1986, Russia 1988
(c) Bhopal 1984, Ukrain 1990
(d) Bhopal 1984, Ukrain 1988 *(1996)*

89. If we uncover half of the forest covering the earth, what crisis will be produced at most and at first?
(a) Some species will be extinct
(b) Population and ecological imbalance will rise up
(c) Energy crisis will occur
(d) Rest half forests will maintain this imbalance *(1996)*

90. When huge amount of sewage is dumped into a river, its B.O.D. will
(a) slightly decrease
(b) remain unchanged
(c) increase
(d) decrease. *(1995)*

91. The Taj Mahal is threatened due to the effect of
(a) oxygen (b) hydrogen
(c) chlorine (d) sulphur-dioxide. *(1995)*

92. In Minamata Bay Japan the animals which remained free from minamata disease, are
(a) dogs (b) cats
(c) pigs (d) rabbits. *(1995)*

93. The toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen approximately by
(a) 200 times (b) 1000 times
(c) 2 times (d) 20 times. *(1995)*

94. Which of the following isotopes is most dangerous to *Homo sapiens*?
(a) Phosphorus-32 (b) Strontium-90
(c) Cesium-137 (d) Iodine-131 *(1995)*

95. A dental disease characterized by mottling of teeth is due to the presence of certain chemical element in drinking water. Which of the following is that element?
(a) Fluorine (b) Boron
(c) Mercury (d) Chlorine *(1995)*

96. Which of the following is the main factor of desertification?
(a) Over-grazing (b) Tourism
(c) Irrigated agriculture (d) All of these *(1995)*

97. Which among the following is likely to have the highest levels of D.D.T. depositions in its body?
(a) Sea gull (b) Phytoplankton
(c) Eel (d) Crab *(1994)*

98. Which one of the following gases contributes maximum to the 'green house effect' on the earth?
(a) Carbon dioxide
(b) Chlorofluorocarbon
(c) Freon
(d) Methane *(1994)*

99. Sounds above what level are considered hazardous noise pollution?
(a) Above 80 dB (b) Above 30 dB
(c) Above 150 dB (d) Above 120 dB *(1994)*

100. A disease caused by eating fish contaminated by industrial waste, containing mercury compounds, is called
(a) osteosclerosis
(b) Hashimoto's oxidase
(c) Bright's disease
(d) Minimata disease. *(1994)*

101. Ultraviolet radiations from sunlight causes a reaction that produces
(a) fluorides (b) carbon monoxide
(c) sulphur dioxide (d) ozone. *(1993)*

102. American water plant that has become a troublesome water weed in India is
(a) *Cyperus rotundus*
(b) *Eichhornia crassipes*
(c) *Typha latifolia*
(d) *Trapa bispinosa*. *(1993)*

103. Most hazardous metal pollutant of automobile exhausts is
(a) mercury (b) cadmium
(c) lead (d) copper. *(1992)*

104. Petroleum is a
(a) synthetic product
(b) renewable resource
(c) nonrenewable resource
(d) inconvenient resource. *(1992)*

105. Minerals and metals are
(a) biodegradable resources
(b) renewable
(c) non-renewable
(d) renewable and nonrenewable resources. *(1992)*

106. Which one is not a pollutant normally?
(a) Hydrocarbon (b) Carbon dioxide
(c) Carbon monoxide (d) Sulphur dioxide *(1992, 1988)*

107. Domestic waste constitutes
(a) nonbiodegradable pollution
(b) biodegradable pollution
(c) effluents
(d) air pollution. *(1991)*

108. Acid rain is due to increase in atmospheric concentration of
(a) ozone and dust (b) CO_2 and CO
(c) SO_3 and CO (d) SO_2 and NO_2. *(1991)*

109. Greenhouse effect is warming due to
(a) infra-red rays reaching earth
(b) moisture layer in atmosphere
(c) increase in temperature due to increase in carbon dioxide concentration of atmosphere
(d) ozone layer of atmosphere. *(1991, 1989)*

