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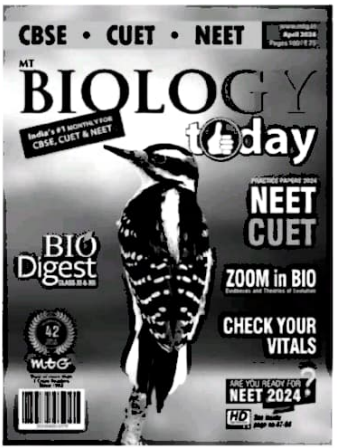

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Practice Paper NEET 2024

Exam on 5th May

SECTION - A (BOTANY)

1. The tumour inducing capacity of *Agrobacterium tumefaciens* is located in large extrachromosomal plasmid called
   (a) Ti plasmid (b) Ri plasmid
   (c) lambda phage (d) plasmid pBR322.
2. Primary endosperm nucleus (PEN) is formed by the fusion of
   (a) 2 polar nuclei + 1 synergid cell nucleus
   (b) 1 polar nucleus + 1 antipodal cell nucleus + 1 synergid cell nucleus
   (c) 2 polar nuclei + 1 male gamete nucleus
   (d) 2 antipodal cell nuclei + 1 male gamete nucleus.
3. Read the following statements and select the correct option.
   Statement I : Red algae reach upto the maximum depth in sea.
   Statement II : Red algae possess the red thalli which is multicellular.
   (a) Both statement I and statement II are correct
   (b) Both statement I and statement II are incorrect
   (c) Statement I is correct but statement II is incorrect
   (d) Statement I is incorrect but statement II is correct.
4. In case of incomplete dominance, in F_2 generation
   (a) the genotypic ratio = phenotypic ratio
   (b) the phenotypic ratio is 3 : 1
   (c) the genotypic ratio is 3 : 1
   (d) genotypic ratio > phenotypic ratio.
5. Match the plants in column I with their modification types in column II and choose the right options given below.

	Column-I		Column-II
(A)	Ginger	(i)	Flattened stem
(B)	Pumpkin	(ii)	Thorns
(C)	*Bougainvillea*	(iii)	Stem tendrils
(D)	*Opuntia*	(iv)	Underground stem

   (a) (A) - (iv), (B) - (iii), (C) - (ii), (D) - (i)
   (b) (A) - (iv), (B) - (i), (C) - (ii), (D) - (iii)
   (c) (A) - (ii), (B) - (iv), (C) - (i), (D) - (iii)
   (d) (A) - (iii), (B) - (iv), (C) - (ii), (D) - (i)
6. In sigmoid growth curve, the exponential phase slows down leading to a stationary phase due to
   (a) toxic effect of some plant hormones
   (b) genetic nature
   (c) limited nutrient supply
   (d) absence of differentiation.
7. **Assertion :** Amount of organic matter synthesised by producers per unit time and per unit area during the process of photosynthesis is referred to as net primary productivity.
   Reason : Secondary productivity is the rate of formation of new organic matter by consumers.
   (a) Both assertion and reason are true and reason is the correct explanation of assertion.
   (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
   (c) Assertion is true but reason is false.
   (d) Assertion is false but reason is true.
8. Read the following statements (A-D) and choose the correct statements.
   (A) In liverworts and mosses gametophytes are free-living.
   (B) Sexual reproduction in *Fucus* and *Volvox* is oogamous.
   (C) The sporophyte in liverworts is more elaborate than that in mosses.
   (D) In liverworts, sporophyte is divided into foot, seta and capsule.
   (a) A and B only (b) A and C only
   (c) B and C only (d) A, B and D only
9. In the somatic cell cycle,
   (a) G_1 phase follows mitotic phase
   (b) DNA replication takes place in S phase
   (c) a short interphase is followed by a long mitotic phase
   (d) in G_1 phase, DNA content is double the amount of DNA present in the original cell.
10. Select the wrongly matched pair.
    (a) Primary metabolite – Ribose
    (b) Secondary metabolite – Anthocyanin
    (c) Chitin – Polysaccharide
    (d) Cellulose – Heteropolymer

11. Read the given statements and select the correct option.
Statement I : Microsporangial wall consist of four different types of layers.
Statement II : Endothecium layer of anther wall plays an important role in dehiscence of anther.
(a) Both statement I and statement II are correct.
(b) Both statement I and statement II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement I is incorrect but statement II is correct.

12. In DNA replication, the small discontinuous segments are synthesised against the 5′ and 3′ strand. The synthesis of these segments occurs in
(a) 5′–3′ direction and joined by DNA ligase
(b) 3′–5′ direction and joined by DNA ligase
(c) 5′–3′ direction and joined by DNA helicase
(d) 3′–5′ direction and joined by DNA helicase.

13. Which of the following statements regarding gibberellin are correct?
(i) GA_3 is used to speed up the malting process in brewing industry.
(ii) GA_3 is a commercially available gibberellin.
(iii) Spraying juvenile conifers with GAs hastens maturity, thus leading to early seed production.
(iv) GA_3 cannot increase the length of internode of sugarcane.
(a) (i), (ii) and (iii) (b) (i) and (ii)
(c) (ii) and (iv) (d) (i) and (iii)

14. Match column I with column II and choose the correct option.

	Column-I		Column-II
(A)	Tobacco	(i)	Vitamin-A
(B)	Bt cotton	(ii)	High yield and pest resistant
(C)	Golden rice	(iii)	*Meloidogyne incognita*

	A	B	C
(a)	III	II	I
(b)	I	II	III
(c)	I	III	II
(d)	III	I	II

15. Gynoecium with fused carpels is known as
(a) syncarpous (b) apocarpous
(c) gynandrous (d) none of these.

16. Drug called 'heroin' is synthesised by
(a) nitration of morphine
(b) methylation of morphine
(c) acetylation of morphine
(d) glycosylation of morphine.

17. Read the given statements and select the correct option.
Statement I : Photorespiration interferes with the functioning of Calvin cycle.
Statement II : Photorespiration oxidises ribulose-1,5 bisphosphate which is an acceptor of CO_2 in Calvin cycle.
(a) Both statements I and II are correct.
(b) Statement I is incorrect but statement II is correct.
(c) Statement I is correct but statement II is incorrect.
(d) Both statements I and II are incorrect.

18. Some cyanobacteria in aquatic and terrestrial environment that enrich the soil by fixing atmospheric nitrogen are
(a) *Rhizobium* and *Azotobacter*
(b) *Azospirillum* and *Glomus*
(c) *Anabaena* and *Nostoc*
(d) *Azospirillum* and *Azotobacter.*

19. Which of the following is economic importance of bryophytes?
(a) Provide food for herbaceous mammals
(b) Decompose rocks for the suitable growth of higher plants
(c) Provide peat that is used as fuel
(d) All of these

20. Match column I with column II and select the correct option.

	Column-I		Column-II
P.	Cytosine	1.	Addition of poly A tail at 3′– end of hnRNA
Q.	Capping	2.	Purine
R.	Splicing	3.	Pyrimidine
S.	Polyadenylation	4.	Removal of introns
T.	Adenine	5.	Addition of methyl guanosine triphosphate at 5′– end of hnRNA

(a) P-3; Q-5; R-4; S-1; T-2
(b) P-4; Q-5; R-3; S-1; T-2
(c) P-2; Q-5; R-4; S-1; T-3
(d) P-4; Q-1; R-3; S-5; T-2

21. Final decarboxylation in Krebs' cycle occur between
(a) citric acid and α-ketoglutaric acid
(b) α-ketoglutaric acid and succinic acid
(c) succinic acid and malic acid
(d) malic acid and oxaloacetic acid.

22. In polyembryony, 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.

23. Select the correct statements regarding pyrimidines.
I. A pyrimidine is 9 membered structure.
II. It has a single ring.
III. It has nitrogen atoms at 1 and 3 positions.
IV. Pyrimidine bases are of three types : cytosine (C), thymine (T) and uracil (U).
V. Pyrimidines are large sized sulphur containing biomolecules.
(a) II, III and IV (b) I, III and V
(c) I, II, III and IV (d) II, III, IV and V

24. **Assertion (A) :** In cymose branching, growth of terminal bud stops after some time.
Reason (R) : The growth of the main stem is definite.
(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is not correct.
(d) (A) is not correct but (R) is correct.

25. Which of the following statements is incorrect?
(a) In photosystem II the reaction centre chlorophyll *a* absorbs 680 nm wavelength of red light.
(b) In Z-scheme, movement of electrons is uphill in terms of redox potential scale.
(c) In Z-scheme of photosynthesis, the electrons flow from H_2O to $NADP^+$.
(d) In Z-scheme, electrons in reaction centre of PS I get excited when they receive red light of wavelength 700 nm and transferred to acceptor having greater redox potential.

26. **Assertion (A) :** Exponential growth cannot be sustained infinitely due to environmental resistance.
Reason (R) : In S-shaped growth form, the population may abruptly crash after attaining a peak value.
(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is not correct.
(d) (A) is not correct but (R) is correct.

27. Consider the following statements and choose the correct option.
A. In the dicot root, the vascular cambium is completely secondary in origin.
B. Phellogen, phellem and phelloderm are collectively known as periderm.
C. All tissues exterior to the vascular cambium forms bark.
D. The parenchymatous cells of phellogen ruptures the epidermis to form lenticels.
(a) A, B and C (b) A, B, C and D
(c) B and D (d) C and D

28. Which one of the following tests will you perform to demonstrate the presence of gibberellin?
(a) Bolting of cabbage
(b) Differentiation of shoots in tobacco callus culture
(c) Rapid division in carrot cells
(d) Elongation of *Avena* coleoptile

29. Read the given statements and select the correct option.
Statement I : Baculovirus are biocontrol agents of Genus *Nucleopolyhedrovirus*.
Statement II : Baculovirus are effective against plant pathogens.
(a) Both statements I and II are correct.
(b) Statement I is correct but statement II is incorrect.
(c) Statement I is incorrect but statement II is correct.
(d) Both statements I and II are incorrect.

30. The reactions of Calvin cycle are not directly dependent on light, rather
(a) they are dependent on ATP
(b) they are dependent on O_2
(c) they are dependent on NADPH
(d) both (a) and (c).

31. 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)

32. Which vector is commonly used in transfer of gene in a crop plant?
(a) Plasmids of *B. subtilis*
(b) Bacteriophages
(c) Ti-plasmids of *Agrobacterium*
(d) *E.coli* phages

33. An immature male gametophyte differs from a mature male gametophyte in that it
(a) has not yet left the pollen sac
(b) has not yet germinated and its generative cell has not divided into two male gametes
(c) is a microspore that has not yet divided by mitosis
(d) still consists of microsporocytes.

34. Read the following statements and select the correct option.
Statement I : GM plants has enhanced nutritional value of food.
Statement II : GM plants has reduced reliance on chemical pesticides.

(a) Both statement I and statement II are correct.
(b) Both statement I and statement II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement I is incorrect but statement II is correct.

35. Which of the following statements is not true for the two genes that show 50% recombination frequency?
(a) If the genes are present on the same chromosome, they undergo more than one cross overs in every meiosis.
(b) The genes may be on different chromosomes.
(c) The genes are tightly linked.
(d) The genes show independent assortment.

SECTION - B

Attempt any 10 questions out of 15.

36. Which of the following is/are correct about bivalents?
(i) Bivalents are tetrads.
(ii) A bivalent means 4 chromatids.
(iii) One bivalent consists of 2 homologous chromosomes.
(iv) Bivalents form in zygotene.
(a) (i), (ii), (iii) and (iv) (b) (iii) only
(c) (iii) and (iv) only (d) (iv) only

37. Match the following columns and select the correct option.

	Column-I		Column-II
(A)	Separation of daughter chromosomes	(1)	Interphase
(B)	Division of cytoplasm	(2)	Karyokinesis
(C)	Phase between two successive	(3)	S-phase
(D)	Synthesis phase	(4)	Cytokinesis

	A	B	C	D
(a)	2	3	1	4
(b)	4	1	3	2
(c)	2	4	1	3
(d)	4	2	3	1

38. In a DNA, transcription is done by RNA polymerase III at some specific time. Which of the following groups of RNAs are transcribed by RNA polymerase III?
(a) *t*RNA only
(b) 28S *r*RNA, 5S *r*RNA and *t*RNA
(c) *t*RNA, 5S *r*RNA, snRNAs
(d) *t*RNA, 18S *r*RNA, 5.8S *r*RNA

39. Biological control methods adopted in agriculture pest control are based on the
(a) predator-prey interaction
(b) prey feeding habitat
(c) prey-prey interaction
(d) predator-predator interaction.

40. Select the correct statements regarding telophase.
A. Chromosomes are highly condensed.
B. Chromosomes become invisible and chromatin materials are clustered at opposite poles.
C. Nucleolus, Golgi complex, ER are invisible.
D. Nuclear envelope is reformed around nucleus.
(a) A and D (b) A, B and C
(c) B and D (d) B, C and D

41. What is common to the seed banks, tissue culture and cryopreservation?
(a) All are *in situ* conservation methods.
(b) All are *on site* conservation methods.
(c) All are modern *ex situ* conservation methods.
(d) Both (a) and (b)

42. Read the given statements and select the correct option.
Statement I: In monocot stem, the vascular bundles are scattered.
Statement II: In monocot stem, central vascular bundle are generally smaller than the peripherally located ones.
(a) Both statement I and statement II are correct.
(b) Both statement I and statement II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement I is incorrect but statement II is correct.

43. Match column I with column II and select the correct answer from the given codes.

	Column-I		Column-II
A.	Recombinant DNA technology	(i)	Chilled ethanol
B.	Precipitation of DNA	(ii)	DNA staining
C.	PCR	(iii)	Gene amplification
D.	Ethidium bromide	(iv)	Genetic engineering

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

44. Choose the correct equation for the aerobic respiration.
(a) $\text{Acetyl CoA} + CO_2 + \text{FADH} \xrightarrow[\text{ADH}]{Zn^{2+}} \text{Pyruvic acid} + \text{CoA} + FAD^+$
(b) $\text{Pyruvate} + \text{CoA} + \text{NADH} + H^+ \xrightarrow[\text{PDH}]{Mn^{2+}} \text{AcetylCoA} + CO_2 + NAD^+$
(c) $\text{Pyruvic acid} + \text{CoA} + NAD^+ \xrightarrow[\text{PDH}]{Mg^{2+}} \text{Acetyl CoA} + CO_2 + \text{NADH} + H^+$
(d) $\text{Acetyl CoA} + CO_2 + \text{NADH} + H^+ \xrightarrow[\text{ADH}]{Zn^{2+}} \text{Pyruvic acid} + \text{CoA} + FAD^+$

45. **Assertion (A) :** Both alleles in codominance are equally important.
Reason (R) : In codominance the number of phenotypes is the same as the number of alleles.
(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is not correct.
(d) (A) is not correct but (R) is correct.

46. If in a population, birth rate (b) = 65, death rate (d) = 45 and population density (N) = 100, then find out $\frac{dN}{dt}$.
(a) 2000 (b) 1000 (c) 200 (d) 100

47. Select the incorrect match.

	Drug		Source
(a)	*Ganja*	–	*Cannabis sativa*
(b)	Cocaine	–	*Erythroxylum coca*
(c)	Morphine	–	*Papaver somniferum*
(d)	Smack	–	*Cannabis sativa*

48. Match column-I with column-II and select the correct option using the given codes.

	Column-I		Column-II
A.	Auxin	I.	Fruit ripening
B.	Cytokinins	II.	Phototropism
C.	Abscisic acid	III.	Antagonist to GAs
D.	Ethylene	IV.	Stomatal opening
		V.	Stomatal closing
		VI.	Growth of lateral buds

(a) A-IV; B-V; C-III, VI; D-I (b) A-II; B-VI; C-III, V; D-I
(c) A-I; B-V; C-III, II; D-VI (d) A-III; B-IV; C-II, V; D-I

49. Which of the following is not considered in ecological pyramid?
(a) A species belonging to two or even more trophic levels.
(b) Simple food chains are considered in pyramid that almost never exist in nature.
(c) Ecological pyramids do not consider food web.
(d) All of these

50. Choose the correct options about Basmati rice.
I. In 1997, an American company got patent rights for Basmati rice through the US Patent and Trademark office and was allowed to sell a 'new variety' in US and abroad.
II. This new variety of Basmati was derived from Chinese farmer's varieties.
III. Indian Basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty.
Which of the given statements are correct?
(a) I and II (b) I and III
(c) II and III (d) I, II and III

SECTION - A (ZOOLOGY)

51. The "Red List" records
(a) species diversity of wetlands
(b) list of water pollutants
(c) list of extinct species
(d) rate of population decline.

52. Read the given statements and select the correct option.
Statement I : Ribosomes of polysome translate the *m*RNA into proteins.
Statement II : Ribosomes occur only in eukaryotic organisms.
(a) Both statement I and statement II are correct.
(b) Both statement I and statement II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement I is incorrect but statement II is correct.

53. *Gambusia* is a fish which is being introduced into the ponds in order to check the vector borne diseases such as
(a) dengue (b) malaria
(c) chikungunya (d) all of these.

54. Match the column I with column II and select the correct option.

	Column-I		Column-II
(A)	Placenta	(i)	Androgens
(B)	Zona pellucida	(ii)	Human Chorionic Gonadotropin (hCG)
(C)	Bulbourethral glands	(iii)	Layer of the ovum
(D)	Leydig's cells	(iv)	Lubrication of the penis

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

55. Which one of the following pairs of endocrine glands help in regulation of calcium levels in the body?
(a) Thymus and pineal (b) Adrenal and Ovary
(c) Parathyroid and Adrenal (d) Thyroid and Parathyroid

56. The number of chromosomes in Klinefelter's syndrome is
(a) 47 (44 + XXY)
(b) 47 (44 + XXX)
(c) 47 (46 + 1 extra chromosome 21)
(d) none of these.

57. **Assertion (A) :** Restriction digestion is a process of cutting DNA by restriction enzyme.
Reason (R) : Restriction enzymes cut DNA leaving single stranded portions at the ends.
(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is not correct.
(d) (A) is not correct but (R) is correct.

58. Refer to the given passage and identify X and Y. X is a type of protein that acts as a hormone and Y is protein which enables glucose transport into the cells.
(a) X – Trypsin, Y – Na^+/K^+ pump
(b) X – Pepsin, Y – Carrier proteins
(c) X – Albumin, Y – Na^+/K^+ pump
(d) X – Insulin, Y – GLUT-4

59. 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.

60. Match the contraceptive methods given under column I with their examples given under column II. Select the correct option.

	Column-I		Column-II
A.	Natural method	p.	Tubectomy and vasectomy
B.	IUDs	q.	Copper T and Lippes' loop
C.	Barriers	r.	Condom and cervical cap
D.	Sterilisation	s.	Spermicidal jelly and foam
		t.	Coitus interruptus and periodic abstinence

(a) A-t, B-q, C-r, D-p (b) A-s, B-t, C-q, D-r
(c) A-t, B -r, C-q, D-s (d) A-s, B-q, C-t, D-p

61. During the processing of the pro-hormone "proinsulin" into the mature "insulin"
(a) C-peptide is added to proinsulin
(b) C-peptide is removed from proinsulin
(c) B-peptide is added to proinsulin
(d) B-peptide is removed from proinsulin.

62. Bioluminescence in ctenophores refers to
(a) the property of a living organism to emit light
(b) the emission of electric current
(c) emission of poison from body
(d) both (a) and (b).

63. Select the correct statements.
(1) Colourblindness is a sex-linked recessive disease.
(2) Turner's syndrome is due to aneuploidy.
(3) Phenylketonuria is an autosomal recessive gene disorder.
(4) Thalassemia is an X-linked recessive gene disorder.
(a) (1), (3) and (4) (b) (1), (2) and (3)
(c) (1) and (4) (d) (2) and (4)

64. Match the column A with column B and select the correct option.

	Column-A		Column-B
A.	Nictitating membrane	(i)	Present on the first digit of the forelimbs of male frog
B.	Tympanum	(ii)	Protect eyes while the frog is in water
C.	Copulatory pad	(iii)	Receives sound signals

(a) A-(iii), B-(i), C-(ii)
(b) A-(ii), B-(iii), C-(i)
(c) A-(iii), B-(ii), C-(i)
(d) A-(i), B-(ii), C-(iii)

65. In which disease lumen of arteries get narrower due to deposition of cholesterol?
(a) Atherosclerosis (b) Hypertension
(c) Heart attack (d) Angina

66. The growth and reproduction are mutually exclusive events in
(a) lower plants only
(b) lower animals only
(c) higher animals and plants
(d) all lower organisms.

67. Read the given statement and select the correct option.
Statement I : Streptokinase obtained from the cultures of *Streptococcus* is genetically modified for commercial use.
Statement II : Streptokinase is added in detergents for removing oily stains from laundry.
(a) Both statements I and II are correct.
(b) Both statements I and II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement I is incorrect but statement II is correct.

68. Read the following statements related to Class Chondrichthyes.
I. Heart is three chambered.
II. *Torpedo* possesses poison sting.
III. *Trygon* possesses electric organs.
IV. They are poikilothermous animals.
V. Fertilisation is internal.
Which of the following statements are correct?
(a) I and II only (b) I, II and III only
(c) IV and V only (d) II, III and IV only

69. The maximum (70 – 80 per cent) amount of electrolytes and water 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

70. Match column I (organic compound) with column II (examples) and choose the correct combination from the given options.

	Column-I (Organic compounds)		Column-II (Examples)
A.	Fatty acid	I.	Glutamic acid
B.	Phospholipid	II.	Tryptophan
C.	Aromatic amino acid	III.	Lecithin
D.	Acidic amino acid	IV.	Palmitic acid

(a) A – I; B – II; C – III, D – IV
(b) A – IV; B – III; C – II, D – I
(c) A – II; B – III; C – IV, D – I
(d) A – III; B – IV; C – I, D – II

71. How does steroid hormones influence the cellular activities?
(a) Changing the permeability of the cell membrane
(b) Binding to DNA and forming a gene-hormone complex
(c) Activating cyclic AMP located on the cell membrane
(d) Using aquaporin channels as second messenger

72. The *E. coli* is grown in a culture medium not supplemented with lactose. The *lac* operon system will
(a) remain off completely
(b) remain active at very low level
(c) remain operative at normal level
(d) remain operative at very high level.

73. Which ones of the following statements are incorrect?
(i) Leucocytes are long lived.
(ii) RBCs are produced by bone marrow in adults.
(iii) Neutrophils are non-phagocytic in nature.
(iv) Important function of lymphocytes is to provide immune response.
(a) (i) and (ii) only
(b) (i) and (iv) only
(c) (i) and (iii) only
(d) (ii) and (iii) only

74. **Assertion :** In connective tissue, fibres give elasticity, strength and flexibility to the tissue.
Reason : The cells of connective tissues except blood secrete collagen.
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

75. Match the countries/continents in column I with their respective extinct animals in column II and select the correct option from the codes given below.

	Column-I		Column-II
A.	Mauritius	(i)	Quagga
B.	Africa	(ii)	Thylacine
C.	Australia	(iii)	Dodo
D.	Russia	(iv)	Steller's sea cow

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

76. Which of the following is/are not a feature(s) of viroids?
(a) They are larger than viruses.
(b) They have free living DNA.
(c) The genetic material in viroids has low molecular weight.
(d) Both (a) and (b)

77. Select the incorrect statement.
(a) A cancerous cell manages to move throughout the body using the blood or lymph systems, destroying healthy tissues by a process called metastasis.
(b) Virus that causes AIDS spreads through sexual contact with infected person.
(c) Cancer symptoms are quite varied and depend upon where the cancer is located and where it has spread.
(d) In advanced HIV infection (AIDS), helper T-cell count increases beyond the normal value.

78. Match column I with column II and select the correct answer from the given codes.

	Column-I		Column-II
A.	*amp*^{R} gene	(i)	*E.coli* cloning vector
B.	Separation of DNA fragments	(ii)	Selectable marker
C.	*Eco*RI	(iii)	Electrophoresis
D.	pBR322	(iv)	*Escherichia coli RY13*

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

79. **Assertion (A) :** Serious lung damage occurs in occupational respiratory disorders.
Reason (R) : On exposure to dust, respiratory surface area decreases as bronchi clog due to secretion of excess mucus.
(a) Both (A) and R are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.

80. Pick out the incorrect statement(s) regarding amino acids.
I. Valine is a basic amino acid.
II. Essential amino acids cannot be synthesised by the human body from raw materials.
III. Phenylalanine is an aromatic amino acid.
IV. Essential amino acids are obtained from dietary proteins.
(a) I, II and III (b) II and III
(c) I only (d) III and IV

81. When two similar species live in the same area, they may evolve to become more different in order to
(a) drive the other species to extinction
(b) reduce competition
(c) use up the other species resources
(d) reduce genetic variation.

82. In male cockroach, genital pouch contains
(a) dorsal anus, ventral genital pore and gonapophysis
(b) dorsal anus, gonopore and gonapophysis
(c) ventral anus, dorsal spermathecal pore and gonapophysis
(d) gonopore, spermathecal pores and collateral glands.

83. Read the following statements and choose the correct option.
Statement I : All copulations do not lead to the fertilisation and pregnancy.
Statement II : Fertilisation can occur only if the ovum and sperms are transported simultaneously to the ampullary – isthmic junction.
(a) Both statements I and II are correct.
(b) Statement I is incorrect but statement II is correct.
(c) Statement I is correct but statement II is incorrect.
(d) Both statements I and II are incorrect.

84. Which one of the following is showing the correct sequential order of vertebrae in the vertebral column of human beings?
(a) Cervical – lumbar – thoracic – sacral – coccygeal
(b) Cervical – thoracic – sacral – lumbar – coccygeal
(c) Cervical – sacral – thoracic – lumbar – coccygeal
(d) Cervical – thoracic – lumbar – sacral – coccygeal

85. Match the causative organisms with their diseases and select the correct option.

	Column-I		Column-II
(A)	*Haemophilus influenzae*	(1)	Malignant malaria
(B)	*Entamoeba histolytica*	(2)	Elephantiasis
(C)	*Plasmodium falciparum*	(3)	Pneumonia
(D)	*Wuchereria bancrofti*	(4)	Typhoid
(E)	*Salmonella typhi*	(5)	Amoebiasis

(a) A – 1, B – 5, C – 3, D – 2, E – 4
(b) A – 3, B – 5, C – 1, D – 2, E – 4
(c) A – 5, B –1, C – 3, D – 4, E – 2
(d) A – 1, B – 3, C – 2, D – 5, E – 4

SECTION - B

Attempt any 10 questions out of 15.

86. Vasopressin released from the neurohypophysis is mainly responsible for
(a) facultative reabsorption of water through Henle's loop
(b) obligatory reabsorption of water through Bowman's capsule
(c) facultative reabsorption of water through DCT
(d) obligatory reabsorption of water through PCT.

87. Read the following statements and select the correct option.
Statement I : In eukaryotes, replication and transcription occur in the cytoplasm but translation occurs in the nucleus.
Statement II : *m*RNA is transferred from the cytoplasm to the nucleus where ribosomes and amino acids are available for protein synthesis.
(a) Statement I is true but statement II is false.
(b) Statement I is false but statement II is true.
(c) Both statement I and statement II are false.
(d) Both statement I and statement II are true.

88. A young crocodile has eaten a lamb. A hawk attacks the crocodile and consumes the same. In ecological terms, the hawk is
(a) producer (b) primary consumer
(c) secondary consumer (d) tertiary consumer.

89. Read the given statements and select the option with two correct statements.
(A) Medical termination of pregnancy (MTP) during first trimester is generally safe.
(B) Generally chances of conception are nil until mother breast-feeds the infant upto two years.
(C) Intrauterine devices like copper-T are effective contraceptives.
(D) Contraceptive pills may be taken upto one week after coitus to prevent conception.
(a) (A) and (C) (b) (A) and (B)
(c) (B) and (C) (d) (C) and (D)

90. Which of the following makes possible selection of transformants from non-transformants?
(a) Presence of more than one recognition sites in the vector DNA
(b) Presence of *rop* gene in the vector DNA
(c) Antibiotic resistance gene gets inactivated due to insertion of alien DNA
(d) Both (b) and (c)

91. **Assertion (A) :** SA node is called the "contraction centre" or "pacemaker".
Reason (R) : The nodal fibres of SA node are embedded in the wall of right atrium.
(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is not correct.
(d) (A) is not correct but (R) is correct.

92. The list of homologous and analogous organs is given below.
I. Sweet potato and potato
II. Flippers of penguins and dolphins
III. Hearts of different vertebrates
IV. Forelimbs of whales, bat and cheetah
The correct option which represent only homologous organs.
(a) I, II and III only (b) III and IV only
(c) I and II only (d) II and III only

93. In the following table, the hormones and their related functions are given. Select the correct option.

	Hormone	Function
A.	Prolactin	Growth of mammary glands and milk formation in them
B.	TSH	Stimulate thyroid to secrete PTH
C.	ACTH	Secretion of glucocorticoids from adrenal medulla
D.	LH	Secretion of androgens from testes

(a) A and B are correct. (b) B, C and D are correct.
(c) C and D are correct. (d) A and D are correct.

94. In human females, the blastocyst
(a) forms placenta after completion of 2nd trimester.
(b) gets implanted into fallopian tube within 3 days of ovulation
(c) gets implanted in endometrium by the trophoblast cells
(d) all of these.

95. 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.

96. Which of the following options correctly represents the lung conditions in asthma and emphysema, respectively?
(a) Inflammation of bronchioles; Decreased respiratory surface.
(b) Increased number of bronchioles; Increased repiratory surface.
(c) Increased respiratory surface; Inflammation of bronchioles.
(d) Decreased respiratory surface; Inflammation of bronchioles.

97. Which of the following is/are correct about Adenosine Deaminase (ADA) deficiency?
I. In the absence of adenosine deaminase enzyme, T-lymphocytes fails to function.
II. ADA deficiency is caused by the deletion of the gene for ADA.
III. In some cases, it can be cured by bone marrow transplantation and enzyme replacement therapy. But in both approaches, the patients are not completely cured.
IV. For permanent cure, genes isolated from the bone marrow cells producing ADA at early embryonic stages can be a possible cure.

Which of the given statements are correct?

(a) I, II and III only (b) II, III and IV only
(c) I, III and IV only (d) I, II, III and IV

98. *Ascaris* is characterised 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.

99. Which of the following regions of the brain is incorrectly paired with its function?

(a) Corpus callosum - Connects left and right cerebral hemispheres
(b) Cerebrum - Major part of human brain
(c) Medulla oblongata - Control gastric secretions
(d) Cerebellum - Regulates sexual behaviour

100. Read the given statements and select the correct option.

Statement I : Mechanism of muscle contraction is explained by sliding-filament theory.

Statement II : Contraction of muscle fibre takes place by the sliding of thick filaments over the thin filaments.

(a) Both statements I and II are correct.
(b) Statement I is incorrect but statement II is correct.
(c) Both statements I and II are incorrect.
(d) Statement I is correct but statement II is incorrect.