110. Major aerosol pollutant in jet plane emission is
(a) sulphur dioxide (b) carbon monoxide
(c) methane (d) fluorocarbon. *(1990)*

111. Gas released during Bhopal tragedy was
(a) methyl isocyanate
(b) potassium isothiocyanate
(c) sodium isothiocyanate
(d) ethyl isothiocyante. *(1990)*

112. Deforestation will decrease
(a) soil erosion (b) land slides
(c) soil fertility (d) rainfall. *(1990)*

113. Soil conservation is
(a) conversion of sterile soil into fertile one
(b) aeration of soil (c) erosion of soil
(d) protection against loss. *(1989)*

114. Acid rains are produced by
(a) excess NO_2 and SO_2 from burning fossil fuels
(b) excess production of NH_3 by industry and coal gas
(c) excess release of carbon monoxide by incomplete combustion
(d) excess formation of CO_2 by combustion and animal respiration. *(1989, 1988)*

Answer Key

1.	(b)	**2.**	(c)	**3.**	(d)	**4.**	(b)	**5.**	(d)	**6.**	(a)	**7.**	(b)	**8.**	(c)	**9.**	(b)	**10.**	(d)
11.	(c)	**12.**	(c)	**13.**	(d)	**14.**	(b)	**15.**	(b,d)	**16.**	(c)	**17.**	(d)	**18.**	(c)	**19.**	(a)	**20.**	(c)
21.	(c)	**22.**	(d)	**23.**	(c)	**24.**	(b)	**25.**	(b)	**26.**	(d)	**27.**	(b)	**28.**	(a)	**29.**	(b)	**30.**	(d)
31.	(c)	**32.**	(d)	**33.**	(c)	**34.**	(d)	**35.**	(b)	**36.**	(a)	**37.**	(c)	**38.**	(a)	**39.**	(c)	**40.**	(a)
41.	(d)	**42.**	(d)	**43.**	(a)	**44.**	(b)	**45.**	(c)	**46.**	(c)	**47.**	(b)	**48.**	(b)	**49.**	(d)	**50.**	(b)
51.	(a)	**52.**	(d)	**53.**	(c)	**54.**	(c)	**55.**	(d)	**56.**	(b)	**57.**	(c)	**58.**	(d)	**59.**	(b)	**60.**	(c)
61.	(c)	**62.**	(b)	**63.**	(c)	**64.**	(c)	**65.**	(b)	**66.**	(b)	**67.**	(b)	**68.**	(d)	**69.**	(c)	**70.**	(a)
71.	(c)	**72.**	(b)	**73.**	(a)	**74.**	(c)	**75.**	(d)	**76.**	(b)	**77.**	(b)	**78.**	(d)	**79.**	(a)	**80.**	(a)
81.	(c)	**82.**	(b)	**83.**	(d)	**84.**	(d)	**85.**	(b)	**86.**	(c)	**87.**	(c)	**88.**	(a)	**89.**	(a)	**90.**	(c)
91.	(d)	**92.**	(d)	**93.**	(a)	**94.**	(b)	**95.**	(a)	**96.**	(a)	**97.**	(a)	**98.**	(a)	**99.**	(d)	**100.**	(d)
101.	(d)	**102.**	(b)	**103.**	(c)	**104.**	(c)	**105.**	(d)	**106.**	(b)	**107.**	(b)	**108.**	(d)	**109.**	(c)	**110.**	(d)
111.	(a)	**112.**	(d)	**113.**	(d)	**114.**	(a)												

EXPLANATIONS

1. (b) : Aerosols are harmful environmental pollutants which have negative effects on agriculture.

2. (c) : Biochemical oxygen demand (BOD) is the measure of oxygen required by aerobic decomposers for biochemical degradation of the biodegradable organic materials. BOD indicates the degree of organic pollution in water. Petroleum is not degraded by decomposer microbes.