SOLUTIONS

1. (a)

2. (c) : During the event of double fertilisation in angiosperms, the second male gamete fuses with the two haploid polar nuclei or diploid secondary nucleus of the central cell to form a triploid primary endosperm nucleus (PEN). This second fertilisation is called vegetative fertilisation.

3. (a)

4. (a) : In case of incomplete dominance, the hybrid individuals are intermediate type between the parents, *e.g.*, *Mirabilis* (4 O' clock plant) where one allele is incompletely dominant over the other allele. This can be illustrated as :

Parents: RR (red) × rr (white)

Gametes: R, r

F_1 generation : Rr (Pink)

On selfing

F_2 generation :

♀ / ♂	R	r
R	RR (Red)	Rr (Pink)
r	Rr (Pink)	rr (White)

Genotypic ratio: 1 : 2 : 1

Phenotypic ratio: 1 : 2 : 1
Red Pink White

Both genotypic ratio and phenotypic ratio are same, *i.e.*, 1 : 2 : 1.

5. (a) : Ginger – Underground stem
Pumpkin – Stem tendrils
Bougainvillea – Thorns
Opuntia – Flattened stem

6. (c)

7. (d) : The total amount of organic matter synthesised by producers per unit time and per unit area in the process of photosynthesis is called as gross primary productivity (GPP). Net primary productivity is the available biomass for the consumption to heterotrophs (herbivores and decomposers).

8. (d) : The sporophyte in mosses is more elaborate than that in liverworts.

9. (b) : All cells other than the germ cells or gametes in an organism are called somatic cells. In synthetic phase of somatic cell cycle, DNA replicates in semi-conservative manner so each chromosome is formed of two sister chromatids joined at centromere or primary constriction. Synthesis of histones (basic proteins) occurs. In this phase, each cell is with double the amount (4n) of DNA.

10. (d) : Cellulose is a polysaccharide and homopolymer that consists of a long unbranched chain of glucose units.

11. (a)

12. (a) : The small segments called Okazaki segments are synthesised in 5'–3' direction and they are joined by DNA ligase to form lagging strand.

13 (a) : GA_3 can increase the length of internode of sugarcane and increase the yield by as much as 20 tonnes per acre.

14. (a)

15. (a) : Gynoecium in which two or more carpels are fused is known as syncarpous. For *e.g.*, mustard and tomato.

16. (c) **17. (a)**

18. (c) : Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments many of which can fix atmospheric nitrogen and enrich the soil, *e.g.*, *Anabaena*, *Nostoc*, *Oscillatoria*.

19. (d) **20. (a)**

21. (b) : In Kreb's cycle, decarboxylation occurs at two steps : first during conversion of isocitrate to α-ketoglutarate and second during conversion of α-ketoglutarate to succinyl CoA.

22. (a) : Polyembryony 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.

23. (a) : Pyrimidines are small sized nitrogen containing biomolecules. They have six membered ring structure.

24. (a) : In cymose branching, the growth of the main stem is definite, that is the terminal bud does not continue to grow, but lower down, the main stem produces one or more lateral branches which grow more vigorously than the terminal one. In some plants, the terminal bud gets modified into a flower, tendril, thorn, etc.

25. (b) : In Z-scheme, the movement of electrons is downhill in terms of an oxidation reduction or redox potential scale.

26. (c) **27. (b)** **28. (a)**

29. (a) : Baculoviruses are pathogens that attack insects and other arthropods. The majority of baculoviruses used as biological control agents are in the Genus *Nucleopolyhedrovirus*. These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications.

30. (d) : Calvin cycle that take place in stroma of the chloroplasts during photosynthesis, is light-independent. But they usually do not occur in night because this cycle is dependent on the products of the light reactions. The Calvin cycle proceeds in three stages: carboxylation (CO_2 is covalently linked to a carbon skeleton (RuBP)], reduction (carbohydrate is formed at the expense of ATP and NADPH) and regeneration (the CO_2 acceptor RuBP reforms at the expense of ATP).

31. (d) **32. (c)**

33. (b) : Immature male gametophyte differs from a mature male gametophyte as immature male gametophyte has not yet germinated and its generative cell has not divided into two male gametes. When the pollen grain is mature, it contains 2 cells-vegetative cell and generative cell. The vegetative cell is bigger, has abundant food reserve and large irregularly shaped nucleus. The generative cell is small and floats in the cytoplasm of vegetative cell.

34. (a)

35. (c) : If two genes show 50% recombination frequency then the genes are not linked as linked genes show more than 50% of parental type.

36. (a) **37. (c)**

38. (c) : RNA polymerase I transcribes 28S, 18S and 5.8S *r*RNA, RNA polymerase II transcribes hnRNA (a precursor of *m*RNA) and RNA polymerase III transcribes *t*RNA, 5S *r*RNA and snRNAs.

39. (a) : Biological control method in agriculture pest control is based on the predator prey relationship. The prickly pear cactus introduced into Australia in 1920's caused Havoc by spreading rapidly into million of hectares of rangeland. Finally invasive cactus was brought under control only after a cactus-feeding predator (a moth) from its natural habitat was introduced into the country.

40. (c)

41. (c) : Seed banks, tissue culture and cryopreservation comes under modern *ex-situ* conservation strategies.

42. (c) : In monocot stem, vascular bundles are scattered and peripheral vascular bundles are generally smaller than the central vascular bundles.

43. (a) **44. (c)**

45. (c) : In codominance, number of phenotypes is one more than the number of alleles.

46. (a) : In a population, change in population density (N) during a unit time period t will be

$$\frac{dN}{dt} = (b - d)\, N = (65 - 45)\, 100 = 2000$$

47. (d) **48. (b)** **49. (d)**

50. (b) : A new variety of Basmati rice in the US and abroad was derived from Indian farmer's varieties.

51. (c) : The red list is a catalogue of taxa facing risk of extinction.

52. (c) : The ribosomes occur in both prokaryotic and eukaryotic cells with the exception of mammalian RBCs. In prokaryotic cells, the ribosomes often occur freely in the cytoplasm. In eukaryotic cells, the ribosomes either occur freely in the cytoplasm or remain attached to the outer surface of the endoplasmic reticulum and nuclear envelope. Several ribosomes may attach to a single *m*RNA and form a chain called polyribosomes or polysomes. The ribosomes of a polysome translate the *m*RNA into proteins.

53. (d) **54. (c)** **55. (d)**

56. (a) : The genotype of Klinefelter's is due to presence of additional one X chromosome thus forms 47, (44 + XXY). In this, males are sterile having secondary female sexual characteristics.

57. (b)

58. (d) : X-Insulin, Y-GLUT-4

59. (a) : The process of evolution of different species in a given geographical area starting from a point and literally

radiating to other areas of geography (habitats) is called adaptive radiation.

60. (a)

61. (b) : Human insulin is made up of 51 amino acids arranged in two polypeptide chains, A having 21 amino acids and B with 30 amino acids. The hormone develops from a storage product called pro-insulin. Pro-insulin has three chains, A, B and C. C – chain with 33 amino acids is removed prior to insulin formation. This C peptide is not present in the mature insulin and is removed during maturation into insulin.

62. (a)

63. (b) : Thalassemia is an autosomal recessive genetic disorder. It can be transmitted from parents to the offspring when both the partners are carriers of the gene (or heterozygous).

64. (b) :

Nictitating membrane	–	Protect the eyes while the frog is in water
Tympanum	–	Receives sound signals
Copulatory pad	–	Present on the first digit of the forelimbs of male frog

65. (a) **66. (c)** **67. (c)**

68. (c) : Heart is two chambered (one auricle and one ventricle). *Torpedo* possesses electric organs and *Trygon* possesses poison sting.

69. (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.

70. (b) **71. (b)**

72. (b) : Even in the absence of lactose in a cell, a very low level of expression of *lac* operon is present, otherwise lactose cannot enter into the cell due to absence of permease.

73. (c) : Leucocytes are generally short lived and neutrophils are phagocytic in nature.

74. (b) **75. (b)**

76. (d) : Viroids are smaller than viruses. They have free living RNA.

77. (d) : In advanced HIV infection, helper T-cell count decreases much below the normal value as HIV virus affects or destroys these helper T-cells.

78. (c) **79. (c)**

80. (c) : Valine is a neutral amino acid.

81. (b) : According to the mechanism of resource partitioning (supported by Mac Arthur), if two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging patterns. Two species evolve to become different to reduce competition, so that both species can co-exist.

82. (a) : In male cockroach, genital pouch contains dorsal anus, ventral genital pore and gonapophysis.

83. (a) : Fertilisation can only occur if the ovum and sperms are transported simultaneously to the ampullary-isthmic junction and ovum is released only once a month. This is one of the reasons why all copulations do not lead to fertilisation and pregnancy.

84. (d)

85. (b) :

Haemophilus influenzae	–	Pneumonia
Entamoeba histolytica	–	Amoebiasis
Plasmodium falciparum	–	Malignant malaria
Wuchereria bancrofti	–	Elephantiasis
Salmonella typhi	–	Typhoid

86. (c) : Osmoreceptors in the body are activated by changes in the blood volume, body fluid volume and ionic concentration. An excessive loss of fluid from the body can activate these receptors, which stimulate the hypothalamus to release ADH (Antidiuretic Hormone) or vasopressin from neurohypophysis (posterior lobe of pituitary). ADH facilitate the water reabsorption from latter parts of the tubule, thereby diuresis.

87. (c) **88. (d)**

89. (a) : Generally, chances of conception are nil until mother breast feeds the infant upto 6 months. Contraceptive pills have to be taken daily for a period of 21 days starting preferably within the first five days of menstrual cycle. After a gap of 7 days (during which menstruation occurs), it has to be repeated in the same pattern till the female desires to prevent conception.

90. (c) **91. (b)**

92. (b) : The flippers of penguins and dolphins, sweet potato and potato are examples of analogous structures.

93. (d) : PTH is secreted by parathyroid gland and ACTH stimulates adrenal cortex, not adrenal medulla.

94. (c)

95. (c) : According to Hardy Weinberg principle,
$p^2 + 2pq + q^2 = 1$; $(p + q)^2 = 1$
AA or p^2 = 360 out of 1000 individuals or $p^2 = 0.36$
Therefore, $p = A = 0.6$.

96. (a) **97. (d)**

98. (d) : *Ascaris* belongs to the Phylum 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.

99. (d)

100.(d) : Mechanism of muscle contraction is best explained by the sliding filament theory which states that contraction of a muscle fibre takes place by the sliding of the thin filaments over the thick filaments.

CUET (UG)

Exam between 15th to 31st May 2024

PRACTICE PAPER 2024

Section II of CUET (UG) is domain specific. In this section of Biology 40 questions to be attempted out of 50.

Time Allowed : 45 Minutes **Maximum Marks :** 200

1. A vasectomy
(a) prevents the production of sperm in the testes
(b) prevents the production of semen
(c) prevents the movement of sperm into the urethra
(d) prevents a man from having an erection.

2. Statins, a blood-cholesterol lowering agent, is commercially obtained from
(a) *Trichoderma polysporum*
(b) *Acetobacter aceti*
(c) *Clostridium butylicum*
(d) *Monascus purpureus.*

3. Match column I with column II and select the correct option.

	Column I		Column II
P.	Transcription	1.	DNA to DNA
Q.	Translation	2.	DNA to RNA
R.	Replication	3.	DNA polymorphism
S.	Central dogma	4.	RNA to protein
T.	DNA fingerprinting	5.	DNA to protein

(a) P-1; Q-2; R-3; S-5; T-4 (b) P-5; Q-4; R-3; S-2; T-1
(c) P-2; Q-4; R-1; S-5; T-3 (d) P-4; Q-2; R-1; S-5; T-3

4. Signals for parturition originate from
(a) both placenta as well as fully developed fetus
(b) oxytocin released from maternal pituitary
(c) placenta only
(d) fully developed fetus only.

5. With regard to the ABO blood typing system, if a man who has type B blood and a woman who has type O blood were to have children, what blood types could the children have?
(a) A or O (b) B or O
(c) AB or O (d) A, B, AB or O

6. Which of the following are used in gel electrophoresis?
I. Ethidium bromide II. *Taq* polymerase
III. Agarose IV. UV radiation
Choose the correct option.
(a) I and II only (b) I and III only
(c) I, II and IV only (d) I, III and IV

7. Which one of the following is related to *ex situ* conservation of threatened animals and plants?
(a) Indo Burma (b) Western ghats
(c) Himalayan region (d) Wildlife safari parks

8. Agarose extracted from the sea weeds is used in
(a) PCR amplification (b) electroporation
(c) gel electrophoresis (d) denaturation.

9. If the sequence of bases in the coding strand of a double stranded DNA is 5'-GTTCGAGTC-3', the sequence of bases in its transcript will be
(a) 5'-GACUCGAAC-3' (b) 5'-CAAGCUCAG-3'
(c) 5'-GUUCGAGUC-3' (d) 5'-CUGAGCUUG-3'.

10. Match column I with column II and choose the correct option.

	Column-I		Column-II
(A)	Aneuploidy	(i)	Increase in whole set of chromosomes
(B)	Monoploidy	(ii)	Loss or gain of a chromosome
(C)	Polyploidy	(iii)	Two sets of chromosomes
(D)	Diploidy	(iv)	A single set of chromosomes

(a) (A)-(i); (B)-(ii); (C)-(iii); (D)-(iv)
(b) (A)-(iii); (B)-(i); (C)-(ii); (D)-(iv)
(c) (A)-(ii); (B)-(iv); (C)-(i); (D)-(iii)
(d) (A)-(iv); (B)-(iii); (C)-(i); (D)-(ii)

11. When a pathogen enters the body, the cells that phagocytose and destroy the pathogen are
(a) tissue macrophages
(b) mast cells and fibroblast cells
(c) neutrophils and mast cells
(d) B-lymphocytes and T-lymphocytes.

12. Which of the following statements are correct?
    1. Mutations are random and directionless while variations are small and directional.
    2. Mutations are random and directional while variations are small and directionless.
    3. Speciation and saltation was given by Hugo de Vries.
    4. Darwinian variations cause evolution.

    (a) 1 and 4 (b) 1 and 3
    (c) 2 and 4 (d) 2 and 3

13. Which of the following is/are an example of adaptive radiation?
    (a) Australian marsupials
    (b) Vermiform appendix in human beings
    (c) Finches of Galapagos island
    (d) Both (a) and (c)

14. Some important events in the human female reproductive cycle are given below. Arrange the events in a proper sequence.
    A – Secretion of FSH, B – Growth of corpus luteum, C – Growth of the follicle and oogenesis, D – Ovulation, E – Sudden increase in the levels of LH
    (a) A → D → C → E → B
    (b) B → A → C → D → E
    (c) C → A → D → B → E
    (d) A → C → E → D → B

15. The embryo sac of angiosperms contains
    (a) 3 celled egg apparatus, 3 antipodal cells and 2 polar nuclei
    (b) 2 celled egg apparatus, 3 antipodal cells and 2 polar nuclei
    (c) 3 celled egg apparatus, 2 antipodal cells and 1 polar nuclei
    (d) 3 celled egg apparatus, 1 antipodal cell and 2 polar nuclei.

16. Yeast is used in the production of
    (a) bread and beer
    (b) cheese and butter
    (c) citric acid and lactic acid
    (d) lipase and pectinase.

17. In which one of the following options, the two examples are correctly matched with their particular type of immunity?

	Examples	Type of immunity
(a)	Polymorphonuclear leukocytes and monocytes	Cellular barriers
(b)	Mucus coating of the epithelium lining respiratory tract	Cytokine barriers
(c)	Saliva in mouth and tears in eyes	Physical barriers
(d)	Secretion of interferons by virus infected cells	Physiological barriers

18. The slow rate of decomposition of fallen logs in nature is due to their
    (a) aerobic environment around them
    (b) low lignin content
    (c) high moisture content
    (d) poor nitrogen content.

19. One out of the following is not responsible for biodiversity loss.
    (a) Alien species invasion (b) Co-extinction
    (c) *Ex-situ* conservation (d) Deforestation

20. What is true for IUDs?
    I. They are self-inserted.
    II. They are inserted by expert nurses.
    III. They may be non-medicated IUDs, copper releasing IUDs or hormone releasing IUDs.
    IV. They are the one of the most widely accepted contraceptives in India.
    V. They are inserted in uterus through vagina.

    (a) I, II, III, V (b) II, III, IV, V
    (c) I, II, III (d) I, II, III, IV, V

21. In Mendelian dihybrid cross when heterozygous Round Yellow are self crossed, Round Green offsprings are represented by the genotype
    (a) RrYy, RrYY, RRYy (b) Rryy, RRyy, rryy
    (c) rrYy, rrYY (d) Rryy, RRyy.

22. Which of the following groups of fungi causes ringworm infection?
    (a) *Trichophyton*
    (b) *Microsporum*
    (c) *Haemophilus influenzae*
    (d) Both (a) and (b)

23. Select the correctly matched pair.
    (a) *Haemophilus influenzae* – Malignant malaria
    (b) *Entamoeba histolytica* – Amoebiasis
    (c) *Plasmodium falciparum* – Pneumonia
    (d) *Wuchereria bancrofti* – Typhoid

24. 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.

25. Identify the correct sequence of processes that occur during secondary treatment.
    I. Primary effluent is passed into large aeration tanks.
    II. Activated sludge is formed.
    III. Growth of useful aerobic microbes into flocs.
    IV. Activated sludge is pumped into large tanks called anaerobic sludge digesters.

V. Anaerobic bacteria digest the bacteria and fungi in the sludge by producing biogas.

VI. Some activated sludge is pumped back into the aeration tank to serve as the inoculum.

(a) I → III → IV → II → VI → V
(b) I → II → III → VI → IV → V
(c) I → III → II → VI → IV → V
(d) I → III → II → IV → VI → V

26. Single step large mutation leading to speciation is also called
(a) founder effect (b) saltation
(c) branching descent (d) natural selection.

27. Match the column I with column II and choose the correct option.

Column I		Column II
A. Incomplete dominance	(i)	Hershey and Chase
B. Linkage	(ii)	*Antirrhinum* sp.
C. Transforming principle	(iii)	Griffith
D. Proved that DNA is the genetic material	(iv)	Morgan

(a) A-(i); B-(iv); C-(iii); D-(ii)
(b) A-(iv);B-(ii); C-(iii); D-(i)
(c) A-(ii); B-(iii); C-(iv); D-(i)
(d) A-(ii); B-(iv); C-(iii); D-(i)

28. Cleistogamous flower is found in
(a) tobacco (b) *Viola*
(c) *Mirabilis* (d) none of these.

29. What is present in the middle piece of sperm?
(a) Acrosome (b) Mitochondria
(c) Nucleus (d) Proximal centriole

30. If the stronger partner is benefitted and the weak partner is harmed, it is known as
(a) predation (b) amensalism
(c) symbiosis (d) commensalism.

31. Protein encoded by gene *cry* IAb controls the infestation of which of the following insects?
(a) Cotton bollworm
(b) *Anopheles* mosquito
(c) Corn borer
(d) *Aedes* mosquito

32. Consider the following statements concerning food chains.
(A) Removal of tertiary consumers from an area resulted in greatly decreased 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 given statements are correct?
(a) A and D (b) A and B
(c) B and C (d) C and D

33. Select the option that contains all plants which produce non-endospermic seeds.
(a) Gram, Pea, Bean, Groundnut
(b) Castor, Peanut, Orchid, Wheat
(c) Coconut, Castor, Wheat, Gram
(d) Castor, Maize, Coconut, Orchid

34. pBR322, which is frequently used as a vector for cloning gene in *E.coli* is a/an
(a) original bacterial plasmid
(b) modified bacterial plasmid
(c) viral genome
(d) transposon.

35. Which component is absent in natural cow's milk that is found in transgenic animal as a nutritionally more balanced product for human babies?
(a) α-1-antitrypsin (b) α-lactalbumin
(c) Phenylalanine (d) Adenosine

36. The logistic population growth is expressed by the equation
(a) $dt/dN=Nr\left(\frac{N+K}{K}\right)$ (b) $dN/dt=rN\left(\frac{K-N}{K}\right)$
(c) $dN/dt = rN$ (d) $dN/dt=rN\left(\frac{N-K}{N}\right)$.

37. In *Lac* operon, *i* gene codes for
(a) inducer of *lac* operon
(b) repressor of *lac* operon
(c) hydrolysis of disaccharide
(d) permease.

38. According to IUCN, some of the recent extinctions include
(i) Dodo (ii) Quagga
(iii) African catfish (iv) Thylacine
(v) Steller's sea cow
(a) (i), (ii), (iii) and (iv) (b) (ii), (iii) and (iv)
(c) (i), (ii), (iv) and (v) (d) (iii), (iv) and (v)

39. The brain capacity of *Homo erectus* was
(a) 900 cc (b) 1650 cc (c) 650 cc (d) 1400 cc.

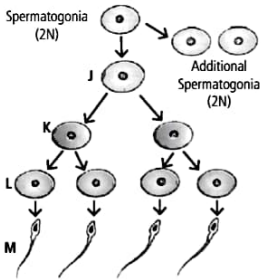
40. If 30 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?
Plant → Mice → Snake → Peacock
(a) 0.03 J (b) 0.003 J
(c) 0.3 J (d) 0.0003 J

Case Based MCQs

Case I : Study the given passage and answer the questions from 41 to 45 given below:

In testis, the immature male germ cells produce sperms by spermatogenesis that begins at puberty. It occurs in the seminiferous tubules of the testes. Seminiferous tubules are lined by germinal epithelium. The schematic representation of spermatogenesis is as follows :

Type of Germ Cells



41. Which cell division occurs during multiplication phase?
(a) Mitosis (b) Meiosis I
(c) Meiosis II (d) Both (b) and (c)

42. How many chromosomes are present in K and L, respectively?
(a) 46, 23 (b) 46, 46 (c) 23, 23 (d) 23, XY

43. Transformation of L into M is known as
(a) spermiation (b) spermiogenesis
(c) spermatogenesis (d) none of these.

44. Which of the following divides by meiosis?
(a) J (b) K
(c) L (d) Both (a) and (b)

45. Which hormone helps in secretion of factors required for transformation of L into M?
(a) LH (b) GnRH (c) Estrogen (d) FSH

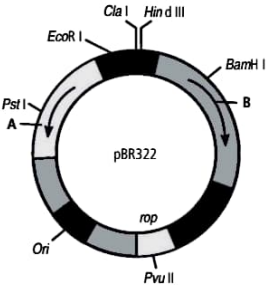
Case II : Read the following and answer questions from 46 to 50 given below:

The vectors are DNA molecules that can carry a foreign DNA segment and replicate inside the host cell. Vectors may be plasmids, bacteriophages (viruses that attack bacteria), cosmids, yeast artificial chromosomes (YACs), Bacterial artificial chromosomes (BACs) and viruses. The most widely used, versatile, easily manipulated vector pBR 322 is an ideal plasmid vector. Features that are required to facilitate cloning into a vector includes *ori*, selectable marker genes and cloning sites.

46. p in pBR322 denotes that it is a
(a) plasmid (b) prokaryote
(c) protist (d) plant cell.

47. *Ori* is a specific DNA sequence that help in
(a) attachment of primers (b) initiation of replication
(c) extension of DNA base (d) initiation of denaturation.

48. A and B shown in the figure respectively indicates



(a) *Pvu* I and *amp*^{R} (b) *tet*^{R} and *Sal* I
(c) *amp*^{R} and *tet*^{R} (d) *tet*^{R} and *amp*^{R}.

49. Selectable markers in vector
(a) are responsible for replication
(b) help in selecting transformants from non-transformants
(c) code for proteins involved in the replicating plasmids
(d) contain unique recognition sites.

50. Plasmid vectors are
(a) dsDNA molecule (b) extra-chromosomal
(c) present in bacteria and yeast
(d) all of these.

SOLUTIONS

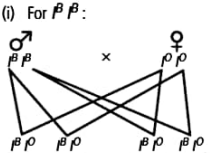
1. (c)

2. (d) : Statins produced by the yeast *Monascus purpureus* have been commercialised as blood cholesterol lowering agent. Statins act by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

3. (c) **4.** (a)

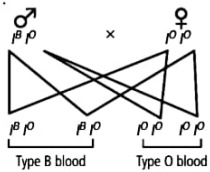
5. (b) : The man has type B blood and woman has type O blood. So, the genotype of their blood group will be I^BI^B or I^BI^O and I^OI^O respectively. The blood type of child will be either B or O. This is illustrated below :

(i) For I^BI^B :



All type B blood

(ii) For $I^B i$:



6. (d) : In gel electrophoresis, DNA fragments move towards the anode according to their molecular size through the agarose gel. The separated DNA fragments can be observed only after staining them with ethidium bromide. The bright orange coloured bands of DNA can be seen only under UV light. These bands of DNA fragments are cut out from the gel and extracted by technique called elution.

7. (d) : *Ex situ* conservation is conservation of selected rare or threatened animals and plants in places outside their natural homes. It includes off site conservation like botanical gardens, zoological parks, cryopreservation, tissue culture, wildlife safari parks, gene banks, etc.

8. (c) : Fragments of DNA are separated by a technique called gel electrophoresis. In this technique, charged molecules are separated under the influence of an electrical field through a medium matrix. Most commonly used matrix is agarose which is a polysaccharide extracted from sea weeds. DNA fragments separate according to size.

9. (c) : During transcription, one of the two DNA strands functions as template strand and the other functions as coding strand. Template strand serves as template for transcription whereas coding strand does not take part in transcription. Hence, the *m*RNA produced has base sequence complementary to template strand while similar to coding strand except that thymine (T) is replaced by uracil (U).

10. (c)

11. (a) : After entry of pathogen into body tissues, macrophages/ histocytes first engulf microbes. They constitute first line of defence against infection.

12. (b) : Mutations are non-directional and Hugo de Vries believed that it is mutation which causes speciation.

13. (d) : The process of evolution which results in transformation of original species to many new different varieties is called adaptive radiation. Australian marsupials and Darwin's finches of Galapagos island are examples of adaptive radiation.

14. (d)

15. (a) : Fully developed embryo sac of angiosperm is 8 nucleated and 7 celled structure *i.e.*, egg apparatus at micropylar end is having 3 cells (2 synergids + 1 egg cell), 3 antipodal cells at chalazal end and a central cell having two polar nuclei at centre.

16. (a) : The dough which is used for making bread, is fermented by baker's yeast (*Saccharomyces cerevisiae*). Besides bread, yeast fermentation is involved in the production of beer, wine, vinegar, etc. Several traditional drinks and food items are also made by fermentation of yeast.

17. (a) :

Mucus coating of epithelium lining respiratory tract	– Physical barriers
Saliva in mouth and tears in eyes	– Physiological barriers
Secretion of interferons by virus infected cells	– Cytokine barriers

18. (d) **19. (c)**

20. (b) : Intra uterine devices (IUDs) are inserted by doctors or expert nurses in the uterus through vagina.

21. (d) : In Mendelian dihybrid cross when heterozygous round yellow are self crossed, round green offsprings are

Contributed by : Radhika Aggarwal, New Delhi

SOLUTIONS TO MARCH 2024 WORD GRID

A	B	P	F	E	M	U	R	C	H	E	P	R	K	L
B	I	O	O	S	L	D	A	H	I	M	L	E	Q	O
H	O	N	G	U	T	H	E	S	A	N	A	N	P	R
K	F	S	S	L	B	E	N	T	H	I	C	I	R	P
T	E	A	T	K	Y	S	R	U	R	Y	E	N	O	H
O	R	L	H	R	I	C	M	N	C	I	N	P	T	A
T	T	E	R	B	G	K	O	A	U	O	T	R	E	E
I	I	U	O	R	A	D	U	L	A	M	A	U	A	M
P	L	R	M	F	R	O	N	D	Y	M	P	H	S	O
O	I	O	B	V	U	N	K	A	A	S	M	S	E	G
T	S	P	O	L	Y	M	O	R	P	H	I	S	M	L
E	E	L	C	J	K	I	Q	D	O	T	M	S	S	O
N	R	A	Y	A	N	A	B	A	E	N	A	S	M	B
C	P	S	T	S	H	X	E	N	O	G	A	M	Y	I
Y	Q	T	E	I	M	M	I	G	R	A	T	I	O	N

1. Totipotency
2. Biofertiliser
3. Radula
4. Node
5. Polymorphism
6. Aleuroplast
7. Frond
8. Thrombocyte
9. Sternum
10. Detritus
11. *Anabaena*
12. Pons
13. Xenogamy
14. Femur
15. Placenta
16. Haemoglobin
17. Glycolysis
18. Immigration
19. Renin
20. Protease

represented by genotypes RRyy, Rryy as round is dominant trait while green is a recessive trait.

22. (d) : The dermatophytes (*e.g.*, Genera *Trichophyton*, *Microsporum* and *Epidermophyton*) are a group of closely related fungi, which cause ringworm infection.

23. (b)

24. (c) : Two nucleotides are linked through 3′-5′ phosphodiester linkage to form a dinucleotide.

25. (c)

26. (b) : Hugo de Vries believed that mutation causes evolution and not the minor heritable variations which were mentioned by Darwin. According to Darwin, evolution was gradual while Hugo de Vries believed mutations appear suddenly and hence called it saltation (single step large mutation).

27. (d)

28. (b) : Cleistogamous flowers do not open or bloom at all. Thus, they cannot receive foreign pollens and invariably show autogamy *i.e.*, self pollination. *E.g.*, *Commelina*, *Viola* and *Oxalis*. These plants possess both types of flowers, cleistogamous and chasmogamous (flowers which bloom).

29. (b) : The middle piece of human sperm contains mitochondria coiled around the axial filament. They provide energy for the movement of the sperms. So it is the "power house of the sperm". At the end of the middle piece there is a ring centriole (annulus) with unknown function.

30. (a)

31. (c) : Protein encoded by gene *cry* IAb controls the infestation of corn borer in Bt Cotton Plant.

32. (c) : Removal of tertiary consumers from an area resulted in increased growth of vegetation because there will be increased numbers of secondary and decreased numbers of primary consumers which feeds on green plants. The length of food chain is generally limited to 3-4 trophic levels 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 energy is lost in respiration to drive the organisms, metabolism, so less energy is left to support higher trophic level.

33. (a)

34. (b) : pBR322 is a modified bacterial plasmid that carries two sets of antibiotic resistance genes and it has high copy number generally 15 and several restriction sites (*Hin*d II, *Eco*RI, *Bam*HI, *Sal* I, *Pvu* II, *Pst* I and *Sca* I).

35. (b)

36. (b) : The logistic population growth is expressed by the equation $\frac{dN}{dt}=rN\left(\frac{K-N}{K}\right)$, where N is population density at time t, r is intrinsic rate of natural increase and K is called carrying capacity (*i.e.*, maximum sustainable population).

37. (b) : In *Lac* operon, the functioning of the operator gene is dependent on a regulator gene (*i*-gene) also called as inhibitor gene situated some distance away from it. The inhibitor gene constantly transcribes *m*RNA to produce the repressor protein. Repressor is proteinaceous substance synthesised by the regulator gene. Repressor is meant for blocking the operator gene so that the structural genes are unable to form *m*RNAs.

38. (c) **39. (a)**

40. (a) : According to the ten percent law given by Lindeman (1942), only 10% of the total energy is transferred at each trophic level. From producers, 10% of total energy is transferred to the primary consumers (herbivores). Herbivores are eaten by primary carnivores. Only 10% of the herbivores productivity is utilised 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. Accordingly, if plant trapped 30 J of energy, mice will have 3 J, snake will have 0.3 J and hence, peacock will have 0.03 J of energy.

41. (a) : In multiplication phase, the undifferentiated primordial germ cells divide several times by mitosis to produce large number of spermatogonia.

42. (c)

43. (b) : Transformation of spermatids (L) into spermatozoa (M) is known as spermiogenesis.

44. (d)

45. (d) : FSH helps in secretion of some factors which help in the process of spermiogenesis.

46. (a) : In pBR322 plasmid, P denotes that it is a plasmid; BR stands for Boliver and Rodriguez, who constructed this plasmid; 322 is a number given to distinguish this plasmid from others developed in the same laboratory.

47. (b) **48. (c)**

49. (b) : Plasmid pBR322 has two resistance gene, *i.e.*, ampicillin resistance (amp^R) and tetracycline resistance (tet^R) which are considered useful for selectable markers.

50. (d)

EXAM ALERT 2024

Exam	Date
KARNATAKA CET Biology	18th April
NEET	5th May
CUET	Between 15th May and 31st May

Quiz CLUB

Unlock Your Knowledge!

1. World Health day is celebrated on which date?
   (a) 5th April (b) 10th April
   (c) 7th April (d) 29th April
2. Who is known as "Father of Indian Paleobotany"?
   (a) Birbal Sahni (b) Charaka
   (c) Ramdeo Mishra (d) Aristotle
3. Long term exposure of which of the following causes Blackfoot disease?
   (a) Arsenic (b) Potassium
   (c) Nitrate (d) Iodine
4. Which part of human body has smallest bone?
   (a) Fingers (b) Ear
   (c) Toe (d) Thigh
5. What is the study of plant poison called?
   (a) Physiology (b) Phytotoxicology
   (c) Plant pathology (d) Entomology
6. Which of the following teeth are modified into tusks in elephant?
   (a) Incisor (b) Premolar
   (c) Canine (d) Molar
7. What genetic term describes the situation when a part of a chromosome is broken off and lost?
   (a) Chromosome inversion
   (b) Chromosome deletion
   (c) Chromosome multiplication
   (d) Chromosome duplication
8. Which of the following is not a composition of hormones?
   (a) Peptide (b) Protein
   (c) Steroid (d) Nucleic acid
9. Which species got saved from extinction by IVF technology for the first time?
   (a) Northern white rhino (b) Asiatic lion
   (c) Vulture (d) Mountain gorilla
10. Which disease can be treated by the first cellular therapy 'Amtagvi' approved by US Food and Drug Administration?
    (a) Melanoma (b) Anaemia
    (c) AIDS (d) Influenza
11. Who was the World's first successful transplanted kidney recipient?
    (a) Shanmughan (b) Richard Herrick
    (c) David Hume (d) Joseph Kelly.
12. What does CAM stands for in plants?
    (a) Carbon acid metabolism
    (b) Crassulacean acid metabolism
    (c) Conserve acid metabolism
    (d) Cacti acid metabolism
13. Autophagy is associated with which organelle?
    (a) Mitochondria (b) Plastid
    (c) Endoplasmic reticulum (d) Lysosome
14. Which of the following led Senator Gaylord Nelson to create the first Earth Day in 1970?
    (a) Santara Barbara oil spill disaster
    (b) Chernobyl disaster
    (c) Methyl isocyanate disaster
    (d) Tropical Cyclone Audrey
15. Which is first biosphere reserve of India?
    (a) Nanda devi biosphere reserve
    (b) Sundarban biosphere reserve
    (c) Nilgiri biosphere reserve
    (d) Pachmarhi biosphere reserve

Answer Key

1. (c) 2. (a) 3. (a) 4. (b) 5. (b)
6. (a) 7. (b) 8. (d) 9. (a) 10. (a)
11. (b) 12. (b) 13. (d) 14. (a) 15. (c)

Unique Career in Demand

Explore the available Unique Career Options!

Bachelor of Science in Agriculture

B.Sc Agriculture is a 4-year undergraduate course that primarily focusses on research and practices in agricultural science. This course provides comprehensive knowledge of various disciplines of agriculture like genetics, plant breeding, agricultural microbiology, soil science, plant pathology, etc. This course consists of agricultural science and implementation of modern technologies on real basis. This course plays an important role in addressing global food security issues, advancing sustainable agriculture, and improving crop yields and livestock production.

Selection Criteria

- The admission is either done on the basis of merit and direct interview or through entrance exams.
- Some institutions may conduct National, State-level or University Level entrance exams as part of the admission process. These exams include Physics, Chemistry and Biology/Maths questions followed by questions on Numerical aptitude, Logical reasoning, Verbal ability, Reading comprehension.
- Entrance exams conducted by various universities across India includes CG PAT, MHT CET, KCET, UPCATET, KEAM, AP EAMCET.
- Students can also apply for CUET (ICAR – UG) to get admission in this course. The exam is set to be held from 15th May to 31st May 2024.

Job Perspectives

- As a B.Sc Agriculture graduate, student can expect promising job opportunities in the public and private sectors. Various academic establishment, as well as agricultural corporations and research institutions provide many job opportunities to students with the B.Sc Agriculture degree. Students can also work as Agriculture Officer, Assistant Plantation Manager, Agricultural Research Scientist, Agriculture Development Officers, Agricultural Technician, Farm Manager, Food Inspector, Plant Breeder, etc.
- Top recruiters that employ B.Sc Agriculture are Big Basket, Raguvansh Agrofarms Limited, JK Agri Genetics Limited, etc.

Eligibility

- To seek admission to the B.Sc Agriculture course, students should have a Class 12 or any equivalent examination.
- They should have completed their higher secondary school with Science stream subjects such as Physics, Chemistry, Mathematics, and Biology.
- Students should have a minimum score of 50% in their higher secondary school examination or any equivalent examination.
- The B.Sc Agriculture age limit is a minimum age of 17 years and above.

Best Colleges offering B.Sc. Agriculture

S.No.	Name of the University/College	City/State
I.	**Anbil Dharmalingam Agricultural College and Research Institute**	**Tiruchirappalli, Tamil Nadu**
II.	ICAR - National Dairy Research Institute	Pantnagar, Uttarakhand
III.	Anand Niketan College of Agriculture	Warora, Maharashtra
IV.	Khalsa College	Karnal, Haryana
V.	Professor Jayashankar Telangana State Agricultural University	Hyderabad, Telangana
VI.	Govind Ballabh Pant University of Agriculture and Technology	Amritsar, Punjab
VII.	Chaudhary Charan Singh, Haryana Agricultural University	Hisar, Haryana
VIII.	Indira Gandhi Krishi Vishwavidyalaya	Raipur, Chhattisgarh
IX.	University of Agricultural Sciences	Bangalore, Karnataka
X.	Uttar Banga Krishi Vishwavidyalaya	Cooch Behar, West Bengal

College Info

Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu

Anbil Dharmalingam Agricultural College and Research Institute (ADAC & RI) is one of the top agricultural colleges in Tamil Nadu. The institute established in 1989, is affiliated to Tamil Nadu Agricultural University and is approved by ICAR. The college is famous for its research activities.

The college offers undergraduate course for B.Sc. (Hons.) Agriculture and Postgraduate courses in Agronomy, Soil Science, Genetics and Plant Breeding.

The college was awarded the "best college" of Tamil Nadu Agricultural University (TNAU), Coimbatore during the year 2014.

Selection Criteria

Candidate must have passed 10 + 2 with physics, chemistry, biology and scored minimum 50% marks in their 10 + 2 examination from a recognised board. Candidates should not have completed the age of 21 years on the first day of July of the admission year *i.e.*, 1st July 2024. Candidates are selected through exam CUET (ICAR – UG).

Class XI

BIO

Digest

This article covers high yield facts of the given topic.

The Living World

WHAT IS LIVING?

- Life is a unique, complex organisation of molecules that expresses itself through chemical reactions which lead to growth, development, responsiveness, adaptation and reproduction, etc. The objects exhibiting these characteristics of life are designated as **living beings.**
- Maintenance of life or living condition by **protoplasm** requires continuous energy conversions and using it for performing certain vital activities by which we can easily distinguish living from non-living. **Huxley** called protoplasm "physical basis of life".
- The overall organisational distinction of living objects from non-living objects is manifested in following structural and functional characteristics of living organisms:

Characteristics of living beings

Cellular Structure

All living organisms are formed of one or more cells made up of protoplasm (living matter). In most multicellular organisms, the cells are further organised into definite tissues, organs and organ systems.

Organism

All living beings consist of several components and subcomponents which cooperate with one another for their well being.

Metabolism

The sum total of all chemical reactions occurring in an organism due to specific interactions amongst different types of molecules within interior of cells is called metabolism.

Growth

Growth is an irreversible increase in mass of an individual. Living organisms grow due to addition of materials and formation of cells inside the body (intussusception). In plants, growth continues throughout life whereas in animals, it occurs upto a certain age.

Consciousness

Organisms possess inherent capability to perceive environmental change and to bring about necessary changes in their own functioning to preserve their integrity.

Reproduction

It is the ability of an individual to give rise to new individual of its own kind. Reproduction may be sexual (biparental) or asexual (uniparental). It is not essential for survival of individuals but is required for perpetuation of population.

Healing and Repair

Living beings can repair and heal their broken or injured parts upto certain extent.

Movement

Living beings show movements of their body parts or may even move from one place to another (locomotion, shown by animals).

Homeostasis

Organisms have ability to maintain a constant internal environment through self regulated manner called homeostasis.

Death

The stoppage of various life activities accompanied by increase in entropy is called death. It occurs due to ageing, disease, accident or predation.

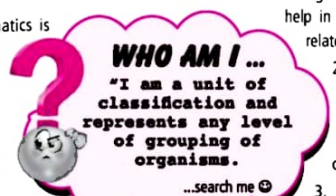
- **Cellular organisation**, **metabolism** and **consciousness** (responsiveness) are three defining features of all living organisms without exception.

DIVERSITY IN THE LIVING WORLD

- We see a large variety of living organisms, be it potted plants, insects, birds, your pets or other animals and plants.
- There are also several organisms that we cannot see with our naked eyes but they are all around us.
- Each different kind of plant, animal or organism that we see, represents a species. The number of species that are known and described range between 1.7-1.8 million. This refers to biodiversity or the number and types of organisms present on earth.
- As we explore new areas, new organisms are continuously being identified.

SYSTEMATICS

- The variations among organisms have posed a great problem to human beings for their study, *i.e.*, how to recognise them with their differences and similarities.
- So, there was a need of system to organise the vast number of known organisms into categories that could be named, remembered and studied.
- According to Simpson, "Systematics is the scientific study of kinds and diversity of organisms and all relationships among them".
- Classical systematics is based on observable morphological characters with normal individuals considered to be expression of the same while their variations are believed to be imperfect expressions. It originated with Plato followed by Aristotle (Father of Zoology), Theophrastus (Father of Botany) upto Linnaeus (Father of Taxonomy) and his contemporaries.
- New systematics is the systematic study which takes into consideration all types of characters including those from morphology, anatomy, cytology, physiology, biochemistry, ecology, genetics, development (embryology), behaviour, etc. of the whole population instead of a few typological specimens. It strives to bring out evolutionary relationships amongst organisms.
- All living organisms are classified into various groups based on their characteristics according to the principles of identification, nomenclature and classification. This branch of study is known as **taxonomy**.



Types of taxonomy are as follows:

Alpha taxonomy – Identification and classification of organisms on the basis of only morphological characters is called alpha taxonomy.

Beta taxonomy – β taxonomy involved not only gross morphological features but also genetical, anatomical, cytological, palynological (pollen and pores study), physiological and other characters. It is also called biosystematics.

Omega taxonomy – Analysis and synthesis of all information and types of data to develop classification system based on phylogenetic relationships is called omega taxonomy.

- Systematics includes characterisation, identification, classification and nomenclature of organisms.

Basis of systematics study

1. **Characterisation :** The description of a taxon involves listing its features by recording the appropriate characteristics and shortlisting only those taxonomic characters which help in separating a taxon from other closely related taxa.
2. **Identification :** Based on the studied characteristics organism is identified to know whether it is similar to any of the known groups or taxa and assigning a correct rank and position.
3. **Nomenclature :** It deals with determining a distinct and proper name to organisms placed in various taxa.
4. **Classification :** Arrangement of organisms into groups on the basis of similarities and dissimilarities.

Phylogeny : It is the study of genealogy and evolutionary history of a taxonomic group. Phylogenetic system is not static but highly dynamic. Its major source is fossil record. The systems of classification proposed after Darwin's theory of Natural Selection, are mostly claimed to be phylogenetic. Modern attempts for developing a phylogenetic classification of flowering plants were done by Cronquist, Hutchinson (1959), Takhtajan (1967).

INTEXT PRACTICE QUESTIONS

1. **Mention the characteristics of living beings.**
2. **Name the two books written by Carolus Linnaeus.**

Binomial Nomenclature (Linnaeus, 1751)

- The scientific names recognised internationally are those given by Linnaeus in 10th edition of his book, *'Systema Naturae'*.
- Linnaeus described **5900 species** of plants in his book *'Species Plantarum'* (1753) and **4326 species** of animals in *'Systema Naturae'* (1758).

Guidelines for Binomial Nomenclature

- A scientific name consists of two words, the first word represents the genus while the second component denotes the specific epithet.
- They are derived from Latin or latinised irrespective of their origin.
- Both the words in a biological name, when handwritten, are separately underlined or printed in italics to indicate their Latin origin. An exception is made when biological name is written as title of paragraph.
- The first word denoting the genus starts with a capital letter while the specific epithet starts with small letter. Two species belonging to same genus cannot have same specific names.
- Scientific names are based on agreed principles and criteria, which are provided in international codes. There are five codes for nomenclature of organisms.

ICBN - International Code of Botanical Nomenclature
ICZN - International Code of Zoological Nomenclature
ICNB - International Code for Nomenclature of Bacteria
ICVN - International Code of Viral Nomenclature
ICNCP - International Code of Nomenclature for Cultivated Plants

TAXONOMIC HIERARCHY

- First proposed by Linnaeus, hierarchy of categories is the classification of organisms in a definite sequence in a descending order from kingdom to species or in an ascending order from species to kingdom.
- In Linnaeus hierarchy, there were only five categories – Class, Order, Genus, Species and Variety. The last one was discarded and three new categories were added so that now there are seven obligate categories, *i.e.*, Kingdom, Division (or Phylum), Class, Order, Family, Genus and Species.
- In order to make taxonomic position of species more precise, certain categories have been added to this list. They are called **intermediate categories, *e.g.*,** Subkingdom, Superphylum or Superdivision, Subdivision, Superclass, Subclass, Superorder, Suborder, Superfamily, Subfamily, Tribe, Subspecies, etc.
- Each taxonomic category is referred to as **taxon** (plural-taxa), which is a unit of classification and represents any level of grouping of organisms. The common categories are as follows:

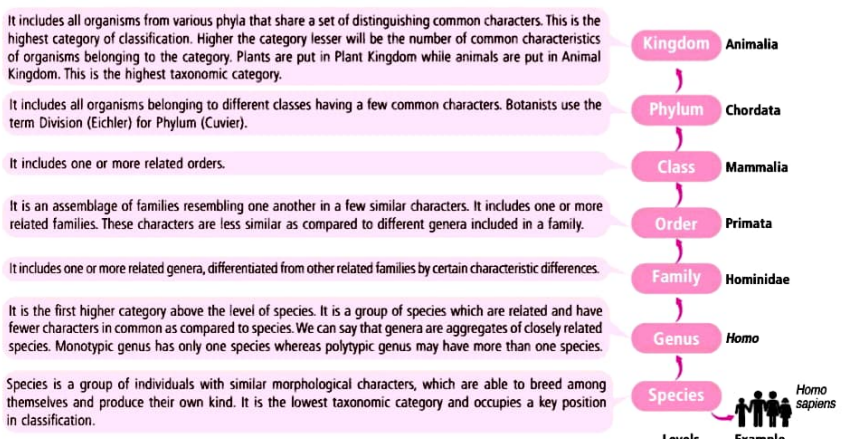


Fig.: Taxonomic catagories showing hierarchial arrangement in ascending order

- As we go higher from species to kingdom, the number of common characteristics goes on decreasing. Lower the taxa, more are the characteristics that the members within the taxon share. Higher the category, greater is the difficulty of determining the relationship to other taxa at the same level. Hence, the problem of classification becomes more complex.

Table: Organisms with their taxonomic categories

Common Name	Biological Name	Genus	Family	Order	Class	Phylum/Division
Man	*Homo sapiens*	*Homo*	Hominidae	Primata	Mammalia	Chordata
Housefly	*Musca domestica*	*Musca*	Muscidae	Diptera	Insecta	Arthropoda
Mango	*Mangifera indica*	*Mangifera*	Anacardiaceae	Sapindales	Dicotyledonae	Angiospermae
Wheat	*Triticum aestivum*	*Triticum*	Poaceae	Poales	Monocotyledonae	Angiospermae

INTEXT PRACTICE QUESTIONS

3. **Name the highest category of classification system.**
4. **Who gave the Binomial Nomenclature?**

Biological Classification

- The scientific procedure of arranging organisms into groups and subgroups on the basis of their similarities and dissimilarities and placing them in taxonomic hierarchy, is known as biological classification.
- A classification system helps in identification of organisms and understanding the relationships amongst different groups of organisms.
- The organisms of the past can be studied only with a proper system of classification and evolutionary tendencies can be known on the basis of relationship and simplicity or complexity found in the members of various taxa.

TYPES OF CLASSIFICATION SYSTEM

- Depending upon the type of system of classification, organisms are classified into two kingdoms, three kingdoms, four kingdoms, five kingdoms and now into six kingdoms.

Two Kingdom Classification

- Two kingdom classification system was suggested by Carolus Linnaeus (the father of taxonomy) in 1758.
- The organisms were divided into two kingdoms - **Kingdom Plantae** and **Kingdom Animalia**.
- Two kingdom system of classification did not distinguish between the eukaryotes and prokaryotes, unicellular and multicellular and photosynthetic (green algae) and non-photosynthetic (fungi) organisms. Hence, two kingdom classification was found inadequate.

Three Kingdom Classification

- Haeckel (1866) separated unicellular animals, algae and fungi from other organisms on the basis of lack of tissue differentiation. The new group was called **Kingdom Protista**.
- Later on fungi and multicellular algae were taken out from the group so that Kingdom Protista came to have only unicellular organisms. The organisms were divided into three Kingdoms : Plantae, Protista and Animalia.

Four Kingdom Classification

- With the discovery of electron microscope, it became clear that bacteria and related organisms have a different nuclear structure as compared to others.
- They are **prokaryotes** in contrast to others which have a true nucleus and are called **eukaryotes**.
- Copeland (1956) created a separate **Kingdom Monera** for them.
- This divided the living world into four Kingdoms : Monera, Protista, Plantae and Animalia.
- In this system, fungi continued to remain with the plantae.

Five Kingdom Classification

- Five kingdom classification was proposed by an American taxonomist, R.H. Whittaker (1969).
- The kingdoms were named Monera, Protista, Fungi, Plantae and Animalia.

- The main criteria for classification used by him include cell structure, thallus organisation, mode of nutrition, mode of reproduction and phylogenetic relationships.

Table: Characteristics of the five kingdoms

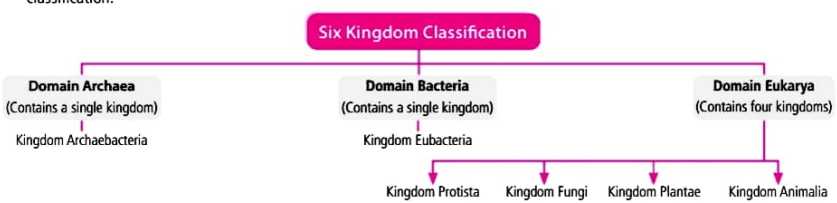
Characters	Five Kingdoms				
	Monera	**Protista**	**Fungi**	**Plantae**	**Animalia**
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Non-cellulosic (Polysaccharide + amino acid)	Present in some	Present (with Chitin)	Present (with cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular	Cellular	Multicellular/ loose tissue	Tissue/organ	Tissue/organ/ organ system
Mode of nutrition	Autotrophic (chemosynthetic and photosynthetic) and heterotrophic (saprophytic/parasitic)	Autotrophic (photosynthetic) and heterotrophic	Heterotrophic (saprophytic/ parasitic)	Autotrophic (photosynthetic)	Heterotrophic (holozoic/ saprophytic, etc.)
Mode of reproduction	Conjugation	Gametic fusion and conjugation	Fertilisation	Fertilisation	Fertilisation

Shortcomings of five kingdom classification

- The Kingdoms Monera and Protista are still heterogenous groups. Both include photosynthetic (autotrophic) and non-photosynthetic (heterotrophic), walled and wall-less organisms.
- Phylogenetic relationships, particularly of lower organisms, are not fully reflected. For example, certain green algae and some photosynthetic bacteria get hydrogen from sources other than water but these are assigned to different kingdoms.
- A distinction between unicellular and multicellular organisms is not possible in case of algae. Due to this, unicellular green algae such as *Chlamydomonas*, *Volvox*, etc., have not been included in the Kingdom Protista.
- Viruses have not been included in this system of classification.
- Archaebacteria differ from other bacteria in structure, composition and physiology.

Three Domains of Life (Six Kingdom Classification)

- The three-domain system was introduced by Carl Woese (1990) that divides cellular life forms into **archaea, bacteria** and **eukarya** domains.
- It emphasises the separation of prokaryotes into two groups, originally called Eubacteria (now Bacteria) and Archaebacteria (now Archaea).
- Thus, the three-domain system divides the monera into two 'domains', leaving the remaining eukaryotic kingdoms in the third domain.
- It is actually a six kingdom classification.



KINGDOM MONERA

- It is a kingdom of prokaryotes, therefore, also known as prokaryota.
- Two major groups of monera include: **Archaebacteria** and **Eubacteria**. Eubacteria is further of two types : **bacteria** and **cyanobacteria (blue green algae)**.
- The true nucleus with nuclear membrane is absent in bacterial cell. The nuclear material consisting of naked DNA molecule is called as **nucleoid**.
- A layer of slime over the cell wall is present in bacterial cell. It is usually composed of polysaccharides.
- Bacterial cell wall consists of acetyl glucosamine, acetyl

muramic acid and a peptide chain of four or five amino acids. All these chemicals together form a polymer called **peptidoglycan**.

- A thin, elastic and selectively permeable plasma membrane is situated just internal to the cell wall in each bacterial cell.
- In many bacteria the plasma membrane gives rise to infoldings called **mesosomes** which participate in the separation of replicated nucleoid and formation of septa during cell division.
- The ribosomes in bacteria are of 70S type.
- Many bacteria (*e.g., E.coli*) have accessory rings of DNA called **plasmids** in addition to bacterial chromosomes. The plasmid DNA replicates independently and maintain independent integrity.
- Bacteria reproduce asexually by **binary fission**. Sometimes under unfavourable conditions, they produce spores.
- Sexual reproduction or genetic recombination in bacteria takes place by three methods: **conjugation**, **transformation** and **transduction**.
- Based on their shape bacteria are grouped under four categories : the spherical **coccus**, the rod shaped **bacillus**, the comma shaped **vibrio** and the spiral **spirillum**.
- Bacteria show both autotrophic and heterotrophic nutrition.
- Autotrophic nutrition is of two types : chemosynthesis and photosynthesis. The bacteria performing these modes of nutrition are called **chemoautotrophs** and **photoautotrophs** respectively.
- Heterotrophic nutrition is of three types : saprotrophic, symbiotic and parasitic.
- Some of them can fix atmospheric nitrogen in specialised cell called heterocysts, *e.g., Nostoc* and *Anabaena*.
- **Archaebacteria** are a group of most primitive prokaryotes characterised by the absence of peptidoglycan in their cell wall.
- Archaebacteria are of three major types: **methanogens, halophiles** and **thermoacidophiles**. Methanogens are present in the gut of several ruminant animals such as cows and buffaloes and they are responsible for production of methane from dung of these animals. Methanogens are obligate anaerobes and produce methane in biogas fermenters, *e.g., Methanobacterium, Methanococcus*. Halophiles are "salt-loving" bacteria as they are found in environment with a very high salt concentration. Thermoacidophiles (hot springs) live in extremely acidic environment that have extremely high temperatures. They are found in hot sulphur springs.
- Cyanobacteria (blue-green algae) are photosynthetic prokaryotes that have evolved more than 3 billion years back and paved the path for evolution of aerobic forms, including aerobic bacteria.

Mycoplasma (PPLO)

- Mycoplasmas are the simplest and the smallest of the free living prokaryotes. The organisms are often called PPLOs (Pleuro pneumonia like organisms). A cell wall is absent and plasma membrane forms the outer boundary of the cell. Due to the absence of cell wall the organisms can change their shape and are called pleomorphic. Mycoplasmas are heterotrophic in their nutrition and can survive without oxygen.

KINGDOM PROTISTA

- Kingdom Protista includes all the unicellular eukaryotic organisms. Phylogenetically, the Kingdom Protista acts as a connecting link between the prokaryotic Kingdom Monera on one hand and the complex multicellular Kingdoms Fungi, Plantae and Animalia on the other hand.
- These are microscopic unicellular and eukaryotic organisms with cosmopolitan habitat. Many protists are found in water bodies in the form of plankton.
- The cell body contains well defined nucleus.
- The cell is surrounded by plasma membrane and well developed membrane bound organelles are present inside the cell.
- Mode of nutrition may be photosynthetic, holozoic, saprotrophic, parasitic and symbiotic etc.
- Most of free living protists perform aerobic respiration, however, the parasitic protists respire anaerobically.
- Protists reproduce by both asexual and sexual methods involving cell fusion and zygote formation.
- The major groups of protists include **chrysophytes**, **dinoflagellates**, **euglenoids**, **slime moulds** and **protozoans**.
- **Chrysophytes** include diatoms and golden algae. They are found in fresh water as well as in marine environments.
  - The cell walls of chrysophytes are embedded with silica and thus are indestructible.
  - Chrysophytes produce diatomaceous earth and are the chief 'producers' in the oceans.
- **Dinoflagellates** are mostly marine and photosynthetic. They appear yellow, green, brown and

blue or red depending on the main pigment present in their cells.

- Majority of **euglenoids** are fresh water organisms found in stagnant water. A protein rich layer called pellicle is present instead of a cell wall which makes their body flexible.
- Euglenoids are photosynthetic in the presence of sunlight, however, when deprived of sunlight they behave like heterotrophs.
- **Slime moulds** are saprophytic protists. They form an aggregate called **plasmodium** which may move and **spread** over several feet under favorable conditions.
- **Protozoans** are heterotrophs and live as predators or parasites. They are considered to be primitive relatives of animals.
- Four major groups of protozoans are as follows :

– **Amoeboid protozoans :** They live in freshwater, sea water or moist soil. They move and capture their prey with the help of pseudopodia. Some of them such as *Entamoeba* are parasites.

– **Flagellated protozoans :** The members of this group are either free-living or parasitic. They have flagella. The parasitic forms such as *Trypanosoma* cause disease called sleeping sickness.

– **Ciliated protozoans :** These are aquatic and actively moving organisms because of presence of thousands of cilia, *e.g., Paramecium.*

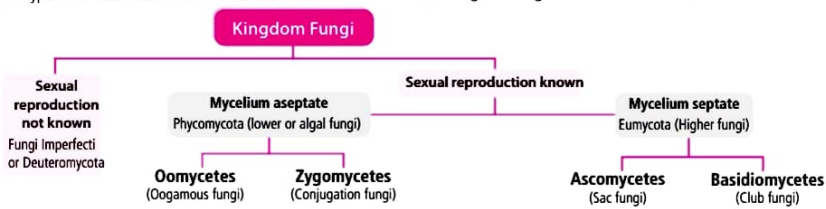
– **Sporozoans :** These include diverse organisms that have an infectious spore-like stage in their life cycle, *e.g., Plasmodium.*

Intext Practice Questions

5. **Which group of protista is photosynthetic in the presence of sunlight and behave like heterotrophs when deprived of sunlight?**
6. **How does archaebacteria differ from eubacteria?**

KINGDOM FUNGI

- They are achlorophyllous, heterotrophic, spore-forming, non-vascular, eukaryotic organisms which often contain chitin or fungal cellulose in their cell walls and possess glycogen as food reserve.
- They have absorptive type of nutrition and are parasites or saprotrophs.
- The body of fungus is filamentous and is called mycelium. The filaments are known as hyphae.
- Hyphae are either multicellular or multinucleate.
- Reproduction is of three types : sexual, vegetative and asexual.
- Vegetative reproduction occurs by **budding, fission, fragmentation, sclerotia** and **rhizomorphs**.
- Asexual reproduction occurs through the formation of different type of spores.
- Sexual reproduction occurs by planogametic copulation, gametangial contact, gametangial copulation, spermatogamy and somatogamy.
- Kingdom Fungi is classified as follows :



- In **oomycetes** the mycelium is coenocytic (multinucleate and aseptate).
- Asexual reproduction involves the formation of spore containing sacs or sporangia which produce zoospores in aquatic environment. In terrestrial environment, the sporangia often behave as spores and equivalent to conidia.
- Zoospores are usually biflagellate.
- Gametes are usually non-flagellate.
- Sexual reproduction takes place by gametangial contact and the product of sexual reproduction is oospore.
- Some examples are *Albugo candida*, *Phytophthora infestans*, *Pythium debaryanum*.
- **Zygomycetes** is a class of terrestrial fungi which are mostly saprotrophic, rarely parasitic.
- The mycelium is coenocytic.
- Motile cells are absent. Sexual reproduction occurs through gametangial copulation or conjugation.
- The gametes are multinucleate and are called coenogametes.
- Sexual reproduction produces a diploid spore called zygospore.
- Some examples are *Rhizopus stolonifer*, *Mucor pusillus*, *Pilobolus crystallinus*.
- **Ascomycetes** include pigmented moulds, yeasts, morels, truffles, cup fungi and powdery mildews. The mycelium consists of septate hyphae.
- Motile structures do not occur in the life cycle.
- The common mode of asexual reproduction is through the formation of conidia. However, in yeasts asexual reproduction occurs through budding and fission. Oidia stage is found in some other ascomycetes. Sexual reproduction takes place through gametangial contact.
- Fertilisation takes place in two steps **plasmogamy** and **karyogamy**.
- Karyogamy is delayed after plasmogamy and a new transitional phase called **dikaryophase** appears in the life cycle.
- The cells of dikaryophase are called dikaryotic cells. Each cell possesses two nuclei (n + n). Later the two nuclei fuse and the cells become diploid.
- The fungi form fruiting bodies, in which reduction division occurs, leading to formation of haploid spores.
- Some examples are yeast, *Aspergillus*, *Penicillium*, *Claviceps* and *Neurospora*.
- **Basidiomycetes** grow in soil on logs and in living plant bodies as parasites.
- The mycelium is septate and branched. Septa have dolipores (pores with barrel shaped outgrowths). Vegetative reproduction occurs by **fragmentation**. The asexual spores are not found. The sex organs are absent but plasmogamy is brought about by fusion of two vegetative or somatic cells of different strains or genotypes. The resultant structure is **dikaryotic** which gives rise to basidium.