3. (d) : High amount of organic waste in a lake will trigger and activate decomposer microbes which will decompose organic waste. Biochemical Oxygen Demand (BOD) of this lake will shoot up and decomposers will utilise most of the dissolved oxygen present in lake. Consequently the level of dissolved oxygen will go down to alarming extent. Aquatic animals like fish which totally depend on the oxygen dissolved in water will ultimately die.

4. (b) : DDT is non-biodegradable and is not metabolised within the body of an organism rather it accumulates in the fat tissues therefore its concentration goes on increasing from one trophic level to another of a food chain, highest amount being present in top consumer *i.e.,* it shows biomagnification. In an aquatic food chain sea gull is the top carnivore therefore will possess highest concentration of DDT.

5. (d) : Ozone layer or shield is present in stratosphere. It functions as a shield against strong UV radiations coming from sun. UV radiations are very harmful and may cause mutations in living organisms. Thinning of ozone layer increases the amount of UV radiations reaching the earth. It would increase occurrence of cataract, skin cancers, dimming of eye sight, photoburning, deficient functioning of immune system, etc.

6. (a) : In India, Joint Forest Management was started in 1980s. Village and tribal communities are being involved in development and protection of degraded forests on share basis.

7. (b) : *Refer to answer 3.*

8. (c) : Acid rain is rainfall and other forms of precipitation with a pH of less than 5. Acid rain is caused by large scale emission of acidic gases into the atmosphere from thermal power plants, industries and automobiles. The common ones are sulphur dioxide, nitrogen oxides (NO_x), volatile organic carbons (VOCs) and hydrogen chloride. Sulphur dioxide and nitrogen oxides are changed in the atmosphere into sulphuric acid and nitric acid by combining with oxygen and water, which then fall on earth in the form of acid rain.

9. (b) : Eutrophication is the excessive growth of algae, plants and animals in water bodies due to the nutrient enrichment particularly with nitrogen and phosphate. Nutrients present in sewage, agricultural wastes and fertilisers cause dense growth of plants and planktonic algae. The excessive growth of planktonic algae that cause colouration of water is called algal bloom, which is toxic to animals and humans. Eutrophic water bodies also support excessive growth of floating plants. Algal blooms and floating plants cut off light form submerged plants, resulting in their death. There is drastic decrease in oxygen replenishment inside water. Non-availability of oxygen results in the death of aquatic animals such as fish, which further adds to organic loading of water. Decomposition is replaced by putrefraction which is anaerobic, leading to absence of oxygen in water and death of aquatic animals.

10. (d)

11. (c) : Lichens are very sensitive to SO_2 pollution. They are completely destroyed at places where there is SO_2 pollution in atmosphere. Therefore, they act as very good indicators of SO_2 pollution.

12. (c) : Heavy metals and persistent pesticides (*e.g.*, chlorinated hydrocarbons like DDT) pass into food chain and increase in amount per unit weight of organisms with the rise in trophic level due to their accumulation in fat. The phenomenon is called biomagnification/ bioconcentration/biological amplification, *e.g.*, 0.003 parts per billion of DDT in water becomes 0.003 ppm in phytoplankton, 0.04 ppm in zooplankton, 0.5 ppm in clams and small fish, 2.0 ppm in predator fish and 25 ppm in fish eating birds like sea gulls.

13. (d)

14. (b) : Ultraviolet radiations are of three types-UV-C (100 - 280 nm), UV-B (280 - 320nm) and UV-A (320 - 390nm). Shorter ultraviolet radiations (UV-C) are absorbed by the atmosphere. The longer ones (UV-A) are not much harmful. The intermediate or UV-B are harmful as well as capable of deep penetration. Thinning of ozone layer increases the amount of UV-B radiations reaching the earth. UV-B radiations damage skin cells, cause ageing of skin, skin cancer and eye damage.

15. (b,d): Biochemical oxygen demand or BOD is the oxygen required for microbial decomposition of a unit mass of organic remains. The degree of impurity of water due to organic matter is measured in terms of BOD. A higher BOD of a river indicates that water is highly polluted.

16. (c)

17. (d) : *Refer to answer 11.*

18. (c) : *Refer to answer 5.*

19. (a) : Dust separation is carried out by scrubbers. They are of two types, dry and wet. Both can be used to separate particulate matter by passing through dry or wet packing material but more commonly they are employed in removing gaseous pollutants like SO_2.

20. (c) : Kyoto protocol is an international treaty to reduce emission of green house gases which was adopted at the third session of the Conference of Parties (CoP - 3) to the UNFCCC (United Nations Framework Convention on Climate Change) in 1997, in Kyoto, Japan.

21. (c) **22. (d)**

23. (c) : International conference held in Kyoto, Japan obtained commitments from different countries for reducing overall green house gas emissions at a level 5% below than that in 1990 by 2008-2012. In Doha, Qatar on 8th December 2012, the "Doha amendment to the Kyoto Protocol" was adopted. The second commitment period is from 1st January 2013 to 31st December 2020.

24. (b) : Carbon dioxide is a greenhouse gas with warming effect of 60%. Greenhouse gases are essential for keeping the earth warm and hospitable. They prevent a substantial part of long wave radiations emitted by earth to escape into space and radiate a part of this energy back to the earth. The phenomenon is called greenhouse flux. Because of greenhouse flux, the mean annual temperature of earth is 15°C. Recently the concentration of greenhouse gases has started rising that is resulting in increasing the mean global temperature. It is called global warming. Deforestation has reduced carbon dioxide assimilation. The excess remains in the air. Excessive use of fossil fuel is adding more CO_2 to atmosphere. This causes greenhouse effect.

25. (b) : Particulate matter consists of soot, flyash, dust, spores, pollen grains etc. Particulate matter is differentiated into settleable (larger than 10 mm and remaining in air for less than one day) and suspended (less than 10 mm and remaining in air for more than one day to several weeks). Particles of 2.5 μm and lesser diameter (PM 2.5) are the most harmful to human health (as per Central Pollution Control Board or CPCB). They pass deep into the lungs causing breathing and respiratory problems, irritation, inflammation and damage to lungs resulting in premature death. It cannot directly enter circulatory system but indirectly through respiratory system.

26. (d) : Higher amounts of DDT disturb calcium metabolism of birds resulting in thinning of egg shells and their premature breaking that kills the embryos. Thus many of the eggs laid by birds did not hatch.

27. (b) : Ozone present in upper atmosphere forms a distinct layer that is known as ozone layer. Ozone layer is necessary for the survival of life on earth as it blocks harmful UV rays of sun from reaching earth's surface.

28. (a) : Biochemical oxygen demand (BOD) is the amount of oxygen taken up by microorganisms that decompose organic waste matter in water. It is therefore used as a measure of the amount of certain types of organic pollutant in water.

29. (b) : *Refer to answer 9.*

30. (d) : Nitrous oxide is commonly known as laughing gas or sweet air. It is a chemical compound with formula N_2O. It is also a major greenhouse gas and air pollutant along with CO_2 with tremendous global warming potential. When compared to CO_2, N_2O has 310 times the ability to trap heat in the atmosphere. N_2O is produced naturally in the soil during the microbial processes of nitrification and denitrification. Carbon dioxide from coal-fired power stations and car exhausts, is the main greenhouse gas.

31. (c) **32. (d)**

33. (c) : Bad ozone is formed in the lower atmosphere (troposphere) that harms plants and animals. Good ozone is found in the upper part of the atmosphere called the stratosphere and it acts as a shield absorbing ultraviolet radiation from the sun. UV rays are highly injurious to living organisms since DNA and proteins of living organisms preferentially absorb UV rays and its high energy breaks the chemical bonds within these molecules.