ANSWERS MARCH 2024

Across

1. Erythropoietin
3. Ultrafiltration
5. Troponin
7. Analogous

Down

2. *Neem*
4. Protozoa
6. Allergy
8. Operculum

Winner : Nisha Santra (West Bengal)

- Karyogamy and meiosis takes place in the basidium producing four basidiospores.
- Some examples are *Agaricus*, *Ustilago* and *Puccinia*.
- Deuteromycetes are commonly known as imperfect fungi because only the asexual or vegetative phases of these fungi are known.
- Some members of deuteromycetes are saprophytes or parasites while a large number of them are decomposers of litter and help in **mineral cycling**.
- The mycelium is septate and branched. The deuteromycetes reproduce only by asexual spores known as **conidia**.
- Some examples are *Trichoderma*, *Alternaria* and *Colletotrichum*.

Most fungi are heterotrophic and absorb soluble organic matter from dead substrates and hence are called saprophytes. Those fungi depend on living plants and animals are called parasites. They can also live as symbionts *i.e.*, in association with algae as lichens and with roots of higher plants as mycorrhiza.

KINGDOM PLANTAE

- It includes all eukaryotic chlorophyll containing organisms commonly called **plants**.
- A few members such as bladderwort and Venus fly trap are insectivorous while few others such as *Cuscuta* are parasitic.
- Kingdom Plantae includes **algae, bryophytes, pteridophytes, gymnosperms** and **angiosperms**.
- Two distinct phases are present in life cycle of plants : the diploid sporophytic phase and the haploid gametophytic phase that alternate with each other.
- These two phases follow each other rigidly but in different patterns in different plant groups. This phenomenon is called **alternation of generation**.

KINGDOM ANIMALIA

- This kingdom is characterised by heterotrophic, eukaryotic organisms that are multicellular and their cells lack cell walls.
- They depend directly or indirectly on plants for food. The mode of nutrition is by ingestion of food, *i.e.*, **holozoic**.
- The food reserves are stored as glycogen or fat. Most of them are capable of locomotion. They have a definite shape and size and follow a definite growth pattern also.
- The sexual reproduction takes place by copulation of male and female followed by embryological development.

VIRUSES, VIROIDS AND LICHENS

- The name virus was given by Pasteur. D.J. Ivanowsky (1892) is credited with the discovery of virus. Beijerinck (1896), called it *contagium vivum fluidum*.
- The viruses are ultramicroscopic, highly infectious agents and non-cellular organisms characterised by having an inert crystalline structure outside the living cell.
- Once they infect a cell they take over the machinery of the host cell to replicate themselves, killing the host.
- Viruses contain **capsid**, the proteinaceous covering and genetic material, that could be either DNA or RNA.
- Viruses that infect plants have single stranded RNA while those that infect animals have either single or double stranded RNA or double stranded DNA. Bacteriophages are usually double stranded DNA viruses.
- In humans, viruses cause diseases like mumps, smallpox, herpes, influenza and AIDS.
- In plants, the symptoms of virus infection can be mosaic formation, leaf rolling, yellowing, leaf curling and stunted growth.
- Stanley (1935) crystallised Tobacco Mosaic Virus (TMV) for the first time.
- An inert virus is called virion that can be crystallised and stored indefinitely.
- **Viroids** are the smallest self replicating particles discovered by Diener (1971). Viroids are infectious RNA particles devoid of protein coat. Like viruses, they are obligate parasites.
- Viroids are known to cause diseases in plants only, *e.g.*, Potato spindle tuber chrysanthemum stunt.
- Prions are highly resistant glycoprotein particles which function as infectious agents. Prions are not affected by proteases, nucleases, temperature upto 800°C, UV radiation and formaldehyde. Prions accumulate in nervous tissue and bring about its degeneration. Common diseases caused by them are mad cow disease, scrapie of sheep, kuru, Creutzfeldt-Jakob disease (CJD). Prions were discovered by Prusiner (1983).
- **Lichens** are dual organisms or entities which contain a permanent association of a fungus or **mycobiont** and an alga or **phycobiont**.
- The algal component is autotrophic while fungal component is heterotrophic.
- Algae prepare food for fungi and fungi provide shelter and absorb mineral nutrients and water for algae.
- Lichens cannot tolerate air pollution especially due to sulphur dioxide.

INTEXT PRACTICE QUESTIONS

7. **Name the scientist who crystallised Tobacco Mosaic Virus (TMV) for the first time.**
8. **Why deuteromycetes are called imperfect fungi?**

Check Your Vitals for NEET

Maximise your chance of success in medical entrance exams by reading this article. This section is specially designed to optimise your preparation by practising more and more. It is a unitwise series having chapterwise question bank, allowing you to prepare systematically and become more competent.

- Recall question or single concept question – indicated by a single finger.
- Application question or question which requires 2 or 3 concepts - indicated by 2 fingers.
- Application question or question which requires 3 or more concepts - indicated by 3 fingers.

UNIT-I : DIVERSITY IN THE LIVING WORLD

CHAPTER 3 : PLANT KINGDOM

Multiple Choice Questions

1. Which of the following is/are edible algae?
   (a) *Porphyra* (b) *Sargassum*
   (c) *Laminaria* (d) All of these

2. In rhodophyceae, major photosynthetic pigments include
   (a) Chlorophyll a and c
   (b) Chlorophyll a and d
   (c) Chlorophyll a and b
   (d) Chlorophyll b and d.

3. *Ulothrix* is an unbranched, green, filamentous alga where the sexual reproduction is
   (a) isogamous type
   (b) oogamous type
   (c) anisogamous type
   (d) both (a) and (b).

4. Which of the following groups is present in Class Pteropsida?
   (a) *Psilotum, Lycopodium, Adiantum*
   (b) *Equisetum, Selaginella, Pteris*
   (c) *Equisetum, Pteris, Psilotum*
   (d) *Dryopteris, Adiantum, Pteris*

5. From which of the following algae, agar is commercially extracted?
   I. *Sargassum* II. *Gelidium*
   III. *Gracilaria* IV. *Polysiphonia*
   V. *Volvox*
   (a) III and V (b) II and III
   (c) IV and V (d) I and II

6. Which taxonomy carried out using computers is based on all observable characteristics?
   (a) Cytotaxonomy
   (b) Chemotaxonomy
   (c) Numerical taxonomy
   (d) Both (a) and (c)

7. Haplo-diplontic life cycle pattern is found in
   (a) bryophytes and pteridophytes
   (b) algae and bryophytes
   (c) bryophytes and gymnosperms
   (d) bryophytes and angiosperms.

8. In pteridophytes, spore germinates to give rise to
   (a) thalloid gametophyte called prothallus
   (b) thalloid sporophyte called prothallus
   (c) sporophytic protonema
   (d) thalloid, photosynthetic sporophyte.

9. Select the incorrect statement about mosses.
   (a) Rhizoids are multicellular and branched.
   (b) Sporophyte is differentiated into foot, seta and capsule.
   (c) Both seta and capsule bear spores, which give rise to gametophyte after mitosis.
   (d) Sex organs are produced at the apex of leafy shoots.

10. In gymnosperm life cycle, the haploid phase is represented by
    (a) male and female cone
    (b) microsporophyll and megasporophyll
    (c) microspores and megaspores
    (d) all of these.

11. *Selaginella* and *Salvinia* are considered to represent a significant step towards 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 is surrounded by seed coat
(d) embryo develops into young embryos within the female gametophyte.

12. Select the number of correct statements among the following.
(i) In liverworts, the plant body is thalloid.
(ii) Antheridium is present in sporophyte of pteridophytes.
(iii) Archegonia is absent in angiosperms.
(iv) In gymnosperms, megasporophyll contains pollen grains.
(v) In algae, sexual reproduction is absent.
(a) 2 (b) 3
(c) 1 (d) 5

13. Identify A, B, C and D in the given table of different algae and their characteristics.

Algae	Stored food	Flagellar number
A	Floridean starch	Absent
Cholorophyceae	B	2 – 8
C	Mannitol	D

Select the correct option.

	A	B	C	D
(a)	Phaeophyceae	Starch	Rhodophyceae	2
(b)	Phaeophyceae	Laminarin	Rhodophyceae	Absent
(c)	Rhodophyceae	Starch	Phaeophyceae	2
(d)	Rhodophyceae	Starch	Phaeophyceae	Absent

14. The coralloid roots of which plant is associated with N_2-fixing cyanobacteria?
(a) *Pinus* (b) *Cycas*
(c) *Ginkgo* (d) *Sequoia*

15. Pyrenoids are structures made of
(a) protein and stored starch
(b) starch and stored lipids
(c) protein and stored lipids
(d) all of these.

Match The Columns

16. Match column I with column II.

	Column I		Column II
A.	Psilopsida	(i)	*Dryopteris*
B.	Lycopsida	(ii)	*Equisetum*
C.	Sphenopsida	(iii)	*Selaginella*
D.	Pteropsida	(iv)	*Psilotum*

17. Match column I with column II. (There can be more than one match for items in column I).

	Column I		Column II
A.	Ice creams and jellies	(i)	*Gelidium*
B.	Food supplement for space travellers	(ii)	*Selaginella*
C.	Heterosporous pteridophytes	(iii)	*Chlorella*
D.	Enclosed seeds	(iv)	*Salvinia*
E.	Naked seeds	(v)	*Eucalyptus*
		(vi)	*Gracilaria*
		(vii)	*Ginkgo*
		(viii)	*Woffia*
		(ix)	*Pinus*

Passage Based Questions

18.(A) Complete the given passage with appropriate words or phrases.

In majority of the pteridophytes, all homosporous the spores are of similar (i) kinds; such kinds of plants are known as (ii). Genera like (iii) and (iv) produce dissimilar spores (large and small) thus, are known as heterosporous. These (v) and (vi) germinate and give rise to female and male gametophyte, respectively. The female gametophytes are retained on the parent (vii) for variable periods. The development of zygote into young embryos take place within the female gametophytes. This particular event is precursor to (viii) habit and considered an important step in evolution.

(B) Read the given passage and correct the errors, wherever present.

The earliest systems of classification used only gross superficial morphological characters. They were mainly based on sexual characters. Such system given by Whittaker were called artificial. As against this, natural classification systems were based on natural affinities among the organisms. The natural system of classification was based on many characteristics and the classification separated the closely related species. In artificial system, unequal weightage was given to vegetative and sexual characteristics. Since the sexual characters are more easily affected by environment, this system of classification is not acceptable. Presently, numerical classification systems which is entirely based on evolutionary relationships between the various organisms are acceptable.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :
(a) If both A and R are true and R is the correct explanation of A.
(b) If both A and R are true but R is not the correct explanation of A.
(c) If A is true but R is false.
(d) If A is false but R is true.

19. **Assertion :** Gymnosperms are homosporous.
Reason : Gymnosperm produce haploid microspores and megaspores.

20. **Assertion :** The main plant body of bryophyte is known as gametophyte.
Reason : Gametophyte is haploid and produces gamete.

21. **Assertion :** Pteridophytes are the first terrestrial plants to possess vascular tissues, xylem and phloem.
Reason : Pteridophytes are found in cool, damp and shady places.

22. **Assertion :** In gymnosperms, female gametophytes have an independent free-living existence.
Reason : Gametophytes of gymnosperms remain within the sporangia retained on the sporophytes.

23. **Assertion :** Genera like *Selaginella* and *Salvinia* are heterosporous.
Reason : They produce two kinds of spores, a large macrospore and a small microspore.

24. **Assertion :** Mosses along with lichens are the first organisms to colonise rocks.
Reason : Mosses decompse rocks making the substrate suitable for growth of higher plants.

25. **Assertion :** In mosses, gametophyte consists of protonema and leafy stages.
Reason : The leafy stage bears the sex organs.

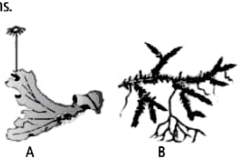
26. **Assertion :** Bryophytes are known as amphibian of plant kingdom.
Reason : Bryophytes can live in soil but are dependent on water for sexual reproduction.

27. **Assertion :** Asexual reproduction in *Marchantia* takes place by formation of a specialised structure called 'gemmae'.
Reason : Gemmae are green, unicellular, sexual buds which develop in gemma cups.

28. **Assertion :** In Rhodophyceae, the food is stored as complex carbohydrates, in the form of laminarin and mannitol.
Reason : Rhodophyceae contain the red pigment, r-phycoerythrin.

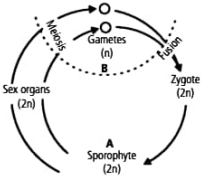
Figure Based Questions

29. Refer to the given figures and answer the following questions.



(a) Name the plants and their division respectively represented by the given figures A and B.
(b) Which plant belongs to the plant group known as Amphibians of the Plant Kingdom and why the plant group is named so?
(c) Write evolutionary importance of the division represented by plant B.

30. Study the given figure answer the following questions.



(a) Identify the type of life cycle along with A and B shown in the given figure.
(b) Name the divisions showing this type of life cycle.
(c) Write the difference between stage A and B.

CHAPTER 4 : ANIMAL KINGDOM

Multiple Choice Questions

1. Read the following statements and select the correct one.
(a) Phylum Arthropoda is the second largest animal phylum.
(b) Presence of water vascular system is the distinctive feature of echinoderms.
(c) Malpighian tubules help in osmoregulation and digestion.
(d) Bioluminescence is the well-marked property in coelenterates.

2. Which of the following is not a flight adaptation in birds?
(a) Presence of feathers
(b) Well developed crop and gizzard
(c) Presence of pneumatic bones
(d) Both (a) and (b)

3. Read the following features.
(i) Mammary glands are present.
(ii) Heart is four chambered.
(iii) Hairs are present on skin.
(iv) Pinnae are present.
Identify the class from the given characters.
(a) Reptilia (b) Mammalia
(c) Aves (d) Amphibia

4. Which of the following snakes is/are poisonous?
(a) *Naja* (b) *Bungarus*
(c) *Vipera* (d) All of these

5. Which one of the following is not a characteristic feature of the Class Reptilia?
(a) Skin bears epidermal scales or scutes
(b) They are oviparous
(c) Usually four chambered heart is present
(d) Tympanum represents ear

6. Which of the following groups is formed of only the hermaphrodite organisms?
(a) Earthworm, tapeworm, housefly, frog
(b) Earthworm, tapeworm, sea horse, housefly
(c) Earthworm, leech, sponge, roundworm
(d) Earthworm, tapeworm, leech, sponge

7. Which one of the following is correct matching pair of a body feature and the animal possessing it?
(a) Ventral central nervous system – *Hirudinaria*
(b) Pharyngeal gill slits absent in embryo – *Chameleon*
(c) Ventral heart – *Balanoglossus*
(d) Post-anal tail present – *Octopus*

8. Which one of the following pairs of animals is correctly matched with the kind of their body symmetry?
(a) *Hydra* and shark - Bilateral symmetry
(b) Tapeworm and *Octopus* - Radial symmetry
(c) *Amoeba* and sea urchin - Asymmetry
(d) Jellyfish and *Obelia* - Radial symmetry

9. Identify the vertebrate group of animals characterised by crop and gizzard in its digestive system.
(a) Amphibia
(b) Reptilia
(c) Aves
(d) Osteichthyes

10. Identify A, B and C in the given table and select the correct option.

Phylum	Symmetry & level of organisation	Distinctive features
Ctenophora	**A**	Comb plates for locomotion
B	Bilateral symmetry with organ system level of organisation	Body segmentation like rings
Echinodermata	Radial symmetry with organ system level of organisation	**C**

UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

Column I	Column II
1. IYTPALISTC	(a) The process of fusion of two nuclei.
2. EASNKISTROETP	(b) The arrangement of veins and veinlets in the lamina of leaf.
3. INETOVAN	(c) The process of removal of anthers from a bisexual flower during artificial hybridisation.
4. LATINOTSA	(d) A phenomenon of single step large mutation.
5. AYGKYORMA	(e) A sex linked recessive disease in which protein involved in blood clotting is affected.
6. ULAEMCSNTOIA	(f) The ability of plant to form different kinds of structure in response to environment or phases of life.
7. DORNF	(g) A limbless amphibian.
8. PHEAIIALMHO	(h) A genetically modified enzyme used for removing clots from blood vessels.
9. YSIHPIHCTOH	(i) The leaf-like photosynthetic organ of algae.
10. TMEPUAT	(j) The innermost wall layer of a microsporangium.

Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month. Winners' names and answers will be published in next issue.

	A	B	C
(a)	Tissue level organisation and radial symmetry	Annelida	Water vascular system
(b)	Tissue level organisation and bilateral symmetry	Annelida	Jointed appendages
(c)	Cellular level organisation and radial symmetry	Aschel-minthes	Water vascular system
(d)	Organ system level organisation and bilateral symmetry	Aschel-minthes	Flat body and suckers

11. Heart of crocodile comprises of
(a) one auricle and two ventricles
(b) one auricle and one ventricle
(c) two auricles and one ventricle
(d) two auricles and two ventricles.

12. Which is not true regarding *Balanoglossus*?
(a) Their body is divisible into proboscis, collar and trunk
(b) They have gills for respiration
(c) They have stomochord
(d) Excretion occurs through parapodia

13. Select the mismatched pair.
(a) *Pennatula* – Sea pen
(b) *Adamsia* – Sea anemone
(c) *Asterias* – Brain coral
(d) *Gorgonia* – Sea fan

14. Which of the following is not present in the members of Phylum Porifera?
(a) Choanocytes (b) Ostia
(c) Flame cells (d) Canal system

15. Read the given statements and select the correct option.
(i) Coelenterates exhibit metagenesis.
(ii) In *Pleurobrachia*, locomotion takes place by comb plates.
(iii) In roundworm, true coelom is present.
(iv) Parapodia are respiratory organs found in arthropods.
Of the above statements
(a) only (i) and (iv) are correct.
(b) only (i) and (ii) are correct.
(c) only (iii) and (iv) are correct.
(d) only (ii) and (iii) are correct.

Match The Columns

16. Match column I with column II.

	Column I		Column II
A.	Mammals	(i)	Epidermal scales
B.	Aves	(ii)	Cartilaginous endoskeleton
C.	Reptilia	(iii)	Mammary Glands
D.	Osteichthyes	(iv)	Bony endoskeleton
E.	Chondrichthyes	(v)	Pneumatic bones

17. Match column I with column II. (There can be more than one match for items in column I).

	Column I		Column II
A.	Platyhelminthes	(i)	Choanocytes
B.	Ctenophora	(ii)	Scypha
C.	Porifera	(iii)	Flame cells
D.	Coelentrata	(iv)	Sea pen
E.	Annelida	(v)	Comb plates
		(vi)	Cnidoblasts
		(vii)	Nephridia
		(viii)	*Pleurobrachia*
		(ix)	Liver fluke
		(x)	*Nereis*

Passage Based Questions

18.(A) Complete the given passage with appropriate words or phrases.
Animals can be categorised on the basis of their symmetry. Sponges are mostly (i). In this kind of symmetry, any plane that passes through the centre does not divide them into (ii) halves. In (iii) symmetry, any plane passing through the central axis of the body divides the organism into two identical halves. This symmetry is shown by (iv), (v), and (vi). Animals like annelids, arthropods, etc., possess (vii) symmetry, where the body of the organism can be divided into identical left and right halves in only (viii) plane.

(B) Read the given passage and correct the errors, wherever present.
In cnidarians, cells are arranged as loose cell aggregates, which means they exhibit cellular level of organisation. Flatworms exhibit tissue level of organisation as the cells performing the different function are arranged into tissues. Tissues are then grouped together to form organs, each specialised for a particular function. In other higher phyla, organs are associated to form organ system. Organ systems in different groups of animals exhibit various patterns of complexities. In platyhelminthes, digestive system has double opening to the outside of the body and therefore is considered as complete digestive system. Circulatory system is closed type in arthropods. A complete digestive system is found in echinoderms with mouth on the dorsal side and anus on ventral side.

Assertion & Reason

In each of the following questions, a statement of Assertion (A) is given and a corresponding statement of Reason (R) is given just below it. Of the statements, mark the correct answer as :
(a) If both A and R are true and R is the correct explanation of A.
(b) If both A and R are true but R is not the correct explanation of A.
(c) If A is true but R is false.
(d) If A is false but R is true.

19. **Assertion :** In poriferans, development is indirect.
Reason : The developmental process in porifera includes a larval stage, which is morphologically similar to the adult.

20. **Assertion :** The body of ctenophores bears eight external rows of ciliated comb plates.
Reason : Comb plates help in locomotion.

21. **Assertion :** Aschelminthes are dioecious.
Reason : Female *Ascaris* is longer than male.

22. **Assertion :** Presence of water vascular system is characteristic feature of echinoderms.
Reason : Water vascular system helps in locomotion, food capturing and respiration.

23. **Assertion :** All vertebrates are chordates but all chordates are not vertebrates.
Reason : In vertebrates, the notochord is replaced by cartilaginous or bony vertebral column in the adults.

24. **Assertion :** Sting ray (*Trygon*) is poikilothermous.
Reason : Trygon does not have the ability to regulate their body temperature.

25. **Assertion :** All the members of animalia are multicellular
Reason : In animal kingdom, all the members exhibit the same pattern of organisation of cell.

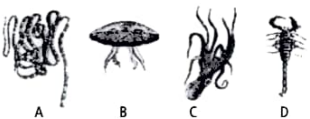
26. **Assertion :** Adult echinoderms show radial symmetry.
Reason : In radial symmetry, the body can be divided into two identical halves in only one plane.

27. **Assertion :** Platyhelminthes to chordates are triploblastic animals.
Reason : Developing embryo of triploblastic animals have a third germinal layer 'mesoderm' in between ectoderm and endoderm.

28. **Assertion :** Notochord is mesodermally derived rod-like structure formed on the ventral side of the body during embryonic development.
Reason : Animals having notochord possess a post anal tail and a closed circulatory system.

Figure Based Questions

29. Refer to the given figures and answer the following questions.



(a) Identify the animals A-D and also mention the phylum to which they belong.
(b) Which of the given animals is/are coelomates?
(c) Name the excretory organ of organisms A and D.

30. Refer the given figure and answer the following questions.

(a) Observe the given organism and mention its phylum, sub-phylum and class.
(b) Give any 3 characters of this class.
(c) Name any 2 other organisms of same class.

SOLUTIONS

CHAPTER 3 : PLANT KINGDOM

1.	(d)	2.	(b)	3.	(a)	4.	(d)	5.	(b)
6.	(c)	7.	(a)	8.	(a)	9.	(c)	10.	(c)
11.	(d)	12.	(a)	13.	(c)	14.	(a)	15.	(a)

16. A-(iv), B-(iii), C-(ii), D-(i)

17. A-(i, vi), B-(iii), C-(ii, iv), D-(v, viii), E-(vii, ix)

18. **(A)** (i) similar (ii) homosporous
(iii) *Selaginella* (iv) *Salvinia*
(v) megaspores (vi) microspores
(vii) sporophyte (viii) seed

(B) The earliest systems of classification used only gross superficial morphological characters. They were mainly based on ~~sexual~~ vegetative characters. Such system given by ~~Whittaker~~ Linnaeus were called artificial. As against this, natural classification systems were based on natural affinities among the organisms. The ~~natural~~ artificial system of classification was based on ~~many~~ few characteristics and the classification separated the closely related species. In artificial system, ~~unequal~~ equal weightage was given to vegetative and sexual characteristics. Since the ~~sexual~~ vegetative characters are more easily affected by environment, this system of classification is not acceptable. Presently, ~~numerical~~ phylogenetic classification systems which is entirely based on evolutionary relationships between the various organisms are acceptable.

19. (d) **20.** (b) **21.** (b) **22.** (d) **23.** (a)
24. (b) **25.** (b) **26.** (a) **27.** (c) **28.** (d)

29. **(a)** The given figures A and B represent female thallus of *Marchantia* (Division Bryophyta) and *Selaginella* (Division Pteridophyta), respectively.

(b) Plant A, *Marchantia* belongs to plant group bryophytes. Bryophytes are called amphibians of Plant Kingdom as they require an external layer of water on the soil surface for their existence. The external water is required for : (i) dehiscence of antheridia and archegonia (ii) swimming of male gametes to archegonia, (iii) protection from transpiration and hence desiccation as the plant body is not covered by cuticle (iv) supply of water to all parts through capillarity as vascular tissues are absent in them.

(c) In pteridophytes (B), female gametophytes are retained on the parent sporophytes for variable periods. The development of zygote into young embryos take place within the female gametophyte. This event is a precursor to the seed habit which is considered as an important step in evolution.

30. **(a)** The life cycle in the given figure is of diplontic type. A is the sporophytic generation while B is the gametophytic generation.

(b) All seed bearing plants *i.e.*, gymnosperms and angiosperms possess diplontic life cycle.

(c) Diploid sporophyte (A) is dominant, photosynthetic and independent phase of the plant, whereas the gametophytic (B) phase is represented by the single few celled haploid and dependent phase of the plant.

CHAPTER 4 : ANIMAL KINGDOM

1. (b) **2.** (b) **3.** (b) **4.** (d) **5.** (c)
6. (d) **7.** (a) **8.** (d) **9.** (c) **10.** (a)
11. (d) **12.** (d) **13.** (c) **14.** (c) **15.** (b)

16. A-(iii), B-(v), C-(i), D-(iv), E-(ii)

17. A-(iii, ix); B-(v, viii); C-(i, ii); D-(iv, vi); E-(vii, x)

18. **(A)** (i) asymmetrical (ii) equal
(iii) radial (iv) coelenterates
(v) ctenophores (vi) echinoderms
(vii) bilateral (viii) one

(B) In ~~cnidarians~~ sponges, cells are arranged as loose cell aggregates, which means they exhibit cellular level of organisation. Flatworms exhibit ~~tissue~~ organ level of organisation as the cells performing the ~~different~~ same function are arranged into tissues. Tissues are then grouped together to form organs, each specialised for a particular function. In other higher phyla, organs are associated to form organ system. Organ systems in different groups of animals exhibit various patterns of complexities. In platyhelminthes, digestive system has ~~double~~ single opening to the outside of the body and therefore is considered as ~~complete~~ incomplete digestive system. Circulatory system is ~~closed~~ open type in arthropods. A complete digestive system is found in echinoderms with mouth on ~~dorsal~~ ventral side and anus on ~~ventral~~ dorsal side.

19. (c) **20.** (b) **21.** (b) **22.** (b) **23.** (a)
24. (a) **25.** (c) **26.** (c) **27.** (a) **28.** (d)

29. **(a)** In the given figure,
A is Tapeworm : Phylum Platyhelminthes
B is *Aurelia* : Phylum Coelenterata
C is Octopus : Phylum Mollusca and
D is Scorpion : Phylum Arthropoda

(b) The animals which possess true coelom are called coelomates. Octopus (C) and Scorpion (D) are coelomates.

(c) In tapeworm (A), specialised cells called flame cells help in excretion and in scorpion (D), excretion takes place through malpighian tubules.

30. **(a)** The given organism is turtle.
Phylum - Chordata
Sub-phylum - Vertebrata
Class - Reptilia

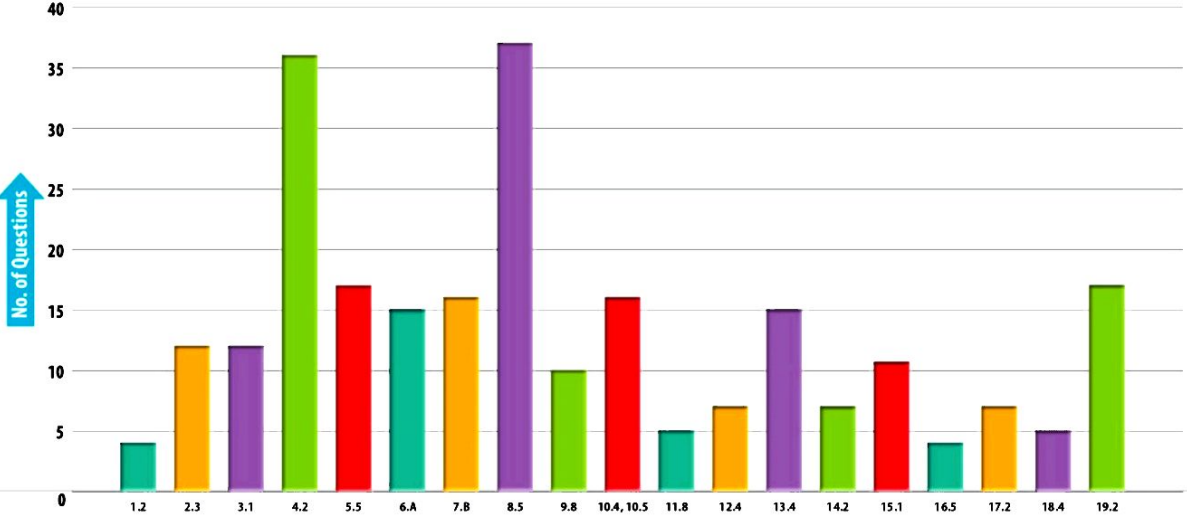
(b) Characters of Class Reptilia are :
(i) These are creeping and cold blooded vertebrates.
(ii) Skin is dry, rough and without glands.
(iii) They have 3-chambered heart, 2 auricles and partially divided ventricles.

(c) *Calotes* (Garden lizard)
Naja naja (Cobra)

Are You Ready for NEET 2024?

Class 11

Past 10 Years (2014-2023) Chapterwise Trend Analysis of NEET Questions



6.A represents the topic 'Secondary Growth' and 7.B represents the topic 'Animal Tissues'

**These are the topics from where maximum number of questions have been asked in the past 10 years.*

Some of the important topics extracted from the graphical analysis are explained here with HD images.

01 The Living World

Taxonomic Categories

Taxonomic Categories in Ascending Order

As we go higher from kingdom to species, the number of common characteristics goes on increasing. Higher the taxa, lesser are the characteristics that the members within the taxon share. Lower the category, lesser is the difficulty of determining the relationship to other taxa at the same level.