34. (d) : Exhaustible resources are those natural resources which are likely to be exhausted or diminished as a result of their continuous use. These are further of two types – renewable and non-renewable. Forest is a renewable exhaustible resource which can be again generated or produced artificially or naturally. Coal, petroleum and minerals are non-renewable exhaustible natural resources which cannot be again produced or generated.

35. (b) : Unwanted sound is called noise and it is measured in terms of decibels (dB). Generally sound above 80 dB is noise.

36. (a) : Due to heavy industrialisation and transportation (modernisation), CO_2 concentration is increasing day by day in the atmosphere. CO_2 has capacity of absorbing heat radiations and thus increases temperature. This increase in global temperature (global warming) is mainly due to CO_2 concentration and is called 'greenhouse effect'. Besides CO_2, other important gases associated with greenhouse effect are CH_4 (methane), oxides of nitrogen (NO_x), CFCs (chlorofluorocarbons) and O_3 (ozone) and these are called 'greenhouse gases'.

Relative contribution of these gases to global warming are : CO_2 (50%), CFCs (20%), CH_4 (16%), O_3 (8%), nitrous oxide (6%).

37. (c) : When sewage mixes with water body, microorganisms present in it biodegrade organic matter of sewage using oxygen. This results into a sharp

decline in dissolved oxygen which may cause mortality of aquatic creatures. Gradually, however, dissolved oxygen increases in concentration with the completion of biodegradation of sewage matter.

38. (a) : The Montreal protocol was signed in Montreal, Canada, by over 150 countries at a convention in 1987 to cut use of CFCs (chlorofluorocarbons). The aim of the protocol was to protect the ozone layer in the stratosphere by decreasing and eventually eliminating the use of ozone depleting substances like CFCs. It is regarded as one of the most successful international treaties in modern history.

39. (c) : *Refer to answer 28.*

40. (a)

41. (d) : *Refer to answer 38.*

42. (d) : Biomagnification is caused by non-degradable pollutant like DDT. Heavy metals and persistent pesticides (*e.g.*, organochlorine or chlorinated hydrocarbons like DDT) pass into food chain and increase in amount per unit weight of organisms with the rise in trophic level because they are lipo soluble.

43. (a)

44. (b) : A lake near a village suffered heavy mortality of fishes within few days due to accumulation of biodegradable pollutant like DDT sprayed by an aircraft or by several industrial effluents (such as acid, alkalies, phenol etc) or fertilizers like urea and phosphate etc in the water body. These pollutants either lead to biomagnification or eutrophication of water body. Excess of pesticides cause immediate and mass scale death of aquatic animals. Eutrophication leads to decreased oxygen level in water and hence kills aquatic animals.

45. (c) : *Refer to answer 25.*

46. (c)

47. (b) : The BOD of the given pollutants in ascending order is PE < S < SE < DE.

48. (b) : SPM is suspended particulate matter which is less than 10 mm remaining in air for more than one day to several weeks. It includes aerosol, dust, mist, smoke, soot etc.

49. (d) : *Refer to answer 9.*

50. (b) : Some plants and animals act as the measure of existing environmental conditions because of their response to these conditions. The organisms are called bioindicators. From the given options, stone flies do not act as bioindicator of water pollution.

51. (a) : According to central pollution control board, limit of BOD prescribed is < 30 ppm (mg/d) for 3 days at 27° C.

52. (d) : Photochemical smog is grey or yellow brown opaque smog having oxidising environment with little smoke. Photochemical smog contains secondary pollutants or photochemical oxidants. It was first reported over Los Angeles in 1940s. Photochemical smog is formed at high temperature over cities and towns due to still air, emission of nitrogen oxides and carbohydrates from automobile exhausts and solar energy. Nitrogen dioxides splits into nitric oxide and nascent oxygen. Nascent oxygen combines with molecular oxygen to form ozone. Ozone reacts with carbohydrates to form aldehydes and ketones. Nitrogen oxides, oxygen and ketones combine to form peroxy-acyl-nitrates (PAN). In areas with intense solar radiations, photoelectrical smog forms brown air.

53. (c) : *Refer to answer 38.*

54. (c) : Irrigation induced salinity can arise as a result of the use of any irrigation water, irrigation of saline water etc. combined with inadequate leaching. Since all surface and ground water contains salts to varying degrees, irrigation is often seen as the primary culprit for bringing salts into the field.

55. (d) : In a sewage efficient treatment plan (CETP) during the tertiary treatment the decreased water is chlorinated with chlorine or perchlorate salts, ozonised or irradiate with UV to kill pathogens. Phenyl is not used for disinfection of drinking water.

56. (b) : *Refer to answer 20.*

57. (c) : *Refer to answer 36.*

58. (d) : Bhopal gas tragedy occurred on 3 December 1984 in a Union Carbide pesticide plant. When water and MIC mixed, an exothermic chemical reaction started, which produced a lot of heat. As a result, the safety valve of the tank burst because of the increase in pressure. This burst was so violent that even the concrete around the tank also broke. The high moisture content (aerosol) in the discharge while evaporating gave rise to a heavy gas which rapidly sank to the ground. It caused several ailments like partial or complete blindness, disorders like, gastrointestinal disorders in many surviving people.

59. (b) : Lead (Pb) is released by combustion of petrol as tetra ethyl lead is used as antiknock in petrol. This lead is very harmful and causes plumbism or lead poisoning, which disturbs nervous system, liver, kidneys in adults and also causes brain damage in children. About 150 to 400 mg of lead is stored in the body of an average adult and blood levels average about 25 mg/100 ml. Increase to 70 mg/100 ml of blood is generally associated with clinical symptoms. Hence a level of 30 mg/100 ml should be considered alarming.

60. (c) : *E.coli* is the most common indicator of water pollution. It naturally occurs in the intestines of human beings and animals. They are commonly found in sewage and if *E.coli* are detected in water then it indicates faecal contamination. So if *E.coli* are detected in drinking water it indicates a serious health risk and that water should not be used for drinking.

61. (c) : Fluorides are given out during refining of materials. Fluorides cause fluorosis. It is a disease which is defined by mottling of teeth, abnormal bones that are liable to fracture because fluorine replaces Ca^{2+} and makes the bones brittle. Fluoride pollution is a serious problem in many districts of Rajasthan, where excess of fluoride in water adversely affects the health of man. Many villagers have aged prematurely or became hunch backs.

62. (b) : *Refer to answer 60.*

63. (c) : Stone fly (Plecoptera Order) larva requires well aerated, non-polluted water. It is absent in polluted water.

64. (c) **65. (b)** **66. (b)**

67. (b) : Pollution is any change in physical, chemical or biological characteristics of the environment that has the potentiality to harm human life, life of other desirable species, natural resources, cultural assests and industries. Another type of pollution is increase in CO_2 and other green house gases and a decrease in stratospheric ozone on global scale which would be affecting air, water and land resources, biological diversity and human health. Thus pollution results in damage to biological effectiveness.

68. (d) : Mercury is changed to water soluble dimethyl mercury which undergoes biomagnification. Eating poisoned animals causes deformity known as Minamata disease (first reported in 1952 due to eating of fish captured from Hg-contaminated Minimata Bay of Japan) which is characterised by diarrhoea, haemolysis, impairment of various senses, numbness of lips, tounge, limbs, deafness, blurring of vision, mental dearrangement, meningitis and death.