02 Biological Classification

Kingdom Fungi

Classification

Kingdom Fungi

Sexual reproduction (known)

Mycelium aseptate, coenocytic

Phycomycota (Lower or algal fungi)

- Asexual reproduction : Zoospores, aplanospores
- Sexual reproduction : Isogamy, oogamy, anisogamy
- *E.g., Mucor, Rhizopus, Albugo*

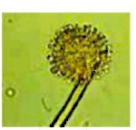
Rhizopus

Mycelium septate, branched

Eumycota (Higher fungi)

Ascomycetes (Sac fungi)

- Saprophytic, decomposers, parasitic or coprophilous
- Mycelium, branched
- Asexual reproduction : Conidiophores
- Sexual reproduction : Ascospores (endogenously)
- *E.g., Penicillium, Saccharomyces, Aspergillus*



Aspergillus

Basidiomycetes (Club fungi)

- Vegetative reproduction : Fragmentation
- Basidiospores are produced exogenously on basidium
- *E.g., Agaricus, Ustilago, Puccinia*

Agaricus

Sexual reproduction (not known)

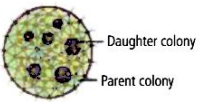
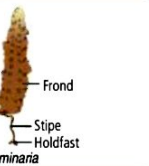
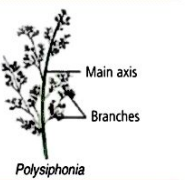
Deuteromycota (Fungi Imperfecti)

- Mycelium usually septate, branched
- Asexual reproduction : Conidia
- Sexual reproduction : Absent or not known
- *E.g., Trichoderma, Alternaria, Colletotrichum*

03 Plant Kingdom

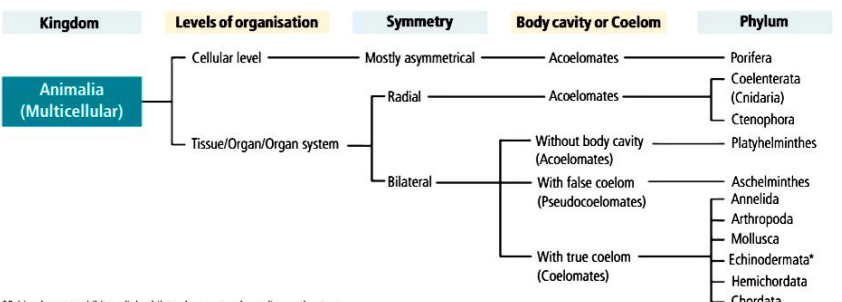
Algae

Classification

Classes (Common name)	Structure	Major pigments	Store food	Examples
Chlorophyceae (Green algae)	Unicellular, colonial, filamentous, cell wall cellulosic, motile cells with 2-8, apical equal flagella.	Chl *a* and *b*	Starch	 *Volvox*
Phaeophyceae (Brown algae)	Branched, filamentous, cell wall composed of cellulose and algin, motile cells with 2 unequal, lateral flagella	Chl *a* and *c*, fucoxanthin	Laminarin, mannitol	 *Laminaria*
Rhodophyceae (Red algae)	Mostly multicellular, filamentous, cell wall pecto-cellulosic and motile cells not known.	Chl *a* and *d*, phycoerythrin	Floridean starch	 *Polysiphonia*

04 Animal Kingdom

Classification of Animals



*Echinodermata exhibits radial or bilateral symmetry depending on the stage

05 Morphology of Flowering Plants

The Flower

Types of the flower on the basis of position of floral parts on thalamus.

(i) Hypogynous (Superior) *E.g.*, Mustard, China rose, Brinjal;
(ii) Perigynous (Half inferior) *E.g.*, Plum, Rose, Peach;
(iii) Epigynous (Inferior) *E.g.*, Guava, Cucumber

Types of placentation

(i) **Marginal** (*e.g.*, Pea)
(ii) **Axile** (*e.g.*, China rose, tomato);
(iii) **Parietal** (*e.g.*, Mustard, *Argemone*);
(iv) **Free central** (*e.g.*, *Dianthus*, Primrose);
(v) **Basal** (*e.g.*, Sunflower, marigold)

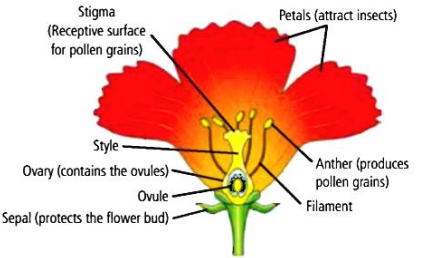


Fig.: A typical flower

06 Anatomy of Flowering Plants

Secondary Growth

- **Spring wood/Early wood :** Wood formed during spring season, more active cambium, large number of xylary elements, vessels with wider cavities.
- **Autumn wood/Late wood :** Wood formed during winter, cambium less active, few xylary elements and narrow vessels.
- **Heartwood :** Central wood of an old stem, dark coloured dead elements, highly lignified walls, living cells absent and provide mechanical support to stem.
- **Sapwood :** Outer wood of an old stem, light coloured, living cells present and provides conduction of water and minerals from root to leaf.

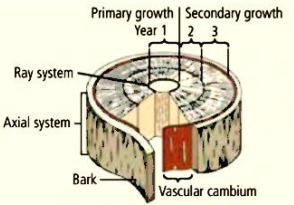


Fig.: Diagram of a woody stem showing the growth increment as annual rings

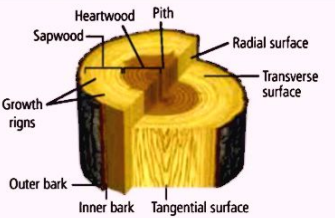


Fig.: T.S. of a tree trunk

07 Structural Organisation in Animals

Animal Tissues

Types of epithelial tissues

Simple epithelium

- Composed of a single layer of cells
- Functions as a lining for body cavities, ducts and tubes

On the basis of structural modification of cells

- Squamous → Air sacs of lungs, walls of blood vessels
- Cuboidal → Tubular parts of nephron in kidneys
- Columnar → Lining of stomach and intestine
- Ciliated → Bronchioles, fallopian tubes

Compound epithelium

- Consists of two or more cell layers
- Protective in function

Muscle tissue (Movement of body)

- Skeletal tissues (*e.g.*, biceps)
- Smooth muscles (*e.g.*, walls of internal organs)
- Cardiac muscles (*e.g.*, heart)

Connective tissues

Loose connective tissues
Cells and fibres loosely arranged in a semi-fluid ground substance.
- Areolar tissue
- Adipose tissue

Dense connective tissues
Tightly packed collagen fibres and fibroblasts..

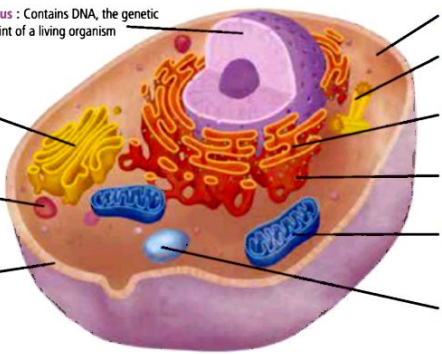
Dense irregular connective tissue
Consists of fibroblasts and many fibres (mostly collagen) that are oriented differently. *E.g.*, skin.

Dense regular connective tissue
Collagen fibres present in rows between many parallel bundles of fibres. *E.g.*, Tendons (attach skeletal muscles to bone), Ligaments (attach one bone to another)

Specialised connective tissues
- Cartilage
- Bone
- Blood

08 Cell : The Unit of Life

Eukaryotic Cell



Nucleus : Contains DNA, the genetic blueprint of a living organism

Golgi apparatus : Membrane-bound sac responsible for producing, packaging and transporting proteins and lipids

Lysosome : An organelle that contains digestive enzymes and breaks down biological molecules

Cell membrane : Two layers of lipid, or fat, molecules that enclose the cell and regulate which molecules can go inside and outside of the cell

Cytosol : Fluid within the cell that surrounds the organelles

Centrosome : Organelle near the nucleus that serves as the initiation site for assembly of microtubules

Endoplasmic reticulum : Network of membranes that helps to synthesize proteins and lipids

Ribosome : Small organelle often attached to the endoplasmic reticulum that helps in protein synthesis

Mitochondrion : A bean-shaped organelle that provides site for aerobic respiration (converting raw materials into usable energy)

Vacuole : Small fluid-filled organelle that stores food and nutrients

Animal cell

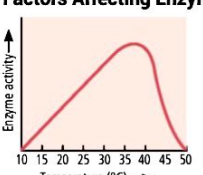
09 Biomolecules

Enzymes

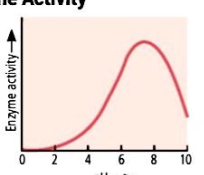
- Enzymes are organic catalysts which catalyse biochemical reactions without being utilising themselves.

$$E + S \rightleftharpoons ES \longrightarrow EP \longrightarrow E + P$$

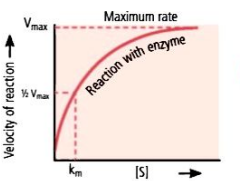
Factors Affecting Enzyme Activity



(a) Temperature



(b) pH



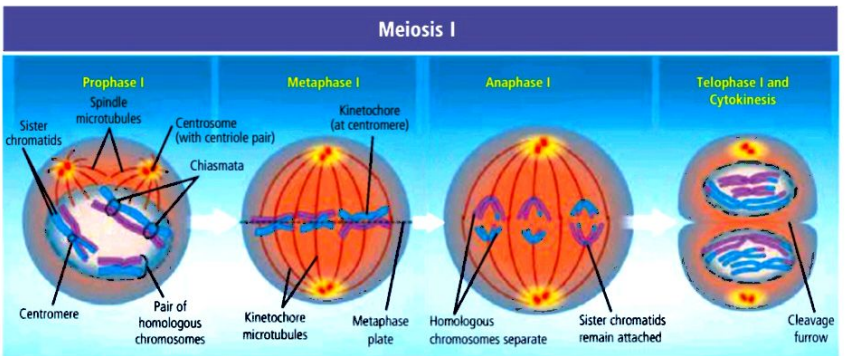
(c) Substrate concentration

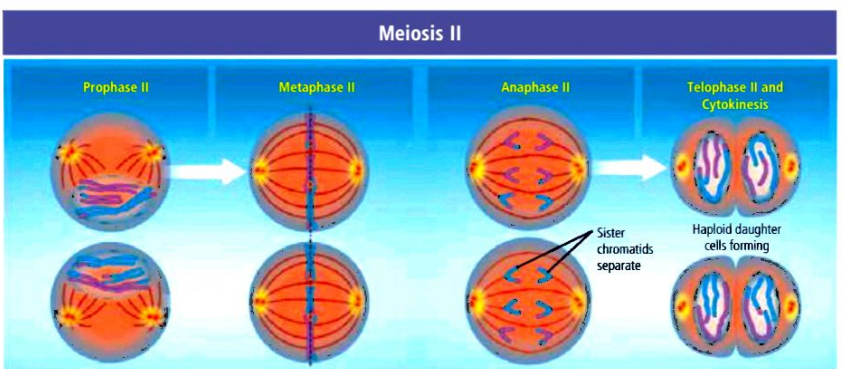
Ribozymes are nucleic acids that behave like enzymes

Meiosis

- Meiosis involves two sequential cycles of nuclear and cell division called **Meiosis I (Reductional division)** and **Meiosis II (Equational division)**.

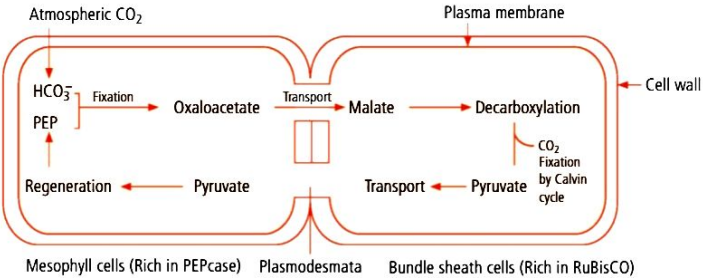
Meiosis involves only a single cycle of DNA replication.





11 Photosynthesis in Higher Plants

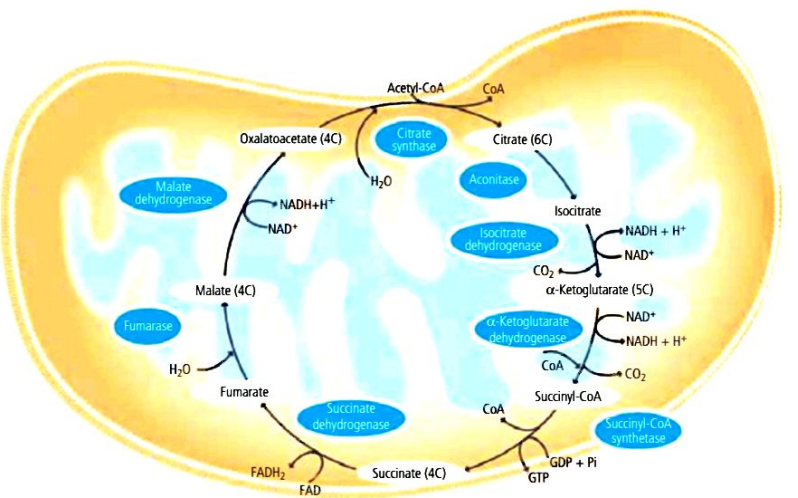
C_4 Pathway (Hatch and Slack Pathway)



12 Respiration in Plants

Aerobic Respiration

Kreb's Cycle or TCA Cycle (Mitochondrial Matrix)



13 Plant Growth and Development

Plant Growth Regulators

Plant growth promoters

Perform growth promoting activities like cell division and enlargement, tropic growth, flowering, fruiting and seed formation. *E.g.,* auxins, gibberellins and cytokinins.

Auxin

- Prevent fruit and leaf drop at early stages
- Promote apical dominance
- Induce parthenocarpy

Gibberellin

- Increases the length of stem
- Promotes bolting (Internode elongation)
- Delay senescence

Cytokinin

- Promote cell division
- Inhibit apical dominance
- Delay leaf senescence

Plant growth inhibitors

Usually induce dormancy and abscission, also induce responses to wounds, biotic and abiotic stresses. *E.g.,* abscisic acid. **Ethylene** could fit either of the groups, *i.e.,* growth promoter or inhibitor, but it is largely an inhibitor of growth activities.

Ethylene

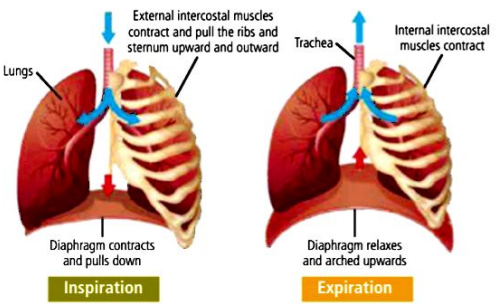
- Hastens fruit ripening
- Initiate flowering
- Breaks seed and bud dormancy

Abscisic acid

- Stress hormone
- Stimulates closure of stomata
- Inhibits seed germination

14 Breathing and Exchange of Gases

Mechanism of Breathing



Respiratory volumes and capacities

- Tidal volume ⇒ 500 mL
- IRV ⇒ 2500 - 3000 mL
- ERV ⇒ 1000 - 1100 mL
- RV ⇒ 1100 - 1200 mL
- IC = TV + IRV
- EC = TV + ERV
- FRC = ERV + RV
- VC = ERV + TV + IRV
- TLC = RV + ERV + TV + IRV or VC + RV

15 Body Fluids and Circulation

Blood

Blood corpuscles

Blood corpuscles or **formed elements** are of three types: erythrocytes, leucocytes and thrombocytes.

Erythrocytes (Red blood cells)

These are most abundant cells in blood and help in O_2 and CO_2 transport.

Thrombocytes (Blood platelets)

These are involved in blood clotting.

Leucocytes (White blood cells)

These are involved in defence mechanism of body.

Granulocytes		Agranulocytes		
Neutrophils (60-65%)	Basophils (0.5-1%)	Eosinophils (2-3%)	Lymphocytes (20–25%)	Monocytes (6-8%)

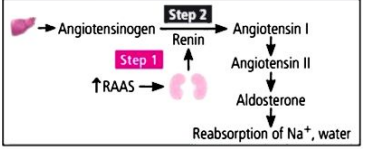
16 Excretory Products and their Elimination

Regulation of Kidney Function

Pituitary gland

- Vasopressin or ADH
- Increase water reabsorption, prevents diuresis
- Constriction of blood vessels, increases GFR

Kidney (Juxtaglomerulas apparatus)

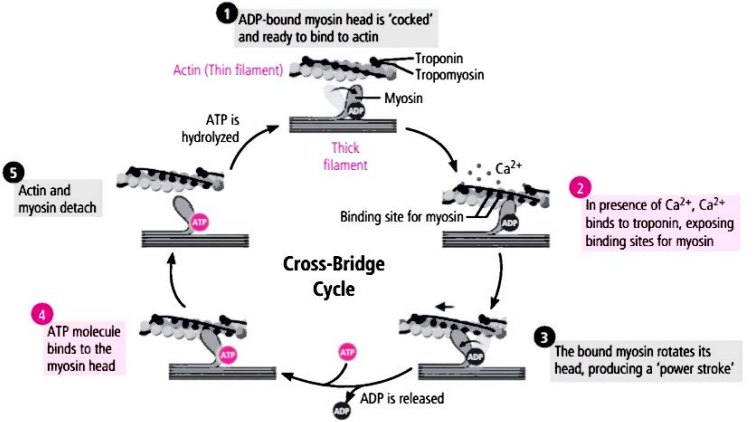


Heart

- Atrial Natriuretic Factor (ANF)
- Causes vasodilation
- Decreases the blood pressure

17 Locomotion and Movement

Mechanism of **muscle contraction** is best explained by **sliding filament** theory which states that contraction of a muscle fibre takes place by the sliding of the thin (actin) filaments over the thick (myosin) filaments.



18 Neural Control and Coordination

Central Neural System

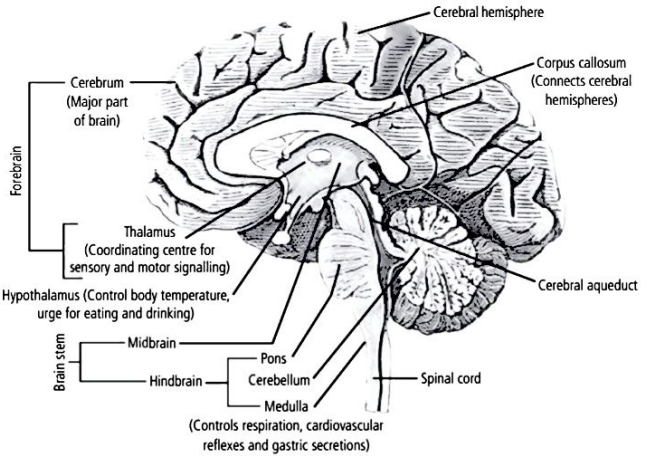


Fig.: Diagram showing sagittal section of the human brain

19 Chemical Coordination and Integration

Human Endocrine System

Secreted by	Hormones	Disorders
Pituitary gland	• Growth hormone (GH)	Hypersecretion : Gigantism and acromegaly (Adults) Hyposecretion : Dwarfism
Thyroid gland	• Thyroxine (T_4) and Tri-iodothyronine (T_3)	Hyposecretion : Cretinism (Children), myxoedema (Adults) Hypersecretion : Graves' disease (exophthalmic goitre)
Pancreas	• Insulin (from β cells) • Glucagon (from α cells)	Hyposecretion : Hypoglycemia Hypersecretion : Diabetes mellitus in which sugar level in blood increases
Adrenal gland	• Adrenaline (epinephrine) • Nor-adrenaline (Norepinephrine)	Hyposecretion : Low blood pressure and slow working of heart and lungs Hypersecretion : Rise in blood pressure, rapid heart beats and breathing
	• Adrenocorticoids (Cortisol, Aldosterone)	Hyposecretion : Addison's disease Hypersecretion : Cushing's syndrome, aldosteronism, adrenal virilism and gynaecomastia

NCERT XTRACT

This Section Covers Questions Extracted from Latest **NCERT Textbook** of Class XI

Unit-III : Cell : Structure and Functions

- Cell : The Unit of Life
- Cell Cycle and Cell Division
- Biomolecules

1. Match the following columns and select the correct option.

	Column-I (Scientists)		Column-II (Discoveries/Proposed theories)
A.	Leeuwenhoek	1.	First saw and described a living cell
B.	Robert Brown	2.	Presence of cell wall is unique to plant cells
C.	Schleiden	3.	Discovered the nucleus
D.	Schwann	4.	All plants are composed of different kind of cells

	A	B	C	D
(a)	1	3	4	2
(b)	3	1	4	2
(c)	1	3	2	4
(d)	1	4	2	3

2. The prokaryotic cells are generally
(a) larger than eukaryotic cells and multiply rapidly
(b) smaller than eukaryotic cells and multiply slowly
(c) smaller than eukaryotic cells and multiply rapidly
(d) larger than eukaryotic cells and multiply slowly.

3. Which of the following statements is incorrect for prokaryotic inclusion bodies?
(a) These are storage granules in the cytoplasm.
(b) They are membrane bound structures.
(c) Phosphate cyanophycean and glycogen granules are the examples of cell inclusions.
(d) Gas vacuole is found in BGA and purple and green photosynthetic bacteria.

4. Na^+/ K^+ pump is an example of
(a) passive transport (b) active transport
(c) osmosis (d) diffusion.

5. Endomembrane system is formed by
(a) ER + Golgi body + Lysosome + Vacuole
(b) ER + Ribosome + Lysosome + Vacuole
(c) ER + Ribosome + Mitochondria + Plastid
(d) ER + Golgi body + Ribosome + Lysosome.

6. Amino acids has four valency positions. Select the four substituent groups occupying them.
(a) Hydrogen, carboxyl group, amino group and a variable group(R)
(b) Two carboxyl groups, one amino group and one OH
(c) Two OH, one carboxyl group and one amino group
(d) Two amino groups, one OH and one carboxyl group

7. 'X' is a phase of mitosis, in which the chromatin condenses into compact chromosomes. At the end of 'X' phase, cells do not show nuclear envelope, golgi complexes, endoplasmic reticulum and nucleolus. Identify 'X'.
(a) Interphase (b) Anaphase
(c) Telophase (d) Prophase

8. Take a living tissue, grind it in trichloroacetic acid using pestle and mortar, and then strain it, you would obtain two fractions: acid-soluble and acid-insoluble fraction. Acid-insoluble fraction does not contain
(a) polysaccharides
(b) nucleic acids
(c) lipids
(d) flavonoids and alkaloids.

9. Transition state structure of the substrate formed during an enzymatic reaction is
   (a) permanent but unstable
   (b) transient and unstable
   (c) permanent and stable
   (d) transient but stable.

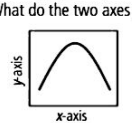
10. Read the given statements and select the correct option.
   Statement I : Variations are very important for the process of evolution.
   Statement II : Meiosis is the mechanism by which conservation of specific chromosome number is achieved.
   (a) Both statements I and II are correct.
   (b) Statement I is correct but statement II is incorrect.
   (c) Statement I is incorrect but statement II is correct.
   (d) Both statements I and II are incorrect.

11. Select the most appropriate definition for an enzyme.
   (a) A protein, acts like a biocatalyst by lowering activation energy in biochemical reactions.
   (b) A protein, acts like a biocatalyst by neither lowering nor increasing activation energy in biochemical reactions.
   (c) A protein, acts like biocatalyst by increasing activation energy in biochemical reactions.
   (d) A protein, but not a biocatalyst and has nothing to do with activation energy.

12. Give the name of the phases of meiosis, in which
   I. the chromosome number is reduced to haploid state
   II. the amount of DNA is reduced to haploid state
   The correct option is
   (a) Anaphase-II, anaphase-I
   (b) Anaphase-I, metaphase-II
   (c) Anaphase-I, anaphase-II
   (d) Anaphase-II, metaphase-I

13. Choose the correct option regarding enzyme (E), substrate (S), product (P), enzyme substrate complex (ES) and enzyme product complex (EP).
   (a) $E + S \rightarrow ES \rightarrow E + P \rightarrow EP$
   (b) $E + S \rightleftharpoons ES \rightarrow EP \rightarrow E + P$
   (c) $E + S \rightarrow ES \rightleftharpoons EP \rightarrow E + P$
   (d) $E + S \rightleftharpoons ES \rightleftharpoons EP \rightleftharpoons E + P$

14. 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

15. Lyases
   (a) catalyse a transfer of group
   (b) link together two compounds
   (c) catalyse lysis of P-N bonds
   (d) catalyse removal of groups from substrate other than hydrolysis leaving double bonds.

16. Which of the following statements is incorrect for centrioles?
   (a) Both the centrioles in a centrosome lie perpendicular to each other.
   (b) Central proteinaceous hub is missing in a centriole.
   (c) Each centriole has an organisation like that of a cartwheel.
   (d) Centrosome usually contains two cylindrical structure called centrioles.

17. While experimenting, a student observes that the sample he has given shows the black-blue colour when he put few drops of iodine on it. Based on the observation identify the given sample.
   (a) Starch (b) Inulin
   (c) Cellulose (d) Glycogen

18. An enzyme which catalyses the inter conversion of positional isomers would be classified as
   (a) transferases (b) isomerases
   (c) hydrolases (d) ligases.

19. Identify the incorrectly matched pair(s).
   A. Zygotene – Synaptonemal complex forms
   B. Diplotene – Chiasmata formation occur
   C. Pachytene – Crossing over occur
   D. Diakinesis – Nuclear envelope reappear
   (a) (B) and (D) (b) (A) and (B)
   (c) Only (C) (d) Only (D)

MONTHLY TEST DRIVE CLASS XI ANSWER **KEY**

1.	(b)	**2.**	(b)	**3.**	(d)	**4.**	(a)	**5.**	(c)
6.	(b)	**7.**	(a)	**8.**	(c)	**9.**	(a)	**10.**	(b)
11.	(d)	**12.**	(c)	**13.**	(c)	**14.**	(b)	**15.**	(b)
16.	(a)	**17.**	(c)	**18.**	(a)	**19.**	(d)	**20.**	(b)
21.	(b)	**22.**	(a)	**23.**	(b)	**24.**	(a)	**25.**	(d)
26.	(b)	**27.**	(c)	**28.**	(c)	**29.**	(d)	**30.**	(c)
31.	(c)	**32.**	(d)	**33.**	(c)	**34.**	(c)	**35.**	(d)
36.	(b)	**37.**	(d)	**38.**	(a)	**39.**	(c)	**40.**	(a)

20. Which type of bonds are found in tertiary structure of protein?
(a) Disulphide bond (b) Hydrogen bond
(c) Ionic bond (d) Both (a) and (b)

21. Which of these is not a key feature of meiosis?
(a) Meiosis involves two sequential cycles of nuclear and cell division.
(b) Meiosis involves pairing of homologous chromosomes.
(c) Two cycles of DNA replication occur during meiosis.
(d) Four haploid cells are formed at the end of meiosis II.

22. Which of the following is absolutely necessary for many biological activities of proteins?
(a) Mostly secondary, sometimes tertiary structure
(b) Mostly tertiary structure, sometimes secondary structure
(c) Tertiary structure
(d) Primary structure

23. The M-phase starts with the A , corresponding to the separation of daughter chromosomes, known as B and usually ends with division of cytoplasm which is known as C .
Identify A-C to complete the given statement.
(a) A-cell division; B-cytokinesis; C-karyokinesis
(b) A-nuclear division; B-karyokinesis; C-cytokinesis
(c) A-cell division; B-karyokinesis; C-cytokinesis
(d) A-nuclear division; B-cytokinesis; C-karyokinesis

24. Which of the following is matrix of nucleus?
(a) Nucleoplasm (b) Nucleolus
(c) Nuclear envelope (d) Chromatin

25. In bacteria, (i) are elongated tubular structures while (ii) are small bristle like fibres sprouting out of the cell.

	(i)	(ii)
(a)	mesosome	pili
(b)	pili	fimbriae
(c)	fimbriae	pili
(d)	cilia	fimbriae

26. Polysome is
(a) *r*RNA + Ribosome (b) *m*RNA + Ribosome
(c) *t*RNA + Lysosome (d) *m*RNA + Lysosome.

27. The active site of biosynthesis of ribosomal RNA is
(a) Golgi complex in cytoplasm
(b) SER of cytoplasm
(c) both SER and RER
(d) nucleolus.

28. The correct sequence of events in prophase I is
(a) Synapsis → Crossing over → Chiasmata forms → Terminalisation
(b) Crossing over → Synapsis → Chiasmata forms → Terminalisation
(c) Chiasmata forms → Synapsis → Crossing over → Terminalisation
(d) Chiasmata forms → Crossing over → Synapsis → Terminalisation

29. Followings are some statements about lysosomes. Select the incorrect statement.
(a) Lysosome are formed by packaging in Golgi apparatus.
(b) Lysosome contains all types of hydrolytic enzymes.
(c) The enzymes of lysosomes are active at acidic pH.
(d) Formation of lysosome occurs due to budding off vesicles from RER.

30. Which of the following is wrongly matched?
(a) Alkaloid – Codeine
(b) Lectin – Morphine
(c) Toxin – Abrin
(d) Drug – Curcumin

31. Function of contractile vacuole in *Amoeba* is
(a) digestion and respiration
(b) osmoregulation and movements
(c) digestion and excretion
(d) excretion and osmoregulation.

32. Ribosomes are
I. membraneless organelle
II. absent in plastids and mitochondria
III. present in the cytoplasm and RER
IV. take part in protein synthesis
Which of the following options is most appropriate?
(a) Only II is correct
(b) I and II are correct
(c) I, II, III and IV are correct
(d) I, III and IV are correct

33. Which of the following is not a characteristic feature during mitosis in somatic cells?
(a) Chromosome movement
(b) Synapsis
(c) Spindle fibres attachment to kinetochores
(d) Disappearance of nucleolus

34. The cell wall in plants is many layered. The sequence of cell wall from outside to inside is
(a) middle lamella, primary cell wall, secondary cell wall
(b) secondary cell wall, primary cell wall, middle lamella
(c) primary cell wall, middle lamella, secondary cell wall
(d) primary cell wall, secondary cell wall, middle lamella.

35. In animal cell, cytokinesis involves
(a) separation of sister chromatids
(b) formation of a furrow in the plasma membrane
(c) growth of furrow to outside from centre of animal cell
(d) formation of cell-plate in the centre of cell.

36. The proteinaceous molecule that joins a non-proteinaceous prosthetic group to form a functional enzyme is called
(a) cofactor (b) apoenzyme
(c) holoenzyme (d) isoenzyme.

37. Refer to the given reactions.
(i) Adenine + X → Adenosine
(ii) Adenosine + Y → Adenylic acid
What does X and Y represent here?