69. (c) : *Refer to answer 4.*

70. (a) : *Refer to answer 4.*

71. (c) : *Refer to answer 61.*

72. (b) : *Refer to answer 58.*

73. (a) : Secondary pollutant is formed from a primary one through change or reaction. The secondary pollutant are more toxic than primary ones. Nitrogen oxides and hydrocarbons react photochemically to produce peroxyacyl nitrates and ozone. Peroxyacyl nitrates are produced due to photochemical reactions between nitrogen oxides and unsaturated hydrocarbons.

$$\text{Nitrogen oxides} + \text{Hydrocarbons} \xrightarrow{\text{UV in sunlight}} \text{Peroxyacetyl nitrate (PAN)} + \text{Ozone } (O_3)$$

74. (c) : *Refer to answer 12.*

75. (d) : *Refer to answer 11.*

76. (b) : Depletion of ozone is due to action of sunlight over pollutants which release chemicals (*e.g.*, chlorine) that destroy ozone. Ozone depleting substances react with ozone present in the stratosphere and destroy the same. The major ODS are chloroflourocarbons (14% of total depletion), nitrogen oxides (3.5% of total depletion), sulphur dioxide, halon, carbon tetrachloride, methyl chloroform, chlorine, etc. Many of these are being released by jets flying in the stratosphere and rockets being fired into space. Major contributor of these gases is USA.

77. (b) : *Refer to answer 60.*

78. (d) : *Refer to answer 24.*

79. (a) : Carbon monoxide is produced due to incomplete combustion, metallurgical operations and naturally by plants as well as animals. Carbon monoxide has 200 times more affinity to haemoglobin as compared to oxygen. Carbon monoxide combines with haemoglobin of blood and forms a stable compound called carboxyhaemoglobin. At 50 ppm, CO converts 7.5% of haemoglobin into carboxy-haemoglobin within 8 hours. It impairs oxygen transport resulting in headache, decreased vision, cardiovascular malfunction and asphyxial.

80. (a) : *Refer to answer 79.*

81. (c) : *Refer to answer 60.*

82. (b) : *Refer to answer 5.*

83. (d) : Man and biosphere programme is an international biological programme of UNESCO (United Nations Educational Scientific and Cultural Organisation) which was started in 1971 but was introduced in India in 1986. MAB has studied human environment, impact of human interference and pollution on biotic and abiotic environments and conservation strategies for the present as well as future.

84. (d) : Depletion in the concentration of ozone over a restricted area as spring time decline over Antartica is called ozone hole. Ozone hole was discovered over Antartica by Faman *et al*, 1985. It is quite large (23 million square km in 1992 and 28.3 million square km in 2000). A small ozone hole also occurs over North Pole. It was discovered in 1990. Thinning of ozone shield has also been reported elsewhere(*e.g.*, 8% between $30^o - 50^o$ N).

85. (b) : Phosphate is an important compound of fertilizer which are added to crop fields and then are passed down to water bodies during rains through run off. It is also present in sewage that is dumped into the water body. This nutrient bring about dense growth of water plants especially the algae and cause algal bloom. This algal bloom leads to oxygen depletion in water bodies and causes death of aquatic life.

86. (c) : *Refer to answer 36.*

87. (c)

88. (a)

89. (a) : Deforestation will affect in different ways. Due to destruction of natural habitat, many species will

get extinct. Man will be deprived of the benefits of trees and wild animals. Soil erosion will be increased. Floods and drought will become more frequent. There will also be a change in climate. Deforestation will also decrease the atmospheric humidity which will affect rainfall and makes the air hot. Economy of the forest dwelling people will be deteriorated and wild life will be adversely affected.

90. (c)

91. (d) : The Taj Mahal is built with white marble and is threatened by environmental pollution, especially due to sulphur dioxide. Sulphur dioxide is produced during combustion of fossil fuels, refining of petroleum and smelting of sulphur containing ores. Threat to Taj Mahal from Mathura refinery is due to pollutant gases composing SO_2, H_2S and nitrogen oxides. They would convert $CaCO_3$ (marble) into calcium sulphate and calcium nitrate.