	X	Y
(a)	Phosphate group	Sugar molecule
(b)	Sugar molecule	Phosphate group
(c)	Sugar molecule	Nitrogenous base
(d)	Nitrogenous base	Sugar molecule

38. Identify the part which connects the peripheral microtubules to the central sheath and select the correct option.
(a) Radial spoke (b) Plasma membrane
(c) Interdoublet bridge (d) Central microtubule

39. Haem part of haemoglobin acts as
(a) apoenzyme (b) prosthetic group
(c) holoenzyme (d) coenzyme.

40. Which polysaccharide is found in cotton fibre?
(a) Starch (b) Glucosamine
(c) Cellulose (d) Chitin

41. What is the function of the enzyme 'recombinase' during meiosis?
(a) Formation of synaptonemal complex
(b) Crossing over between non-sister chromatids
(c) Condensation of chromosomes
(d) Alignment of bivalent chromosomes on equatorial plate

42. Mesosomes are the site for
(a) cell wall formation and DNA replication only
(b) respiration and DNA replication only
(c) respiration and secretion processes only
(d) all of these.

43. What does (i) and (ii) represent in the given flowchart?

$$\underset{(2n)}{\text{Parent cell}} \xrightarrow{\text{M-I}} \underset{(i)}{\text{2 Daughter cells}} \xrightarrow{\text{M-II}} \underset{(ii)}{\text{4 Daughter cells}}$$

(a) (i) = 2n, (ii) = n (b) (i) = n, (ii) = n
(c) (i) = n, (ii) = 2n (d) (i) = 2n, (ii) = 2n

44. Select the incorrect statements regarding pyrimidines.
I. It is a 6 membered structure.
II. It has a double ring.
III. It has nitrogen atoms at 1 and 3 positions.
IV. Pyrimidine bases are of three types : cytosine (C), thymine (T) and guanine (G).
V. When these are attached to a sugar, they forms nucleosides.
(a) II and IV (b) I, III and V
(c) I, II, III and IV (d) II, III, IV and V

45. The steps in catalytic cycle of an enzyme action are given in random order.
(i) The enzyme releases the products. Now enzyme is free to bind to another substrate.
(ii) The active sites, now in close proximity of substrate breaks the bond of substrate and forms E-P complex.
(iii) Binding of substrate induces the enzyme to alter its shape fitting more tightly around the substrate.
(iv) The substrate binds to the active site of enzyme (*i.e.*, fitting into the active site).
The correct order is
(a) (i), (ii), (iii), (iv)
(b) (iv), (iii), (ii), (i)
(c) (i), (iii), (ii), (iv)
(d) (i), (ii), (iv), (iii).

46. Read the given statements and select the correct option.
Statement I : Endoplasmic reticulum having ribosomes is called smooth endoplasmic reticulum.
Statement II : Smooth endoplasmic reticulum helps in lipid synthesis while RER helps in protein synthesis.
(a) Both statement I and statement II are correct.
(b) Both statement I and statement II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement I is incorrect but statement II is correct.

47. 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) Majority of the chloroplasts of the green plants are found in mesophyll cells of leaves.
(d) Both chloroplasts and mitochondria contain an inner and an outer membrane.

48. A person wants to study tetrad form of a chromosome, the person should observe the gametes during which stage of prophase-I?
(a) Leptotene (b) Diplotene
(c) Pachytene (d) Diakinesis

49. Match column I with column II and select the correct option.

	Column I (Bacteria)		Column II (Shape)
A.	*Lactobacillus*	(i)	Spherical
B.	*Streptococcus*	(ii)	Comma
C.	*Vibrio cholerae*	(iii)	Rod like

(a) A-ii, B-i, C-iii (b) A-iii, B-ii, C-i
(c) A-i, B-iii, C-ii (d) A-iii, B-i, C-ii

50. There are 9 chromosomes and 2C DNA in each somatic cell. Different stages of cell undergoing mitosis are given in the table. Read carefully and select the correct option.

	Stage	Chromosome number	DNA content
(i)	G_1	9	2C
(ii)	S	9	4C
(iii)	G_2	18	4C
(iv)	M	18	2C

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

SOLUTIONS

1. (a) **2.** (c)

3. (b) : Prokaryotic inclusion bodies are not bound by any membrane system and lie free in the cytoplasm. Reserve material in prokaryotic cells are stored in the cytoplasm in the form of inclusion bodies.

4. (b) : Few ions or molecules are transported across the membrane against their concentration gradient *i.e.*, from lower to the higher concentration. Such a transport is an energy dependent process in which ATP is utilised and is called active transport, *e.g.*, Na^+/ K^+ pump.

5. (a)

6. (a) : Amino acids are substituted methanes. There are four substituent groups occupying the four valency positions. These are hydrogen, carboxyl group, amino group and a variable group designated as R group.

7. (d) : Prophase is generally identified by the initiation of condensation of chromosomal material. The chromosomal material condenses to form chromosomes. At the end of prophase, cells do not show Golgi complexes, endoplasmic reticulum, nucleolus and nuclear envelope.

8. (d) : The acid-soluble pool represents roughly the cytoplasmic composition whereas the macromolecules from cytoplasm and organelles become the acid-insoluble fraction. Together they represent the entire chemical composition of living tissues of organisms or cellular pool. All the compounds which are found in the acid-soluble pool, have their molecular weights ranging from approx. 18 to around 800 daltons (Da). The acid-insoluble fraction, has only four types of organic compounds *i.e.*, proteins, nucleic acids, polysaccharides and lipids.

9. (b) : Transition state structure formed during an enzymatic reaction is transient and unstable.

10. (a) **11.** (a)

12. (c) : In anaphase-I, chromosome become half in number. Chromosomes split and move to opposite ends of the cell, both in anaphase-I and anaphase-II. The difference is that in anaphase-I, homologous pairs of chromosomes are split and in anaphase-II, sister chromatids are split.

13. (b) : Each enzyme [E] has a substrate [S] binding site in its molecule so that a highly reactive enzyme substrate complex [ES] is produced. This complex is short lived and dissociates into its product and the unchanged enzyme with an intermediate formation of the enzyme product complex [EP]

The formation of the ES complex is essential for catalysis.

$E + S \rightleftharpoons ES \rightarrow EP \rightarrow E + P$

14. (b) : *x* axis represents temperature or pH whereas *y* axis always represents enzyme activity. With increase in temperature/pH enzyme activity increases till optimum but further increase in temperature/pH, the enzyme activity decreases.

15. (d)

16. (b) : The central part of the proximal region of the centriole is proteinaceous and called the hub.

17. (a)

18. (b) : Isomerases are those enzymes which catalyse optical positional isomerisation reaction, *i.e.*, they catalyse intramolecular arrangements, *e.g.* the interconversion of aldose and ketose sugars (*e.g.* Glucose 6-phosphate to Fructose 6-phosphate).

UNSCRAMBLED WORDS

MARCH 2024

1-g-SPECIES	2-f-PLEIOTROPISM
3-e-HETEROCYST	4-j-ANABOLISM
5-d- AMOEBIASIS	6-h-ALGIN
7-b-ENDEMISM	8-i-TAILING
9-c-EPIDIDYMIS	10-a-MYOSIN

Winner : Nitin Biswas, (Pune, Maharashtra)

19. (d) : By the end of diakinesis, the nucleolus disappears and the nuclear envelope also breaks down.

20. (d) : Tertiary structure of proteins gives 3-dimensional view of a protein. It contains both hydrogen and disulphide bond.

21. (c) **22. (c)**

23. (b) : A-Nuclear division; B-Karyokinesis; C-Cytokinesis

24. (a) **25. (b)**

26. (b) : Many ribosomes when attach to a single *m*RNA it forms a chain called polysome.

27. (d) : Nucleolus is the site for active ribosomal RNA synthesis.

28. (a) : The first meiotic prophase is complex and is divided into leptotene, zygotene, pachytene, diplotene and diakinesis. Synapsis occurs during the second stage of prophase I called zygotene. In pachytene, crossing over (exchange of genetic material) takes place between non-sister chromatids of the homologous chromosomes. Chiasmata are formed during diplotene. In diakinesis, the final stage of meiosis I, the terminalisation of chiasmata occurs.

29. (d) : Formation of lysosomes is due to budding off vesicles from *trans* face of Golgi apparatus.

30. (b) : Morphine is an alkaloid.

31. (d)

32. (d) : Ribosomes are present in mitochondria and chloroplast (plastids). Both of these organelles contain 70S ribosomes.

33. (b) : Synapsis is the process of association of homologous chromosomes. It takes place during zygotene stage of prophase I of meiosis.

34. (a) : Middle lamella is first cell wall laid down followed by inner primary cell wall, secondary cell walls.

35. (b) : In animal cells, cytokinesis involves the formation of furrow in the plasma membrane.

36. (b) : Some enzymes work only in the presence of cofactors. Apoenzymes are protein portion of an enzyme. A working combination of an apoenzyme and cofactor (mineral ion, prosthetic group or coenzyme) is called enzyme system or holoenzyme.

37. (b)

38. (a) : The axoneme usually has nine pairs of doublets of radially arranged peripheral microtubules and a pair of centrally located microtubules. Such an arrangement of axonemal microtubules is referred to as the 9+2 array. The central tubules are connected by bridges and is also enclosed by a central sheath, which is connected to one of the tubules of each peripheral doublets by a radial spoke. Thus, there are nine radial spokes. The peripheral doublets are also interconnected by linkers.

39. (b) : Prosthetic groups are organic molecules that are tightly bound to the apoenzyme. Haem is the prosthetic group and it is a part of the active site of the enzyme.

40. (c)

41. (b) : Crossing over is an enzyme-mediated process and the enzyme involved in this process is called recombinase.

42. (d) : Mesosome helps in cell wall formation, DNA replication, respiration, secretion processes and also helps in increasing the surface area of plasma membrane and enzymatic content.

43. (b) : Meiosis I consists of separation of the homologous chromosomes, each made up of two sister chromatids, into two cells. Entire haploid content of chromosomes is contained in each of the resulting daughter cells; the first meiotic division therefore reduces the ploidy of the original cell by a factor of 2. Meiosis II consists of decoupling of each chromosomes sister strands (chromatids) and segregating the individual chromatids into haploid daughter cells. The two cells resulting from meiosis I divide during meiosis II, creating 4 haploid daughter cells.

44. (a) **45. (b)**

46. (d)

47. (a) : Both chloroplasts and mitochondria contain DNA and are double membrane bound organelles having an inner membrane and outer membrane. Mitochondria occur in cytoplasm of both plants and animal cells. A mitochondria contains two chambers. The inner membrane forms mitochondrial cristae. Chloroplast is also a double membranous organelle but found only in plants. The membrane bound matrix of chloroplasts is stroma and inside the stroma thylakoids are present which form grana.

48. (c) : Tetrad formation begins during zygotene stage of prophase-I but these do not appear clear. So, if a person wants to clearly observe the tetrad, therefore, he should observe them during pachytene stage of prophase-I.

49. (d) : The four basic shapes of bacteria are bacillus (rod like), coccus (spherical), vibrio (comma shaped) and spirillum (spiral).

50. (a) : During synthesis S-phase, amount of DNA per cell doubles, but there is no increase in chromosome number. During G_2 and M phase chromosome number will remain (9).

☺☺

Class XI

Monthly test drive

This specially designed column enables students to self analyse their extent of understanding of specific chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Series I — The Living World and Morphology of Flowering Plants

Total Marks : 160 **Time :** 40 Min.

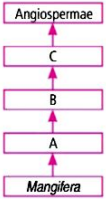
1. _____ are structures present on terminal or axillary portion of stem.
(a) Flowers (b) Buds
(c) Leaves (d) Fruits

2. In following table, the plant and specific leaf conditions are given. Find out the correct matches.

	Plant	Feature
A.	Silk cotton	Palmately compound leaves
B.	China rose	Opposite phyllotaxy
C.	*Calotropis*	Alternate phyllotaxy
D.	*Alstonia*	Whorled phyllotaxy

(a) B and C (b) A and D
(c) B and D (d) A and C

3. Recognise the following flow diagram and find the correct option according to taxonomic hierarchy.



(a) 'A' is comparable to muscidae while 'B' is at the same level as that of primata.
(b) 'C' includes all the angiosperms having two cotyledons in their seeds.
(c) For wheat 'A' is poaceae, 'B' is Poales and 'C' is monocotyledonae.
(d) All of these

4. Free-central placentation is found in
(a) *Dianthus* (b) *Argemone*
(c) *Brassica* (d) *Citrus*.

5. Read the following passage to and fill up the given blanks. The outermost covering of a seed is called the (i) . It has two layers, the outer (ii) and the inner (iii) . The (iv) is a scar on the (i) through which the developing seeds are attached to the fruit. Above the hilum, there is a small pore called (v) .
(a) (i)-micropyle, (ii)-hilum, (iii)-endosperm, (iv)-radicle, (v)-plumule
(b) (i)-seed coat, (ii)-radicle, (iii)-hilum, (iv)-micropyle, (v)-tegmen
(c) (i)-seed coat, (ii)-testa, (iii)-tegmen, (iv)-hilum, (v)-micropyle
(d) (i)-cotyledon, (ii)-plumule, (iii)-radicle, (iv)-hilum, (v)-micropyle

6. *Panthera leo* belongs to Family
(a) Canidae (b) Felidae
(c) Hominidae (d) Muscidae.

7. Match the order in column I with family in column II and select the correct option given below.

	Column I (Order)	Column II (Family)
A.	Polymoniales	(i) Felidae
B.	Carnivora	(ii) Anacardiaceae
C.	Diptera	(iii) Convolvulaceae
D.	Sapindales	(iv) Muscidae

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

8. Which one of the following statements is correct?
(a) The seeds in orchids are 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.

9. How many among the following are endospermic seeds?

Bean, castor, gram, pea, maize

(a) 2 (b) 5
(c) 1 (d) 3

10. Select the correct sequence of taxonomic categories in case of plants showing hierarchial arrangement in descending order.
(a) Kingdom → Division → Class → Family → Order → Species → Genus
(b) Kingdom → Division → Class → Order → Family → Genus → Species
(c) Kingdom → Phylum → Order → Class → Family → Genus → Species
(d) Kingdom → Division → Family → Order → Class → Species → Genus

11. Which two statements are known as the twin characteristics of growth?
(i) Increase in mass
(ii) Differentiation
(iii) Increase in number of individuals
(iv) Response to stimuli
(a) (i) and (ii) (b) (i) and (iv)
(c) (ii) and (iii) (d) (i) and (iii)

12. Which of the following statements is/are incorrect?
(a) Shoot apical meristem changes to floral meristem.
(b) The arrangement of flowers on the floral axis is termed as inflorescence.
(c) In racemose type of inflorescence, flowers are borne in a basipetal order.
(d) All of these

13. Root hairs are the protrusion of
(a) epidermal cells of region of elongation
(b) hypodermal cells of region of maturation
(c) epidermal cells of region of maturation
(d) dermal cells of region of meristematic activity.

14. The species given here belong to how many different families?

Man, housefly, mango, wheat, dog, cat, lion, tiger, potato, brinjal and leopard

(a) 4 (b) 7
(c) 5 (d) 6

15. _____ is the process by which anything is grouped into convenient categories based on some easily observable characters.
(a) Identification (b) Classification
(c) Nomenclature (d) Characterisation

16. Which of the following plants has the floral characters like zygomorphic flower, vexillary aestivation, diadelphous androecium and marginal placentation?
(a) *Pisum* (b) Belladonna
(c) Brinjal (d) Tobacco

17. Select the incorrect match regarding classification of humans.
(a) Family - Hominidae
(b) Genus - *Homo*
(c) Order - Carnivora
(d) Class - Mammalia

18. Which of the following taxonomic categories is being described by the given statements (i-iii) ?
(i) It is the basic unit of classification.
(ii) It is defined as the group of individuals having morphological similarities.
(iii) It is a group of individual organisms with fundamental similarities.
(a) Species (b) Genus
(c) Order (d) Family

19. Select the option that gives correct order of plants showing valvate, twisted, imbricate and vexillary aestivation respectively.
(a) Pea, gulmohar, cotton, *Calotropis*
(b) *Cassia*, bean, China rose, lady finger
(c) Cotton, *Calotropis*, gulmohar, pea
(d) *Calotropis*, China rose, *Cassia*, pea

20. Taxon represents
(a) group of living organism with respect to their size
(b) group of living organisms with respect to their taxonomic rank
(c) group of living organisms irrespective of size or taxonomic rank
(d) group of related species having more common characters.

21. Choose the incorrect statement(s).
(a) Cell division occurs in certain tissues to replace the lost cells.
(b) In majority of higher animals and plants, growth and reproduction are mutually inclusive events.
(c) Growth is also exhibited by non-living objects.
(d) Both (a) and (b)

22. Read the following statements and select the correct option.
Statement A : In cymose inflorescence, the main axis terminates in a flower.
Statement B : The arrangement of flower in cymose inflorescence is basipetal.
(a) Both statements A and B are correct.
(b) Statement A is correct but statement B is incorrect.
(c) Statement A is incorrect but statement B is correct.
(d) Both statements A and B are incorrect.

23. Scientific names of animals based on agreed principles and criteria are given in
(a) IUCN (b) ICZN
(c) ICBN (d) ICNB.

24. *Triticum aestivum* belongs to Class _____.
(a) Monocotyledonae (b) Dicotyledonae
(c) Anacardiaceae (d) Poaceae

25. Arrange the following in ascending order of Linnaean hierarchy.
(a) Anacardiaceae → *Mangifera* → Sapindales → Dicotyledonae
(b) *Mangifera* → Sapindales → Anacardiaceae → Angiospermae
(c) Dicotyledonae → Sapindales → *Mangifera* → Angiospermae
(d) *Mangifera* → Anacardiaceae → Sapindales → Dicotyledonae

26. Complete the given table and select the correct option.

S. No.	Flower	Type of ovary	Example	
A.	Hypogynous flower	P	(i)	Brinjal
B.	Perigynous flower	Half inferior	(ii)	Q
C.	R	Inferior	(iii)	Cucumber

(a) P:Half-superior ovary, Q : Guava, R : Epigynous flower
(b) P : Superior ovary, Q : Rose, R : Epigynous flower
(c) P : Half superior ovary, Q : Plum, R : Epigynous flower
(d) P : Superior ovary, Q : China rose, R : Epigynous flower

27. Match column I with column II and select the correct answer using the codes given below.

	Column I		Column II
A.	Growth	I.	Production of offspring
B.	Reproduction	II.	Composed of one or more cells
C.	Metabolism	III.	Increase in mass and increase in number of individuals
D.	Cellular organisation	IV.	Sum total of all chemical reactions occurring in body

(a) A-I, B-II, C-III, D-IV (b) A-III, B-I, C-II, D-IV
(c) A-III, B-I, C-IV, D-II (d) A-II, B-IV, C-III, D-I

28. Read the given statements and select the correct option.
Statement A : The term 'biodiversity' refers to the number and types of organisms present on earth.
Statement B : The number of known and described species ranges between 10-20 billion.
(a) Both statement A and statement B are correct.
(b) Both statement A and statement B are incorrect.
(c) Statement A is correct but statement B is incorrect.
(d) Statement A is incorrect but statement B is correct.

29. Find out the pair(s), which are incorrectly matched with respect to aestivation of petals.
I. Valvate – *Calotropis*
II. Twisted – Bean
III. Imbricate – *Cassia*
IV. Vexillary – China rose
(a) II only (b) III only
(c) Both I and III (d) Both II and IV

30. Consider the following statements.
(A) Ray florets of sunflowers have half inferior ovary.
(B) Epigynous flowers are seen in rose plant.
(C) In brinjal, the ovary is superior.
Of these statements,
(a) (A) and (B) are correct but (C) is incorrect
(b) (A) and (C) are correct but (B) is incorrect
(c) (A) and (B) are incorrect but (C) is correct
(d) (A) and (C) are incorrect but (B) is correct.

31. Endosperm is completely consumed by the developing embryo before seed maturation in
(a) groundnut and castor
(b) groundnut and coconut
(c) pea and bean
(d) none of these.

32. Which one of the following is incorrectly matched pair?
(a) Pea – Vexillary aestivation
(b) Cotton – Twisted aestivation
(c) Lemon – Axile placentation
(d) Mustard – Marginal placentation

33. Following are some characteristics of a plant family.
(i) Flower : Complete, bisexual, actinomorphic
(ii) Calyx : Sepals 5, gamosepalous
(iii) Corolla : Petals 5, gamopetalous
(iv) Androecium : Stamens five, epipetalous
(v) Gynoecium : Bicarpellary, syncarpous, superior ovary
Select the floral formula that corresponds to the above mentioned family.
(a) $\oplus \, ♀ \, K_{(1)+4} \, C_{(5)} \, A_{(5)} \, \underline{G}_2$
(b) $\% \, ♀ \, K_{(5)} \, \overbrace{C_{1+2+(2)} \, A_{1+(4)}} \, \underline{G}_2$
(c) $\oplus \, ♂ \, K_{(5)} \, \overbrace{C_{(5)} \, A_5} \, \underline{G}_{(2)}$
(d) $\oplus \, ♀ \, K_5 \, C_{(5)} \, A_{(5)} \, \underline{G}_2$

34. In mango, the pericarp is well differentiated into an outer thin __(i)__, a middle fleshy edible __(ii)__ and an inner stony hard __(iii)__.
(a) (i)-endocarp, (ii)-mesocarp, (iii)-epicarp
(b) (i)-mesocarp, (ii)-endocarp, (iii)-epicarp
(c) (i)-epicarp, (ii)-mesocarp, (iii)-endocarp
(d) (i)-endocarp, (ii)-ectocarp, (iii)-mesocarp

35. Which of the following is against the rules of ICBN?
(a) Handwritten scientific names should be underlined separately.
(b) Every species should have a generic name and a specific epithet.
(c) Scientific names are in Latin and written in italics.
(d) Generic and specific names should be written starting with small letters.

36. There are four statements given for systematics marked as A, B, C and D. Which of them are incorrect statement(s)?
A. Systematics consider the evolutionary relationship among organisms.
B. It deals with different kinds of organisms, their diversities and relationships among them.
C. The word systematics has its origin from Greek language.
(a) Only B (b) Only C
(c) A and C (d) A and B

37. Biological names are generally in _____ and written in _____.
(a) Greek, italics (b) Latin, arabics
(c) Greek, arabics (d) Latin, italics

38. 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

39. 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.

40. In plant A, adventitious roots are modified for storage and in plant B, a lateral branch with short internodes with each node bearing a rosette of leaves and a tuft of roots is found. Identify A and B respectively.
(a) Sweet potato and *Eichhornia*
(b) Sweet potato and mint
(c) Carrot and mint
(d) Turnip and *Chrysanthemum*

❖❖

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SELF CHECK

No. of questions attempted	.....
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Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

GK CORNER

Enhance Your General Knowledge with Current Updates!

FOSSIL FUEL AND CLIMATE CHANGE

- The United Nations Climate Change Conference (COP28) closed on 13th December 2023 with an agreement that signals the beginning of the end of the fossil fuel era. In a demonstration of global solidarity, negotiators from nearly 200 parties came together in Dubai with a decision on the world's first 'globe stocktake' of the Paris agreement agreed to ratchet up climate action before the end of the decade with the overarching aim to keep the global temperature increase to 1.5° C above pre-industrial levels. COP28 has also seen parties agree to Azerbaijan as host of COP29 from 11th-22nd November 2024, and Brazil as COP30 host from 10th-21st November 2025.
- New data from global energy think tank Ember revealed that the **share of fossil fuels in Rajasthan's power generation mix has hit record-low levels at 50% from April to July**. From January to July 2023, electricity generation in Rajasthan has increased by 4.4 TWh compared to the same period in 2022. In these four months, Rajasthan added 1.7 GW of solar and 0.5 GW of wind capacity. As of July 2023, Rajasthan's solar and wind capacity stood at 23 GW, accounting for 20% of India's solar and wind capacity. Expansion of solar and wind has made Rajasthan a top supplier of clean electricity in India.
- India plans to double its coal production to 2 billion tons by 2030, as it is facing another energy coundrum, but it ignores climate threat. This move to invest more in the world's dirtiest fuel – one of the biggest contributors to global warming– may seem counterintuitive for the South Asian country which is highly vulnerable to climate impacts.
- A new study by researchers of University of California found that introducing a simple, renewable chemical to the pre-treatment step can finally make next-generation biofuel production both cost-effective and carbon neutral. For biofuels to compete with petroleum, biorefinery operations must be designed to better utilise lignin, one of the main components of plant cell walls. However, it is difficult to extract and utilise lignin from the plant matter due to its greater structural integrity and resiliency from microbial attacks. Charles Cai, Associate Research Professor, University of California, Riverside said: "Lignin utilisation is the gateway to making what you want out of biomass in the most economical and environmentally friendly way possible". The paper also illustrated that lignin utilisation can positively contribute to overall biorefinery economics while keeping the carbon footprint as low as possible. Researchers have shown that it is possible to create cost-effective fuels from biomass and lignin and help curb our contribution of carbon emissions into the atmosphere.
- According to an updated Air Quality Life Index released by the Energy Policy Institute at the University of Chicago (EPIC), the fine particulate air pollution (PM 2.5) is estimated to shorten an average Indian's life expectancy by 5.3 years and by as much as 11.9 years in Delhi, when compared to WHO standards of 5 $\mu g/m^3$. "The impact of PM2.5 on global life expectancy is comparable to that of smoking, more than three times that of alcohol use and unsafe water, more than 5 times that of transport injuries like car crashed and more than 7 times that of HIV/AIDS," said the EPIC report.
- Sweden has a rich supply of moving water and biomass. This country has the highest share of renewables in terms of final energy consumption. Hydropower and bioenergy are the top renewable sources of Sweden – hydropower mostly for electricity production and bioenergy for heating. In 2022, more than 60 per cent of Sweden's electricity came from renewable sources.
- Sweden targets to achieve 100% renewable energy power generation by 2040 and reduce the emissions of

greenhouse gases to 0% by 2045. These targets are likely to act as an opportunity for the Swedish renewable energy market in the future.

- According to the European Union's Copernicus Climate Change Service, the global mean temperature breached the 1.5° Celsius threshold for an entire year for the first time in January. "The current El Nino event, which developed in June 2023, was at its strongest between November and January. It displayed a peak value of about 2°C above the 1991 to 2020 average sea surface temperature for the eastern and central tropical Pacific Ocean. This made it one of the five strongest El Nino events ever, though it was weaker than the 1997-98 and 2015-16 events.
- A new report by Global Alliance for the Future of Food and Dalberg Advisors found that food production accounts for an estimated 15 per cent of global fossil fuel usuage annually, equivalent to 4.6 gigatonnes of carbon dioxide. The data has revealed that as the use of fossil fuels for transport and power diminishes due to the increasing adoption of renewable energy, the fossil fuel industry is reinforcing the reliance of food systems on high carbon energy by making significant investments in petrochemicals to manufacture plastics, pesticides and fertilisers.
- According to report published by international energy agency, the energy sector continues to feel the effects of Russia's invasion of Ukraine. Russian oil export volumes remained stable year-over-year in 2023 at 7.5 million barrels per day, with a slight loss in crude offset by an equivalent gain in oil products. While overall exports to the European Union, the United States, the United Kingdom and OECD Asia stood at negligible levels, dropping 4.3 million barrels per day below their pre-war average, shipments rose sharply to India, China, Türkiye and countries in the Middle East. Even so, the monthly average of Russia's export revenues from commercial oil tumbled in 2023 by USD 4.2 billion year-over-year.

Test Yourself!

1. Which country is the second largest oil exporter?
   (a) Saudi Arabia (b) Russia
   (c) United States (d) Canada
2. Which country has been chosen to host COP29?
   (a) Azerbaijan (b) Turkey
   (c) Georgia (d) France
3. Who is the current power minister of India?
   (a) Shri Mansukh L. Mandaviya
   (b) Shri Ashwini Vaishnaw
   (c) Shri Jagdeep Dhankhar
   (d) Shri Raj Kumar Singh
4. As of July 2023, how much per cent of India's solar and wind capacity contributed by Rajasthan?
   (a) 50% (b) 75%
   (c) 10% (d) 20%
5. When will COP30 take place?
   (a) 10^{th} - 21^{st} March, 2025
   (b) 19^{th} - 20^{nd} February, 2025
   (c) 10^{th} - 21^{st} November, 2025
   (d) 1^{st} - 25^{th} December, 2025
6. China produces _____ % of global fossil fuel CO_2 emissions.
   (a) 10% (b) 31%
   (c) 50% (d) 70%
7. Who is the president of COP28?
   (a) Dr. Sultan al-Jaber
   (b) Christiana Figueres
   (c) Agnes Pannier-Runacher
   (d) Sheikh Mansour
8. Air Quality Index (AQI) is represented by
   (a) unit of $\mu g/m^3$ (b) unit of ppm
   (c) percentage (d) numbers.
9. Who developed the CELF (Co-solvent Enhanced Lignocellulosic Fractionation) biomass pretreatment technology?
   (a) Ellen Garland
   (b) Charles Cai
   (c) Dr. Sethuraman Panchanathan
   (d) Richard Peltier
10. The European country having the highest share of renewables in terms of final energy consumption is
    (a) Norway (b) Ukraine
    (c) Sweden (d) Italy.

☺☺

Answer Key

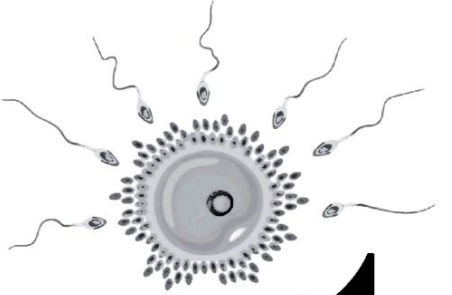
1.	(q)	2.	(e)	3.	(p)	4.	(p)	5.	(c)
6.	(q)	7.	(e)	8.	(p)	9.	(q)	10.	(c)

WHO AM I ...

1. Taxon Pg. 32
2. Mycoplasma Pg. 36
3. Morula Pg. 70
4. Vasectomy Pg. 78

Class XII

BIO



Digest

This article covers high yield facts of the given topic.

Human Reproduction

- Human beings are **sexually dimorphic** organisms, *i.e.*, male and female are separately distinguishable. Reproductive system, whether in male or female is a collection of internal and external organs that work together to produce a new generation of living organisms similar to their parents.
- The external features which provide distinctiveness to the two sexes but have no role in sexual reproduction, are collectively called **secondary sexual characters**.
- The specialised cells for reproduction or reproductive units are called gametes. Gametes are of two types : male gametes are **spermatozoa** and female gametes are **ova**. Gametes are formed in separate, paired organs of mesodermal origin, called **gonads**.
- Sperm producing gonads are called **testes** and ova producing gonads are called **ovaries**. Testes and ovaries are known as **primary sex organs**.

Major Reproductive Events

Gametogenesis
- Formation of gametes. It includes spermatogenesis (formation of sperms) and oogenesis (formation of ova or eggs).

Insemination
- Transfer of sperm into the genital tract of female.

Fertilisation
- Fusion of male and female gametes to form zygote.

Cleavage
- Rapid mitotic divisions of single celled zygote to develop multicellular blastocyst or blastula.

Implantation
- Attachment of blastocyst to the uterine wall.

Placentation
- Formation of placenta between fetus and uterine wall of the mother to exchange essential materials.

Gastrulation
- Development of blastocyst into gastrula with three primary germ layers.

Organogenesis
- Formation of specific tissues, organs and organ-systems from three primary germ layers.

Parturition
- Expelling of baby from mother's womb (uterus) *i.e.*, childbirth.

MALE REPRODUCTIVE SYSTEM

- Male reproductive system comprises of scrotum, a pair of testis, vasa efferentia, epididymes, vasa deferentia, ejaculatory ducts, urethra, penis and certain glands.

Scrotum

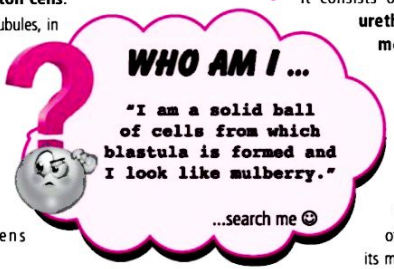
- It is a pouch or pigmented sac consisting of loose skin, muscles and connective tissue that hangs from the root, *i.e.*, attached portion of the penis. A **septum** divides the scrotum into two sacs. Each of these sacs contain one testis.
- The scrotum remains connected with the abdomen or pelvic cavity by two **inguinal canals** on each side of the scrotal septum.
- Scrotum acts as a thermoregulator and maintains testes at a temperature 2°C lower than the body which is optimal for sperm production.

Testes

- There is a pair of testes that are suspended in the scrotum by the spermatic cords. The testes develop in the abdominal cavity just below the kidneys during early fetal life and then they descend into the scrotum.
- A fibrous cord that extends from the caudal end of the testis to the scrotal wall is called **gubernaculum**.

Testis is surrounded by three layers : (i) **Tunica vaginalis**- Serous covering of testis, (ii) **Tunica albuginea** - A layer made of fibrous or collagenous connective tissue. (iii) **Tunica vasculosa** - Delicate, loose connective tissues lining testicular lobules, has rich supply of blood capillaries.

- Each testis has around 250 compartments called **testicular lobules** each of which contains several sperm producing coiled tubules called **seminiferous tubules**.
- The lining of seminiferous tubules called germinal epithelium has two types of cells, **spermatogenic cells** and **supporting cells** or **Sertoli cells**.
- In between the seminiferous tubules, in the connective tissue, there are present small groups of rounded endocrine cells, called **interstitial** or **Leydig's cells.**
- Under the influence of luteinising hormone (LH) or interstitial cell stimulating hormone (ICSH), Leydig's cells produce androgens *e.g.*, **testosterone**.



- Testes perform two functions : (a) production of sperms and (b) secretion of male sex hormones.

Male Accessory Ducts

- **Rete testis**, **vasa efferentia**, **epididymis** and **vasa deferentia,** (or **vas deferens)** are called the male accessory ducts. These ducts store and transport the sperms from the testis to the outside through urethra.
- The seminiferous tubules join at one end to form a network or **rete testis** from where vasa efferentia arise.
- Epididymis is a mass of long narrow closely coiled tubule which lies along the inner side of each testis.
- At the anterior end of the testis epididymis is called **caput epididymis,** in which the vasa efferentia opens. The middle part of the epididymis is known as **corpus epididymis**. The posterior end of the epididymis is called as **cauda epididymis**.
- The vas deferens is a continuation of the cauda epididymis. It leaves the scrotal sac and enters the abdominal cavity through the inguinal canal.
- The **vas deferens** curves over the urinary bladder where it is joined by duct from the seminal vesicle to form the ejaculatory duct. Vasa deferentia carry sperms.

Ejaculatory Ducts

- They are formed by union of ducts from seminal vesicle and vas deferens. They pass through the prostate gland and join the prostatic part of urethra.
- They carry sperms mixed up with secretion of seminal vesicle.

Urethra

- It is the urinary duct which originates from neck of urinary bladder and opens out, at the tip of penis. It also receives secretions of prostate and Cowper's glands.
- It consists of three regions - **prostatic urethra** where prostate gland opens, **membranous urethra** at the urogenital diaphragm and the spongy **penile urethra** that passes through penis.
- The urethra has two sphincters-internal sphincter of smooth muscle fibres at its beginning and external sphincter of striated muscles fibres around its membranous part.

Penis

- The penis is a male copulatory organ used during mating.
- The penis contains three cylindrical masses of erectile tissue – two dorsal **corpora cavernosa** and one ventral **corpus spongiosum**. These bodies are surrounded by fibrous tissue.
- The corpus spongiosum, through which the urethra extends, enlarges at its distal end to form a sensitive cone-shaped **glans penis**.
- During sexual arousal, the three bundles of tissue in the penis become engorged with blood.

Male Accessory Glands

- **Seminal vesicle :** These are paired, glandular, sac-like structures near the base of the bladder, secreting fluids which constitute approximately 60% of the volume of semen. It also contains **fructose** and **prostaglandins**.

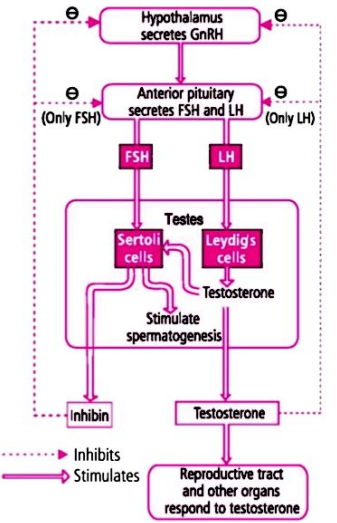
Fructose, which is present in seminal fluid and is not produced anywhere else in the body is used for confirmation of sexual intercourse/rape during forensic test.

- **Prostate gland :** It is a single large gland surrounding urethra. It produce a milky secretion which forms 25% of the volume of semen.
- The secretions of prostate gland also contain glycoprotein **prostate specific antigen (PSA)** which liquefies the clotted semen.
- **Bulbourethral (Cowper's) gland :** These are a pair of glands present on either side of membranous urethra. They secrete an alkaline fluid that neutralises acids from urine in the urethra.

Semen is a collection of secretions from the seminal vesicles; prostate gland; Cowper's glands; sperms from testes. It is ejected from the penis during ejaculation.

Hormonal Control of Male Reproductive System

- The growth, maintenance and functions of the male reproductive organs are under the control of hormonal control.
- Hormonal control of male reproductive system is summarised in the given flow chart.



Flow chart : Hormonal control of male reproductive system

Spermatogenesis

- The process of formation of male gametes *i.e.*, sperms is called spermatogenesis. It occurs in the seminiferous tubules of the testes.

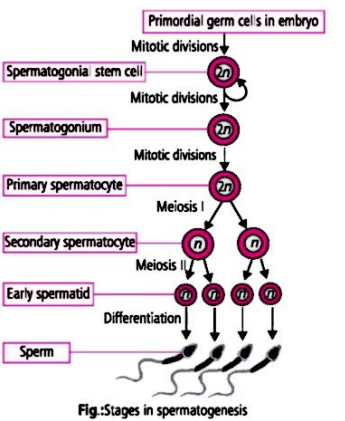


Fig.: Stages in spermatogenesis

Formation of spermatids

- **Multiplication phase:** The undifferentiated germ cells divide mitotically to form large number of spermatogonia.
- **Growth phase :** Each spermatogonium accumulates large amount of nutrients and chromatin material, grows to a larger primary spermatocyte by the process called spermatocytogenesis.
- **Maturation phase :** Each primary spermatocyte undergoes first meiotic division to form two secondary haploid spermatocytes which in turn produce four spermatids *via* second meiotic division. The first meiotic division is a homotypic division, whereas the second meiotic division is heterotypic.

Formation of spermatozoa

- The transformation of spermatids into spermatozoa (sperm) is called **spermiogenesis** or **spermateliosis** or **differentiation phase**.
- The different changes occurring during spermiogenesis are:
  (i) Formation of acrosome by Golgi apparatus. The latter then degenerates.
  (ii) Elongation and condensation of nucleus.
  (iii) Separation of centrioles into anterior proximal centriole and posterior distal centriole.
  (iv) Formation of axial filament from distal centriole.
  (v) Development of mitochondrial spiral around upper parts of axial filament.
  (vi) Formation of flagellum.
- After their maturation, spermatozoa detach from Sertoli cells. The process is called **spermiation**.

Four sperms are differentiated from a spermatogonium cell. The released sperms are stored in epididymis and first portion of vasa deferentia where they complete their maturation and become capable of fertilising an ovum. Nutrition is provided by epithelium of epididymis.

Sperm or Spermatozoon

- Sperm is a microscopic structure composed of a head, neck, a middle piece and a tail. A plasma membrane envelops the whole body of sperm.
- The sperm head contains an elongated haploid nucleus. The anterior portion of head forms **acrosome** containing proteolytic and lysosomal enzyme.
- The middle piece possesses numerous mitochondria which provide energy for sperm motility.

INTEXT PRACTICE QUESTIONS

1. **What is the function of Leydig's cells in male reproductive system?**
2. **Explain the structure and function of a paired gland which secretes 60% of the semen volume.**

FEMALE REPRODUCTIVE SYSTEM

- The female reproductive system consists of a pair of ovaries, a pair of fallopian tubes or oviducts, uterus, vagina, external genitalia or vulva. A pair of mammary glands or breasts are also considered as part of reproductive system due to their role in child care.

Ovaries

- Ovaries are the **primary sex organs** in human female. They are paired structures located in the upper pelvic cavity.
- Each ovary is held in place within peritoneal cavity by several ligaments.

Structure of ovaries

- Anatomically, it is differentiated into following parts — **germinal epithelia**, the outermost layer of the ovary which forms oogonia in the fetus; is made up of squamous or cuboidal epithelium, **tunica albuginea**, sheath of dense connective tissue that lies below germinal epithelium and **ovarian stroma**, differentiated into dense outer **cortex** and less dense inner **medulla**.

At birth, the ovaries contain an estimated total of 2 to 4 million oogonia (egg mother cells). No more oogonia are formed and added after birth.

Follicular development

- During fetal life, all the oogonia develop into primary oocytes, which then begin a first meiotic division by replicating their DNA. They do not complete the division in the fetus.
- Accordingly, all the eggs present at birth are primary oocytes which contain 46 chromosomes each with two sister chromatids. The cells are said to be in a state of **meiotic arrest**.
- This state continues until puberty and the onset of renewed activity in the ovaries.
- The dormant primary oocyte surrounded by follicular cells in the ovary of a newborn female is called **primordial follicle**.

- At puberty, oogenesis is resumed and primordial follicle enlarges to form **primary follicle**.
- In the primary follicle, development proceeds, the follicular cells keep dividing to form several layers around the primary oocyte and at this stage these cells are known as the **granulosa cells.**
- The primary oocyte secretes an acellular glycoprotein layer around itself, called the **zona pellucida.**
- As the granulosa cells keep on dividing, a small cavity appears between these cells called the **antrum** which is filled with a fluid, liquor folliculi, secreted by the granulosa cells. At this stage, the follicle is known as **secondary follicle.**
- Around the granulosa cells, connective tissue of ovarian stroma get differentiated into two layers: a **vascular theca interna** and a **fibrous theca externa.**
- The innermost layer of granulosa cells around the zona pellucida consists of columnar cells and is known as the **corona radiata.**

Ovulation

- The fully formed mature dominant follicle with a large antrum is called Graafian follicle. It has a **primary oocyte,** which is still in meiotic arrest. Just before ovulation this primary oocyte completes its first meiotic division to form a haploid **secondary oocyte** and a **polar body.**
- This secondary oocyte is released in the peritoneal cavity during ovulation from where it is picked up by the fimbriae of the oviduct.
- The ovulated secondary oocyte is carried into the fallopian tube where fertilisation occurs.

Fallopian Tube

- The function of the fallopian tube is to convey the ovum from the ovary to the uterus by peristalsis.
- Fertilisation of the ovum generally takes place in the upper portion of the fallopian tube (ampulla).
- Each fallopian tube (10 - 20 cm) consists of four parts : (i) **Infundibulum :** Funnel shaped free end of the oviduct bearing finger-like processes called fimbriae which help in collection of liberated ovum after ovulation; (ii) **Ampulla:** The widest and longest part of the fallopian tube; (iii) **Isthmus :** Short, narrow, thick-walled portion following ampulla; and (iv) **Uterine part :** Passes through the uterine wall and communicates with the uterine cavity.

Uterus

- It is an inverted pear-shaped highly elastic large part of female reproductive system where development of fetus takes place.
- Uterine wall have three layers : **Perimetrium**, an outer thin covering of peritoneum; **myometrium**, middle thick layer of smooth muscle fibres that shows strong contraction during delivery of the baby and **endometrium**, inner glandular layer lining the uterine cavity.
- Uterus is differentiated into three regions — The upper dome-shaped region called **fundus**, the broad main part called **body** and a small, narrow, cylindrical inferior extremity called **cervix**. Cervix connect to the vagina through external os.

Vagina

- The vagina is a tube, about 10 cm long, that extends from the cervix to the outside of the body. It provides a passage for the menstrual flow, serves as the receptacle for sperm during intercourse and forms part of the birth canal during labour.
- The opening of the vagina is called the **vaginal orifice**. It is partially covered in virgins by a perforate membrane called **hymen**.

External Genitalia

- The female external genitalia include the **mons pubis**, **labia majora, labia minora, clitoris, vestibule of the vagina,** and **vestibular glands**. External genitalia are collectively called vulva.

Female Accessory Glands

- The lesser vestibular glands **(Paraurethral glands or glands of Skene)** are numerous minute glands that are present on either side of the urethral orifice, secreting mucus.
- The greater vestibular glands **(Bartholin's glands)** are a pair of small glands occurring one on each side of vaginal opening, secreting thick, viscous, alkaline fluid.

The same THREE LETTERS will complete these four words.

Can you find the three-letter sequence?

_ _ _ I C A R P

S _ _ _ M

_ _ _ M I A N

C Y _ _ _ U S

Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month.
Winners' names will be published in next issue.

Mammary Glands

- Mammary glands are modified sweat glands that lie over the pectoralis major muscle.
- Its **glandular tissue** comprises about 15-20 mammary lobes. Each lobe consists of a number of **lobules**, which contain glandular alveoli that produce milk in lactating woman.

Hormonal Control of Female Reproductive System

- The hormonal control of female reproductive system is summarised in the given figure.

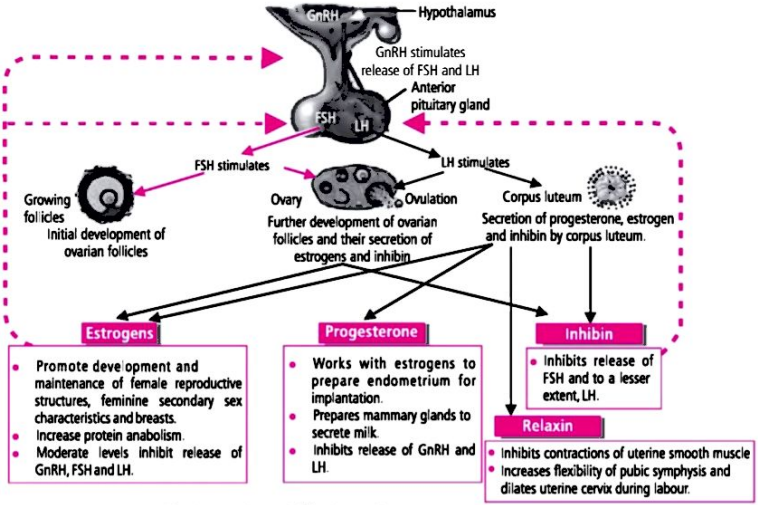


Fig.: Hormonal control of female reproductive system

Oogenesis

- The process of development and maturation of ovum is known as oogenesis. Gametogenesis in female is also called oogenesis.
- It is consists of three phases— multiplication, growth and maturation phase.

Multiplication phase

- During multiplication phase, the germinal epithelium cells divide and detach to produce oogonia, which multiply mitotically and project into the stroma as a cord, **the egg tube of Pfluger**, which later becomes a round mass, **the egg nest**.
- One cell in the egg nest grows to form diploid primary oocyte cells having the same number of chromosomes as in parent somatic cells, which cease to divide and enter the growth phase.

Growth phase

- This phase of the primary oocyte is very long extending over many years.
- There is accumulation of food materials and other resources for nourishment of the oocyte.
- Meiosis begins in the primary oocytes soon after their formation. However, the oocytes are arrested in the early part of meiotic prophase I (diplotene stage), the **first resting stage**. They undergo a round of DNA synthesis and chromosome pairing takes place, but meiosis does not proceed further until years later.

Maturation phase

- After primary oocyte has finished its growth, there are two specialised nuclear divisions, first one is the **reductional division**.
- Beginning of puberty, a small number of primary oocytes are activated each month.
- However, only one continuesmeiosis I, producing two haploid cells of dissimilar size, smaller cell is called **first polar body** and larger cell is called **secondary oocyte**.

- The secondary oocyte proceeds with meiosis II but the division gets arrested in metaphase II stage, the **second resting stage**. This is due to an activity called **cytostatic factor** which maintains arrest through preventing loss of **Maturation Promoting Factor (MPF).**
- MPF is a protein in cell cycle which stimulates M-phase of cell cycle.
- It is in this stage of oocyte that the ovum is shed during ovulation. It passes into oviduct, where in the ampulla part, cell cycle will resume only after the entry of sperm.
- Ca^{2+} rise initiated by fertilising sperm results in degradation of regulatory unit of MPF through **Anaphase Promoting Complex (APC)** thus promoting completion of cell cycle.
- The first polar body may divide to form two-second polar bodies. Thus from **one oogonium, one ovum** and **three polar bodies** are formed.
- The ovum, is the actual female gamete. The polar bodies take no part in reproduction and soon degenerate due to lack of cytoplasm and food. The formation of non-functional polar bodies enables the egg to get rid of excess chromosomes.

MENSTRUAL CYCLE

- The first menstruation begins at puberty and is called **menarche**. In human females, menstruation is repeated at an average interval of about **28/29 days** and the cycle of events starting from one menstruation till the next one is called **menstrual cycle**.
- The menstrual cycle can be functionally divided into four phases.

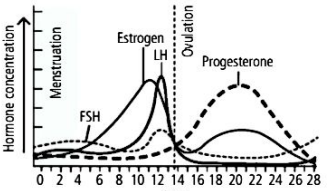


Fig.: Relative concentration of anterior lobe of pituitary hormones (FSH and LH) and ovarian hormones (estrogens and progesterone) during a normal menstrual cycle.

Table : Phases of menstrual cycle

Phases	Days	Events
Menstrual phase	1^{st}-5^{th}	Endometrium breaks down, menstruation begins. The cells of endometrium, secretions, blood and the unfertilised ovum constitute the menstrual flow. Progesterone and estrogen production is reduced.
Follicular phase (Proliferative phase)	6^{th}-13^{th}	Endometrium rebuilds, secretion of FSH and estrogen increases.
Ovulatory phase	14^{th}	Both LH and FSH attain a peak level. Concentration of estrogen in the blood is also high and reaches its peak. Ovulation occurs.
Luteal phase (Secretory phase)	15^{th}-28^{th}	Corpus luteum secretes progesterone. Endometrium thickens and uterine glands become secretory.

Menopause

- It is the phase in the life of a woman when ovulation and menstruation stop. During this condition, ovaries fail to respond or may be resistant to FSH. In this case, FSH levels are very high and the estrogen level very low. It occurs between 45 to 55 years.

FERTILISATION

- Fertilisation is the process of fusion of two types of gametes (spermatozoon and ovum) so as to form a **diploid zygote.**
- In human beings, fertilisation is internal and takes place mostly in the **ampullary-isthmic junction** of the oviduct (fallopian tube).
- The secretions of the female genital tract remove coating substances, deposited on the surface of the sperms particularly those on the acrosome exposing the receptor sites and activating the sperm to penetrate the ovum. This phenomenon of sperm activation is called **capacitation**.
- The **capacitated sperm** undergoes acrosomal reaction and releases various chemicals contained in the acrosome. These chemicals are collectively called **spermlysins.**

MONTHLY TEST DRIVE CLASS XII ANSWER **KEY**

1. (d)	2. (a)	3. (c)	4. (a)	5. (a)
6. (c)	7. (a)	8. (b)	9. (d)	10. (c)
11. (d)	12. (b)	13. (a)	14. (a)	15. (a)
16. (a)	17. (a)	18. (b)	19. (b)	20. (d)
21. (a)	22. (d)	23. (d)	24. (d)	25. (a)
26. (c)	27. (b)	28. (c)	29. (d)	30. (b)
31. (d)	32. (a)	33. (b)	34. (c)	35. (d)
36. (d)	37. (d)	38. (c)	39. (a)	40. (c)

- **Acrosomal reaction,** due to these plasma membrane of the sperm fuses with the plasma membrane of the secondary oocyte so that the sperm contents enter the oocyte.
- **Cortical reaction,** after the fusion of the plasma membrane of oocyte with sperm, the cortical granules fuse with the plasma membrane releasing their contents along with cortical enzymes which hardens the zona pellucida preventing entry of additional sperms, *i.e.*, polyspermy.
- Entry of the sperm induces the completion of the meiotic division of the secondary oocyte. The second meiotic division is also unequal and results in the formation of **second polar body** and a haploid ovum (ootid). Haploid nucleus of the sperm and that of the ovum fuse together to form a diploid **zygote.**

EMBRYONIC DEVELOPMENT

- **Embryonic development** or **embryogenesis** is the development of embryo from fertilised ovum and its subsequent development into a young organism.

Table: **Principal events during development**

	Stage	Time period	Principal events
(i)	Zygote	12-14 hours after ovulation	Haploid sperm unites with haploid egg, making the latter a diploid zygote with unique genotype.
(ii)	Cleavage	30 hours to 3 days	Mitotic divisions increase number of cells without increasing total cytoplasmic mass.
(iii)	Morula	Third to fourth day	Solid ball formed, comprising outer layer of small cells around an inner mass of large cells.
(iv)	Blastocyst	Fifth day to end of second week	Hollow ball formed, comprising trophoblast, embryonic knob and blastocyst cavity, implantation occurs, embryonic disc forms, primary germ layers established.

- Blastocyst then gets attached to the endometrium (trophoblast) and the inner cell mass gets differentiated as the embryo.
- After attachment, the uterine cells divide rapidly and covers the blastocyst. As a result blastocyst become embedded in the endometrium. This is called **implantation**. It begins about seventh day after fertilisation of ovum.
- Implantation leads to **pregnancy**. In human beings it is approximately 9 months ±7days. If hCG (Human chorionic Gonadotropin) is present in a woman's urine, it indicates her pregnancy. After implantation, finger-like projections appear on the trophoblast called **chorionic villi**. Chorionic villi and uterine tissue becomes interconnected with each other and jointly form **placenta** between mother and developing fetus.
- Placenta connects with fetus by a rope-like structure called **umbilical cord**.
- Transformation of blastocyst into gastrula by formation of primary germ layers by rearrangement of cells is called **gastrulation**.
- In all triploblastic animals, three germ layers — ectoderm, mesoderm and endoderm are formed.

Embryonic Changes During Pregnancy

- **After one month** of pregnancy, the embryo's heart is formed. The first sign of growing fetus may be noticed by listening to the heart sound carefully through the stethoscope.
- By the **end of the second month** of pregnancy, the fetus develops limbs and digits.
- By the **end of 12 weeks** (first trimester), major organs (limbs and external genital organs, etc,.) are well developed.
- During the **fifth month**, the first movements of the fetus and appearance of hair on the head are usually observed.
- By the **end of 24 weeks** (end of 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 fetus is fully developed and is ready for delivery.

PARTURITION

- Parturition is the act of expelling the full-term young one from the mother's uterus at the end of gestation.
- **Gestation** (pregnancy) is completed in about **266 days** from conception.
- Process of parturition is induced by both nervous system and hormones secreted by the endocrine glands of the mother.
- The signals for childbirth (parturition) originate from the fully matured **fetus** and **placenta** which induce mild uterine contractions called **fetal ejection reflex.**
- This causes quick release of oxytocin which promotes contraction of uterine muscles from the maternal posterior lobe of pituitary gland. The amount of oxytocin is increased just before and during **"labour pains"** (pains of childbirth).
- **Relaxin** secreted by the placenta increases the flexibility of the pubic symphysis and ligaments of the sacroiliac and sacrococcygeal joints and helps to dilate the uterine cervix during labour pains.

- The hormone most recently found to be produced by the placenta is **corticotropin-releasing hormone (CRH),** which in non-pregnant women is secreted only by neurosecretory cells in the hypothalamus.

LACTATION

- The mammary glands of the female undergo differentiation during pregnancy and start producing milk towards the end of pregnancy by the process called **lactation**.
- Secretion of milk is influenced by **prolactin**, secreted by anterior lobe of the pituitary gland and ejection of milk is stimulated by **oxytocin**, secreted by posterior lobe of the pituitary gland. This helps the mother in feeding the new born.
- The first milk which comes from the mammary glands of mother produced during initial 2 or 3 days after childbirth is called **colostrum**. Colostrum contains antibodies **(IgA)** that provide natural passive immunity to the new born infant.

INTEXT PRACTICE QUESTIONS

3. **In which phase of menstrual cycle both LH and FSH attain a peak level? What are the other events occurring in this phase?**
4. **Name the antibody present in colostrum.**

Reproductive Health

- According to the World Health Organisation (WHO) the reproductive health means a total well being in physical, emotional, behavioural and social aspects in reproduction.
- Reproductive health problems include population explosion, low birth weight, preterm birth, reduced fertility, impotency, menstrual disorder and sexually transmitted diseases.

STRATEGIES FOR REPRODUCTIVE HEALTH PROBLEMS

- Government of India undertook a number of programmes to attain total well being of reproductive health as a social goal.
- **'Family Planning programmes'** were initiated in 1951 and were periodically assessed over the past decades.
- Improved programmes covering wider reproduction – related areas are currently in operation under the popular name **'Reproductive and Child Health Care (RCH) Programmes'**.
- **Sex education** should be introduced in schools to provide right information about sex-related aspects.
- Statutory ban on amniocentesis for sex-determination to legally check increasing female feticides, massive immunisation of children etc., are some appreciable steps.

POPULATION EXPLOSION

- Human population is increasing at a very fast rate over a relatively short period of time. Such a rapid or exponential increase in population is termed as **population explosion**.
- Increased health facilities along with better living conditions has an explosive impact on the growth of population.
- Over population leads to a number of problems which exert adverse impact on a nation.
- It increases poverty, unemployment, scarcity of food, water, natural resources, home, etc. It also causes eco-degradation, energy crisis etc. So, **over population must be checked to maintain continuity of human race**.

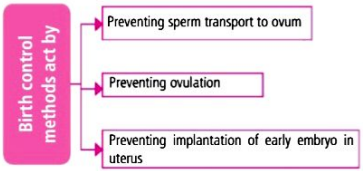
Reasons for population explosion

- Early marriage
- Religious orthodoxy against family planning
- Increased health facilities
- Better food storage and transportation facilities
- Increased sanitation and life amenities
- Better means of protection from natural calamities
- Reduced death rate particularly IMR and MMR
- Desire of male child
- Increased agricultural production
- Lack of social awareness
- Advanced postnatal care

BIRTH CONTROL METHODS

- The regulation of conception by various preventive methods or devices to limit the number of offspring is called **birth control** or **contraception**.

- Contraceptive methods can be broadly grouped into two groups: temporary and permanent method.



Temporary Methods

- Temporary methods include natural methods, barrier methods, chemical methods, IUDs, oral contraceptive pills, subcutaneous implants and hormone injections.
- **Natural methods** avoid meeting of sperm and ovum by following ways:
  (i) **Periodic abstinence or rhythm method :** The couples avoid or abstain from coitus from day 10 to 17 of the menstrual cycle because ovulation can occur during this period. The effectiveness of this method is limited.
  (ii) **Coitus interruptus or withdrawal method :** It involves withdrawal of penis from vagina by the male just before ejaculation. Effectiveness is moderate.
  (iii) **Lactational amenorrhea method :** This method is based on the fact that ovulation and therefore the menstrual cycle does not occur during the period of intense lactation following parturition. It can be effective only upto a maximum period of six months after child birth.
- **Barrier methods** prevent the meeting of sperm and ovum by use of following barriers:
  (i) **Condoms** are made of thin rubber/latex sheath used to cover penis in male or vagina and cervix in female just before coitus. Condom is also a safeguard against AIDS and other sexually transmitted diseases. Female condoms are called **femidoms**.
  (ii) **Diaphragms, Cervical caps** and **Vaults** are also made of rubber and are inserted into the female reproductive tract to cover the cervix before coitus.
- **Chemical methods** include foam tablets, creams, jellies and pastes that are inserted in the vagina before intercourse. These contain spermicides such as lactic acid, citric acid, boric acid, zinc sulphate and potassium permanganate which kill sperms.
- **Intrauterine devices** are plastic or metal objects which are inserted by doctors in the uterus through vagina. These are available as **non-medicated IUDs** (*e.g.*, Lippes loop), **copper releasing IUDs** (CuT, Cu7, Multiload 375) and **hormone releasing IUDs** (Progestasert, LNG-20). IUDs increase phagocytosis of sperms within the uterus and the Cu^{2+} ions released suppress sperm motility and fertilising capacity of sperms. The hormone releasing IUDs make the uterus unsuitable for implantation and the cervix hostile to the sperms.
- **Oral contraceptives** are physiological contraceptives used in the form of pills. These are of two types:
  (i) **Combined pills** are most commonly used oral contraceptive pills which contain synthetic progesterone and estrogen to check ovulation.
  (ii) **Mini pills** contain progestin (progesterone like synthetic hormone) only.
  – ***Saheli***, a new oral contraceptive pill for female contains a **non-steroidal** preparation called **centchroman** which is taken once in a week after an initial intake of twice a week dose for three months.
- **Morning after pills** are also known as **emergency contraceptives**. These pills can prevent pregnancy when taken within 72 hours after unprotected intercourse. It is not a regular contraceptive method.
- Hormonal pills act in four ways: (i) Inhibition of ovulation. (ii) Inhibition of motility and secretory action of oviducts. (iii) Impairing cervix's ability to allow sperm passage and transport. (iv) Alteration in uterine endometrium making it unsuitable for implantation.
- **Subcutaneous implants** or **norplant** is a six matchstick-sized capsule containing steroid which is inserted under the skin of the inner arm above the elbow. The capsules slowly release the synthetic progesterone for about five years. It is very safe, convenient, effective and long-lasting.
- **Hormone injections** are progesterone derivative injections which are given once every three months.

Permanent Methods

- These include sterilisation by surgery, surgical methods block gamete transport and prevent

fertilisation. It is effective but **reversibility is very poor**. It includes:

Fig.: Vasectomy **Fig.:** Tubectomy

(i) **Vasectomy** is the sterilisation procedure in males. In this method, a small part of vas deferens is removed or tied up through a small cut on the scrotum.