92. (d)

93. (a) : *Refer to answer 79.*

94. (b) : Strontium-90 is a long lived radioactive isotope. It tends to cycle like calcium.It causes bone cancer, blood and tissue degeneration.

95. (a) : *Refer to answer 61.*

96. (a) : Desertification means a process of spread of desert that occurs due to degradation of environment, cutting of trees, soil erosion etc. It can be natural or man made. The main causes for desertification are overcultivation of poor soils, over grazing by animals, excessive cutting of fuelwood and inappropriate irrigation practises resulting in salinization. Among them overgrazing is the most important factor as it causes maximum effect.

97. (a) : *Refer to answer 4.*

98. (a) : *Refer to answer 36.*

99. (d) : Noise level are expressed on a logarithmic scale of decibels. The baseline noise levels in the community vary around 40 dB. International standards prescribe a maximum of 50 dB for day and 40 dB for night time in a residential area. Noise over 115 dB is regarded as highly avoidable. The World Health Organization (WHO) recommends an industrial noise limit of 75 dB.

100. (d) : *Refer to answer 68.*

101. (d) : Ozone is generated in the lower atmosphere during the formation of photochemical smog when nitrogen dioxide splits to produce reactive oxygen atoms which combine with molecular oxygen. Oxygen molecules split under ultraviolet radiations to produce oxygen atoms which combine with molecular oxygen to form ozone. It is this gas which forms the protective ozone umbrella in the stratosphere and shield life from biocidal high energy radiations. It can also damage DNA molecules and cause carcinogenesis.

102. (b)

103. (c) : *Refer to answer 59.*

104. (c)

105. (d) : Metals and minerals are both renewable and non-renewable resources. Non renewable due to very long recycling in case of metals and some minerals but renewable due to shorter recycling in case of biogenetic nutrients.

106. (b) : The common gaseous pollutants are oxides of carbon (CO and CO_2), oxides of nitrogen (NO and NO_2) oxides of sulphur (SO_2 and SO_3), all these together contribute 90% of the global air pollution. Out of all these CO_2 is not a pollutant normally, the green plants, by photosynthesis balance the CO_2 and O_2 ratio in the air to a great extent, whereas others like carbon monoxide, NO_2 etc. are poisonous gases.

107. (b) : Domestic waste constitutes biodegradable pollution. These are also called non-conservative pollutants. These are decomposed chemically or by activity of microorganisms into harmless products and are recycled back into the atmosphere.

108. (d)

109. (c) : The mean global temperature rise by 2°-6°C and the concentration of carbon dioxide increases in the troposphere upto 600 ppm. Hence, the surface of the earth becomes warm which causes global warming. The phenomenon is similar to that of green house in which the glass enclosed atmosphere gets heated up due to its insulation from the rest of the environment. Hence, global warming is also known as green house effect and the gases responsible for it are called green house gases *e.g.,* CH_4, CO_2 etc.

110. (d) : Aerosols are chlorofluoro-hydrocarbon compounds released into air with force in the form of vapour. Main source of aerosols is the emission of jet planes, where fluorocarbon are used. These chlorofluorocarbons depletes the ozone layer in the higher atmosphere. These CFC's have produced a hole in the ozone layer.

111. (a) : *Refer to answer 58.*

112. (d) : *Refer to answer 89.*

113. (d) : Soil conservation is to conserve fertile soil from the losses like heavy rainfall, drainage, high wind, flood, drought etc. Soil is the top cover of the Earth in which plants can grow. The rotation of crops, contour ploughing and use of proper fertilizers help in maintaining the fertility of soil. Plantation of trees, controlled grazing of grasslands, reforestation, prevention of forests fires will protect the erosion of top soil. The regulation of water resources to prevent flood will help not only in soil conservation but also supply an adequate water supply in the period of drought.

114. (a) : *Refer to answer 8.*