(ii) **Tubectomy** is the sterilisation procedure in females. In this method, a small part of the fallopian tube is removed or tied up through a small cut in the abdomen or through vagina.

MEDICAL TERMINATION OF PREGNANCY (MTP)

- **Medical termination of pregnancy (MTP) or induced abortion** is **intentional** or **voluntary termination** of pregnancy before the fetus becomes viable. Nearly 45 to 50 million MTPs are performed in a year all over the world which accounts to 1/5th of the total number of conceived pregnancies in a year.
- MTP is comparatively safe **upto 12 weeks** (the first trimester) of pregnancy.
- Government of India **legalised MTP** in **1971**.
- At present, termination is legally allowed upto 28th week of pregnancy if the gynaecologist consider the need for abortion.

SEXUALLY TRANSMITTED DISEASES

- Infections and diseases which are transmitted through sexual contact with infected persons are collectively called **sexually transmitted diseases (STDs)** or **venereal diseases (VD)** or **reproductive tract infections (RTI)**.

Table: Some Important STIs and Common Techniques for their Detection

	STI	Causal agent	Detection Techniques
(i)	Syphilis	*Treponema pallidum*	Antibody detection, *e.g.*, VDRL, ELISA test.
(ii)	Gonorrhoea	*Neisseria gonorrhoeae*	Gram-staining of discharge, culture microscopic examination
(iii)	Trichomoniasis	*Trichomonas vaginalis*	Microscopic examination, culture
(iv)	AIDS	Human Immunodeficiency Virus (HIV)	ELISA, PCR
(v)	Hepatitis B	Hepatitis B Virus (HBV)	ELISA
(vi)	Genital herpes	Herpes simplex virus	Clinical, antigen test, PCR
(vii)	Genital warts	Human papilloma virus (HPV)	Clinical, antibody detection, culture. DNA hybridisation
(viii)	Chlamydiasis	*Chlamydia trachomatis*	Clinical, gram-staining of discharge, antigen detection, nucleic acid hybridisation.

- The sexually transmitted infections are transmitted by sexual intercourse with infected persons, sharing of injection needles, surgical instruments and transfusion of blood from an infected mother to the fetus. Except HIV infection, hepatitis B and genital herpes, all other diseases are completely curable if detected early and treated properly.
- Early symptoms are itching, swellings, fluid discharge, slight pain, etc. If proper treatment is not given to the infected person, this could lead to abortions, still births, ectopic pregnancies, infertility, cancer of reproductive tract or pelvic inflammatory diseases.
- Though all persons are vulnerable to STIs, their incidences are reported to be very high among persons in the age group of 15-24 years.

- For prevention, following simple principles should be followed:
  (i) Avoid sex with unknown partners/multiple partners.
  (ii) Always use condoms during coitus.
  (iii) In case of doubt, go to a qualified doctor for early detection and get complete treatment if diagnosed with infection.

INFERTILITY

- Inability to conceive or produce children inspite of unprotected sexual intercourse is called **infertility**.
- In case the treatment of cause of infertility is not possible, the couple can be assisted to have children through certain special techniques called **assisted reproductive technologies (ART)**. Some important techniques of ART are:

Test Tube Baby

- This method involves *in vitro* fertilisation (IVF), *i.e.*, fertilisation of male and female gametes outside the body in almost similar conditions as that *in vivo* followed by **embryo transfer (ET).**
- In this method, ova from wife/donor female and sperms from husband/donor male are induced to form zygote in laboratory.
- Embryo upto 8 blastomeres is transferred into the fallopian tube (**ZIFT - Zygote Intra Fallopian Transfer**) to complete its further development.
- If the embryo is with more than 8 blastomeres, then it is transferred into uterus (**IUT - Intra Uterine Transfer**) to complete its further development.

Artificial Insemination (AI) Technique

- AI technique is used in case of infertility of male partner, where the husband is either unable to inseminate the female or has very low sperm count in the ejaculation.
- In this technique, the semen collected either from the husband or a healthy donor is artificially introduced into the vagina or uterus (**IUI - intrauterine insemination**) of the female.

Gamete Intra Fallopian Transfer (GIFT)

- This method is used in females who cannot produce ova but can provide suitable environment for fertilisation and further development of embryo in the oviducts.
- In this technique, both sperms and unfertilised oocytes are transferred into fallopian tubes of female and fertilisation takes place inside the body of female.

Intracytoplasmic Sperm Injection (ICSI)

- In this technique, one single spermatozoon or even a spermatid is injected directly into the cytoplasm of an oocyte by micropuncture of the zona pellucida.
- The embryo is later transferred by ZIFT or IUT in woman.

DETECTION OF FETAL DISORDERS

- The fetal disorders during early pregnancy can be detected by following techniques:

Amniocentesis

- Amniocentesis is a fetal sex determination and disorder test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo.
- At the early stage of pregnancy (14^{th} or 15^{th} week), the location of the fetus and placenta is determined by sonography.
- Then a small amount of amniotic fluid is drawn by passing a special surgical syringe needle into the abdominal wall and uterine wall into the amniotic sac containing amniotic fluid.
- The amniotic fluid contains cells from fetus skin and respiratory tract. These cells are cultured and are used to determine chromosomal abnormalities (Down's syndrome, Klinefelter's syndrome, etc.) and metabolic disorders (phenylketonuria, sickle cell anaemia, etc.) of the fetus.
- Unfortunately, this useful technique, is being misused to kill the normal female fetuses. It has been **legally banned for the determination of sex** to avoid female feticide.

INTEXT PRACTICE QUESTIONS

5. **How the fetal sex and disorder can be diagnosed by amniocentesis? At which stage of pregnancy it is usually done?**
6. **Do you think introduction of sex education in schools can improve reproductive health?**

ZOOM in BIO

The syllabus of biology for boards and competitive exams is very vast which impedes students from acquiring indepth knowledge and covering the entire syllabus at the same time. An important topic for biology is therefore presented here in elaborate form to enable students grasp the topic.

Evidences and Theories of Evolution

Evolution means orderly change from one condition to another.

Organic evolution is **"descent with modification"**, *i.e.*, process of cumulative change of living populations and in the descendant populations of organisms.

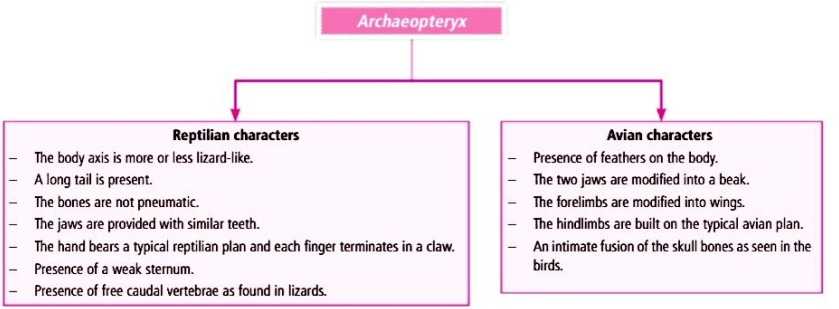
EVIDENCES OF ORGANIC EVOLUTION

1. Palaentological Evidences (Evidences from Fossil Records)

Fossil records have shown that complex forms have evolved from simple forms by an evolution in gradual manner.

Palaentological Evidences

- **Number and nature of fossils in early rocks**
  Rocks of early era contain less number of fossils than rocks of later era. Life first originated in sea as simple forms, so fossils of only marine invertebrates were found.
- **Distribution of fossils in the successive strata**
  Fossils present in bottom rocks are simple, however recent fossils in upper layers are more complex.
- **Disparity between the past and present forms of life**
  Early organisms were very different from their modern forms.
- **Missing links (Transitional forms)**
  Organisms showing characters of two different groups. ***E.g.*, *Archaeopteryx*** show characters of both reptiles and birds.



Study of *Archaeopteryx* has revealed that **"birds are glorified reptiles"**, *i.e.*, birds have evolved from reptilian ancestors.

Evolution of Horse

Table: Evolution of modern horse

	Eohippus	Mesohippus	Merychippus	Pliohippus	Equus
(i)	60 million years ago in **Eocine** epoch.	40 million years ago in **Oligocene** epoch.	25 million years ago in **Myocene** epoch.	10 million years ago in **Pliocene** epoch.	9-10 lakhs years ago in **Pleistocene** epoch.
(ii)	Horse was about the size of fox or terrier dog. Had short head and neck. (About 30 cm high at shoulders).	It was of the size of modern sheep. (About 60 cm high at shoulders).	It was of the size of small pony. (About 100 cm high at shoulders).	It was of the size of modern pony. (About 120 cm high at shoulders).	It is modern horse. (About 150 cm high at shoulders).
(iii)	The fore feet with 4 complete fingers and 1 splint (reduced and non-functional side finger and toe of horse). Hind feet with 3 toes and 2 splints of 1^{st} and 5^{th} toe.	Fore feet with 3 fingers and 1 splint of 5^{th} finger, and hind feet with 3 toes. (Middle one longer and supported most of the body weight).	Fore and hind feet with 3 fingers and 3 toes. Middle finger and toe being longer than others and supported entire body weight.	Each fore and hind feet with 1 complete finger and 1 complete toe and 2 splints is hidden beneath the skin.	Each fore and hind foot has 1 finger and 1 toe and 2 splints.
(iv)	Low crowned molar teeth adapted to browsing of soft lush vegetation. Molar teeth had no serrations.	Molar teeth had some serrations.	Teeth were longer with cement and molars had well developed serrations.	Molar teeth with well developed cement and serrations. Teeth adapted for eating grass.	Molar teeth have elongated crowns with enameled ridges and are highly suitable for grinding.

2. Evidences from Comparative Anatomy and Morphology

Organisms of today and those that existed years ago show similarities and differences. Such evidences can be interpreted to know whether common ancestors were shared or not.

Evidences from comparative anatomy and morphology

Vestigial organs
Organs which are present in reduced form and do not perform any function, but were complete and functional in their ancestors.

Connecting links
Organisms which possess the characters of two different groups.

Atavism
Reappearance of certain ancestral characters which had either disappeared or were reduced.

Organ systems
Different systems of animal body are similar in many groups of organisms. *E.g.*, blood vascular system, respiratory system, nervous sytem, etc.

Homologous organs
Organs which have same fundamental structures but different functions. Homologous organs are result of **divergent evolution** and homology indicates common ancestry.

Analogous organs
Organs which have similar functions but different structures and origin. The analogous structures are result of **convergent evolution.**

Examples of Homologous Organs

The forelimbs of man, cheetah, whale and bat
They have same basic structural plan. Each forelimb consists of humerus, radio-ulna, carpals, metacarpals and digits, but the forelimbs of these animals have different shapes and functions. In man they are used for grasping, in cheetah for running, in whale for swimming and in bat for flying.

Mouth parts of insects
The mouth parts of cockroach, honey bee, mosquito and butterfly have the same fundamental plan. In each of these insects the mouth parts comprise of labrum, a pair of mandibles and two pairs of maxillae, but they have different functions to perform according to their different feeding habits. The mouth parts in cockroach are adapted for biting and chewing. In honey bee for chewing and lapping, in mosquito for piercing and sucking, in housefly for sponging and in butterfly for siphoning.

Thorns of *Bougainvillea* or tendrils of *Cucurbita*
Both thorns and tendrils in *Bougainvillea* and *Cucurbita* arise in the axillary position but have different functions. Thorns are for protection and tendrils for climbing.

Molecular phylogeny
Proteins found in blood of man and ape are similar. By comparing base sequence of nucleic acid and amino acid sequence of proteins, phylogeny of organism can be traced.

Examples of Analogous Organs

Wings of an insect and wings of birds
Basic structure of wing of an insect is different from wings of birds, as wings of an insect do not have bones but bird's wings have bones and are covered by feathers. However, their function is similar in both.

Pectoral fins of sharks and flippers of dolphins
Pectoral fins of sharks are not pentadactyl. The flippers of dolphins are pentadactyl. Thus basic structure of pectoral fins of sharks and flippers of dolphins are different but both are useful in swimming.

Sting of honeybee and scorpion
The sting of honey bee is a modification of its ovipositor (structure that helps in egg laying) while that of scorpion is modified last abdominal segment. Stings of both arthropods perform similar function.

Eye of octopus and cat
Eye of octopus have slit-like horizontal pupil while cats have vertical pupil.

Examples of Vestigial Organs

Human
Nictitating membrane, muscles of pinna, vermiform appendix, caudal vertebrae, third molar, hair on body and nipples in male.

Animals
Hindlimbs and pelvic girdles of pythons, wings of flightless birds, splint bones in feet of horse.

Plants
Non-functional pistils in male flowers of Cucurbitaceae, rudimentary pistil with functionless stigma and ovule-less ovary in ray florets of sunflower.

Table: Examples of connecting links

(i)	*Euglena*	Connecting link between animals and plants, as it is chlorophyll containing green protozoan.
(ii)	*Proterospongia*	Connecting link between Protozoa and Porifera. It is colonial protozoans and consists of flagellated and collared individuals that resemble choanocytes of sponges.
(iii)	*Neopilina*	Connecting link between Annelida and Mollusca. It possess segmentally arranged gills, nephridia and trochophore larva like annelida and a shell, mantle and muscular foot like mollusc.
(iv)	*Peripatus*	Connecting link between Annelida and Arthropoda. Its arthropod characters include haemocoel, tracheae as respiratory organs and tubular heart with ostia. The annelid characters are the worm-like body, structure of the eyes, unjointed legs, presence of segmental nephridia and continuous muscle layers in the body wall.
(v)	*Balanoglossus*	It is hemichordate and connecting link between non-chordates and chordates.
(vi)	*Latimeria*	Connecting link between fish and amphibians
(vii)	*Ornithorhynchus, Tachyglossus,* Duck-billed platypus	Egg laying mammals and are connecting link between reptiles and mammals. They bear hair and mammary gland like mammals and lay eggs like reptiles.

Examples of Atavism

Plants

In *Citrus* leaf, the lamina is separated from wing petiole by means of a joint or constriction. Sometimes the winged part of the petiole is enlarged to produce two lateral leaflets making the leaf trifoliate. It shows that *Citrus* leaf was once trifoliate compound but during evolution two leaflets have degenerated.

Human beings

Power of moving pinna, greatly developed canine teeth, short tail in some babies, presence of additional mammae.

3. Embryological Evidences

Evidences based on the comparative study of the embryos of various animals are given below:

Similarity in early development

In all the multicellular animals, the fertilised egg (**zygote**) undergoes rapid mitotic divisions (**cleavage**) to produce a solid structure, the **morula**. The morula develops into a single layered hollow **blastula**. The latter changes into either two or three layered **gastrula**. The animals having two layered gastrula are said to be diploblastic, *e.g.*, coelenterates and with three layered gastrula are triploblastic, such as frogs, lizards, etc. These two or three layers of gastrula known as primary germ layers give rise to the entire animal. Such a similar early development establishes a close relationship among all multicellular animals.

Progressive metamorphosis

Ammocoete larva of Lamprey resembles the adult form of Amphioxus or *Branchiostoma* in most of the details which are possible only if we presume that Lamprey has evolved from *Branchiostoma* like animals.

Embryological Evidences

Recapitulation theory/Biogenetic law

Van Baer stated biogenetic law as **"Ontogeny recapitulates 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 its development. In the development of the frog, a fish like tailed larva (**tadpole**) is formed, which swims with the tail and respires by the gills. This indicates that the frog has been evolved from a fish like ancestor.

Resemblance among vertebrate embryos

Embryos of the same age of vertebrates, such as a fish, a salamander, a tortoise, a chick and a man resemble one another closely. They have more or less the same form and structure, such as gill clefts, tail etc.

Resemblance among invertebrate larvae

Annelids and molluscs possess a similar type of larva called trochophore. Echinoderms and hemichordates also have similar larvae. Larval resemblance indicates common ancestry.

4. Biogeographical Evidences

Biogeography is the study of distribution of animals and plants on this earth.

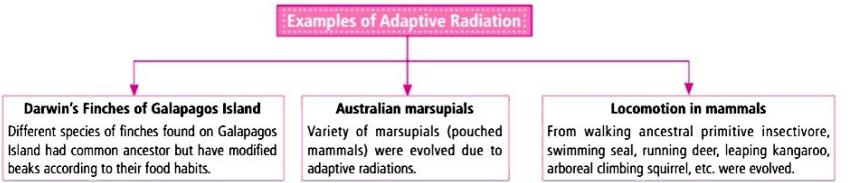
Pangaea: All the present day continents were present in the form of single big land mass, called pangaea. Due to various geographical changes, huge land mass broke off and drifted apart from one another. Biogeographical evidences are explained as follows:

A. Biogeographical realms

On the basis of distribution of plants and animals, earth has been divided into six major biogeographic regions; Palaearctic, Oriental, Australian, Ethiopian, Nearctic and Neotropical.

B. Adaptive radiation (Divergent evolution)

Adaptive radiation refers to the development of different functional structures from a common ancestral form. Homologous organs show adaptive radiations.



C. Adaptive convergence (Convergent evolution)

Convergent evolution leads to the development of similar adaptive functional structures in unrelated groups of organisms. Analogous organs show convergent evolution. ***E.g.***, (i) Wings of insect, bird and bat; (ii) Australian marsupials and placental mammals; (iii) Spiny anteater and scaly anteater.

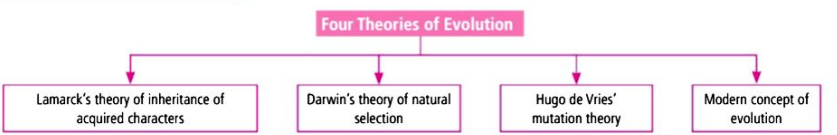
5. Evidences from Biochemistry and Comparative Physiology

Chemical constitution, biochemical reactions and body functions exhibit large degree of similarity among living beings. Evidences of common ancestry and evolution of different groups of organisms are protoplasm, nucleic acids and chromosomes, enzymes, hormones, blood and lymph and serum tests.

6. Evidences from Cytology

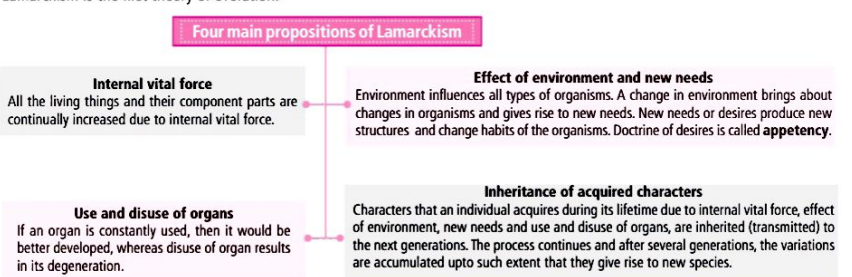
Study of cellular nature, protoplasm, plasmalemma, cell wall, nucleus, ribosomes, mitochondria, chloroplasts, cell division provides cytological evidences of evolution.

THEORIES OF EVOLUTION



Lamarckism

Lamarckism is the first theory of evolution.



Inheritance of Acquired Characters

Support of Lamarckism

- Ancestors of **giraffe** had short neck and forelimbs. Continuous stretching of neck and forelimbs to take leaves for food resulted in elongation of these parts, and was transmitted to next generaton.
- **Webbed toes** of aquatic birds show that they have evolved from terrestrial ancestors.
- **Flightless birds** - ancestors of these birds were capable of flying, but due to some environmental factors they had plenty of food and were well protected. So, they did not use their wings and that is why the latter became vestigial.
- **Deer**, the ancestors of deer were not having so much speed in running, but as they needed protection from predators, they started running by which present speed was achieved by the deer.

Criticism of Lamarckism

- **Theory of continuity of germplasm by Weismann**- According to Weismann, the characters influencing the germ cells are only inherited. There is a continuity of germplasm (protoplasm of germ cells) but the somatoplasm (protoplasm of somatic cells) is not transmitted to the next generation. He cut off the tails of rats for as many as 22 generations and allowed them to breed, but tailless rats were never born.
- Boring of pinna (external ear) and nose of Indian women is never inherited to the next generations.
- The wrestler's powerful muscles are not transmitted to the offspring.
- Chinese women used to wear iron shoes in order to have small feet, but their children at the time of birth always had normal feet.
- Circumcision of penis in Jews and Muslims, but it is not inherited to the next generation.

Neo-Lamarckism

Environment influences an organism and changes its heredity.

At least some of the variations acquired by an individual can be passed on to the offspring.

Internal vital force and appetency do not play any role in evolution.

Only those variations are passed on to the offspring which also affect germ cells or where somatic cells give rise to germ cells.

Darwin's Theory of Natural Selection

Natural selection occurs through an interaction between the environment and variability inherent in the population.

Salient Features of Darwin's Theory of Natural Selection

Rapid multiplication
All organisms possess enormous fertility and they multiply in geometric ratio, resulting in over production. ***E.g.***, a cod fish lays several hundred eggs at a time.

Struggle for existence
- **Intraspecific struggle** between individuals of same species for similar requirements of food and shelter.
- **Interspecific struggle** between members of different species.
- **Environmental struggle** between the organisms and environmental factors.

Survival of the fittest
Organisms better adapted to their surroundings survive and unfit ones are eradicated.

Limited food and space
Resources such as food and space remain limited and are not liable to increase with increase in population.

Variations
Variations are differences among the individuals. Variations helpful in adaptation of organism are passed onto the next generation.

Inheritance of useful variations
Useful variations are passed to next generation and useless variations are eliminated.

Formation of new species
Accumulation of useful variations forms a new species.

Evidences

In favour of Darwinism

- Higher rate of reproduction in all organisms.
- Limitation of food, space and other resources.
- Struggle for existence is seen in all organisms.
- Abundance of variations among individuals of a population.
- Mimicry and protective colouration in certain animals.
- Co-relation between position of nectaries in flowers and length of proboscis in pollinating insects.

Against Darwinism

- Darwin did not differentiate between somatic and germinal variations and considered all variations as heritable.
- Occurrence of organisms that remained unchanged for several million years.
- Occurrence of discontinuous variations.
- Arrival of the fittest cannot be explained.
- The effect of use and disuse and the presence of vestigial organs cannot be explained.

Hugo de Vries' Mutation Theory

Mutations are sudden variations, that are heritable, random and directionless and lead to formation of new species.

Salient features of mutation theory

- Mutations or discontinuous variations are the raw material of evolution.
- Mutations appear all of a sudden and become operational immediately.
- Unlike Darwin's continuous variations or fluctuations, mutations do not revolve around the mean or normal character of the species.
- The same type of mutations can appear in a number of individuals of a species.
- All mutations are inheritable.
- Mutations appear in all conceivable directions.
- Useful mutations are selected by nature. Lethal mutations are eliminated. However, useless and less harmful ones can persist in the progeny.

Evidences of Mutation Theory

Evidences in favour of theory

- Mutations have genetic basis and are therefore heritable.
- It explains both progressive and retrogressive evolution.
- Mutations have given rise to new varieties, *e.g.*, Ancon sheep, hornless cattle, hairless cats, dogs, etc.

Evidences against theory

- Natural mutations are not common.
- Most of the mutations are negative or retrogressive.
- Mutation does not explain development of mimicry.
- Mutations are generally recessive.

Modern Concept of Evolution

1. Genetic variations in population

Changes in genes occur in following ways:

(a) Changes in chromosome number (increases in number of chromosome set) and structure (change in the morphology of chromosome), due to duplication, inversion, deletion or translocation.
(b) Change in structure and expression of gene by mutations and mutated genes add new alleles to the gene pool.
(c) Gene recombination due to independent assortment of chromosomes, crossing over, random fusion of gametes, etc.
(d) Gene migration (gene flow) is the movement of individuals from one place to another, which add new alleles to the local gene pool.
(e) Genetic Drift (Sewall Wright Effect) is the drastic change in allele frequency when population size becomes very small and it alters gene frequency of remaining population. Examples of genetic drift are:
  (i) **Founder effect** (small group of persons leave the population and find new settlement. Their genotypic frequency becomes different from parent population).
  (ii) **Bottleneck effect** (cyclic phenomenon of decrease and increase of a size of population).

2. Isolation

Isolation is the prevention of mating amongst interbreeding groups due to physical and biotic barriers. It prevents interbreeding by: (i) restricting random dispersal, (ii) restricting random mating and (iii) restriction to fertility.

3. Natural selection

It is the process by which those organisms which are better adapted to the environment survive and reproduce while the organisms that are not so well adapted either fail to reproduce or die. The former organisms pass on their successful characters to the next generation.

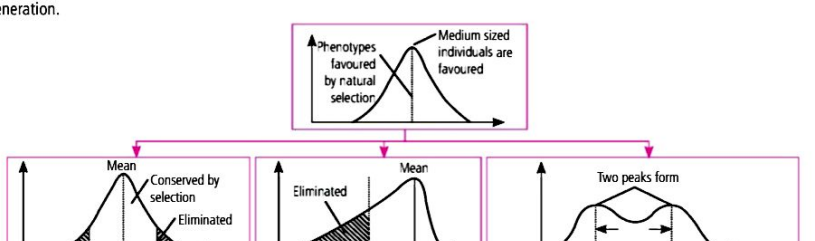


Fig.: Different Types of Natural Selection

Examples of Natural Selection

Sickle cell anaemia

The sickle cell gene produces a variant form of the protein haemoglobin, which differs from the normal haemoglobin by a single amino acid. Sickle cell anaemia is caused by the substitution of glutamic acid by valine at sixth position of beta chain of haemoglobin. In people, homozygous for this abnormal haemoglobin, the red blood cells (RBCs) become sickle-shaped. The people affected by this disease usually die before reproductive age, due to a severe haemolytic anaemia. Inspite of its disadvantageous nature, the gene has a high frequency in some parts of Africa, where malaria is also in high frequency. The heterozygotes for the sickle cell trait are exceptionally resistant to malaria. Thus, in some parts of Africa, people homozygous for the normal gene tend to die of malaria and those homozygous for sickle cell anaemia tend to die of severe anaemia; while the heterozygous individuals survive and have the selective advantage over either of homozygotes.

Industrial melanism

In Great Britain, *Biston betularia* (peppered moth) existed in two forms, light coloured (white) and melanic (black). Before industrialisation, bark of trees was covered by white lichens, so white moths escaped unnoticed from predatory birds. After industrialisation, barks got covered by smoke, so population of white moths were selectively picked up by birds and black moths increased as they escaped unnoticed.

Resistance of insects to pesticides

When DDT was introduced as an insecticide, it was effective against pests. But within two to three years of the introduction of this insecticide, new DDT resistant mosquitoes appeared in the population. These mutant strains, which are resistant to DDT, soon became well established in the population and to a great extent, replaced the original DDT-sensitive mosquitoes.

SPECIATION

Formation of one or more new species from an existing species is called **speciation**.

Types of Speciation

Allopatric speciation

In allopatric speciation, a part of the population becomes geographically isolated from the main population and becomes entirely separated and finally constitutes a new species. Thus, geographic isolation brings about allopatric speciation, for example: formation of Darwin's finches that formed separate species in the Galapagos islands.

Sympatric speciation

A small segment of the original population becomes isolated reproductively. As the isolating mechanism comes into force, a new subspecies emerges and new species is formed. Thus, sympatric speciation is the formation of species within a single population without geographical isolation.

Parapatric speciation

It takes place when a population of a species enters a new niche or habitat. It occurs only at the edge of the parent species range. Although there is no physical barrier between these populations, yet the occupancy of a new niche results as a barrier to gene flow between the population of new niche. Two species are produced due to reproductive isolation from single one. *E.g.*, speciation in flightless grasshoppers, snails and annual plants.

Quantum speciation

The budding off a new and very different daughter species from a semi-isolated peripheral population of the ancestral species is quantum speciation. This type of speciation is based on the observation of H.L. Carson on *Drosophila* inhabiting Hawaii islands. It is a sudden and rapid speciation. Genetic drift or chance plays a major role in quantum speciation.

HARDY-WEINBERG PRINCIPLE

Hardy-Weinberg principle states that allele frequencies in a population are stable and is constant from generation to generation. The gene pool (total genes and their alleles in a population) remains constant, this is called **genetic equillibrium**. Stability of population and species over number of generation is applicable when there is no mutation, no gene flow, no genetic drift, no genetic recombination and no natural selection. Individual frequencies may be named p, q etc. In a diploid, p and q represent the frequency of allele 'A' and allele 'a'. The frequency of AA individuals in a population is p^2. This can be stated in another way, *i.e.*, the probability that an allele A with a frequency of p appears on both the chromosomes of a diploid individual is the product of the probabilities *i.e.*, p^2. Similarly of aa is q^2 and of Aa is 2pq. Thus, $p^2 + 2pq + q^2 = 1$. This is a binomial expansion of $(p + q)^2$.

Class XII

Monthly test drive

This specially designed column enables students to self analyse their extent of understanding of specific chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Series I

Sexual Reproduction in Flowering Plants and Principles of Inheritance and Variation

Total Marks : 160 **Time :** 40 Min.

1. Wall of a pollen sac consists of
   (a) endothecium and tapetum only
   (b) tapetum and middle layers only
   (c) endothecium, middle layers and tapetum only
   (d) epidermis, endothecium, middle layers and tapetum.

2. In which of the following number of ovules in an ovary is one?
   (a) Maize (b) Papaya
   (c) Watermelon (d) Orchids

3. Out of seven pairs of contrasting characters of pea plant chosen by Mendel, the number of characters related to seed were
   (a) one pair (b) three pairs
   (c) two pairs (d) four pairs.

4. The cells of tapetum have
   (a) dense cytoplasm, usually more than one nucleus
   (b) light cytoplasm, uninucleate
   (c) light cytoplasm, haploid
   (d) dense cytoplasm, haploid.

5. Read the given statements and select the correct option.
   Statement 1 : Wind pollination requires light and non-sticky pollen grain.
   Statement 2 : Wind pollinated flowers have well exposed stamens and large feathery stigma.
   (a) Both statements 1 and 2 are correct.
   (b) Statement 1 is correct but statement 2 is incorrect.
   (c) Statement 1 is incorrect but statement 2 is correct.
   (d) Both statements 1 and 2 are incorrect.

6. Select the incorrect match.
   (a) Nucellus – Diploid structure
   (b) Megaspore mother cell – Diploid structure
   (c) Embryo sac – Diploid structure
   (d) Megaspore – Haploid structure

7. Law of segregation of gametes was proposed by
   (a) Mendel (b) Huxley
   (c) de Vries (d) Robert Hooke.

8. In which one of the following, both autogamy and geitonogamy are prevented?
   (a) *Oxalis* (b) Papaya
   (c) Castor (d) Maize

9. A man of A-blood group marries a woman of AB blood group. Which type of progeny would indicate that man is heterozygous A?
   (a) AB (b) A
   (c) O (d) B

10. In a fertilised ovule, 3n, 2n and n conditions occur respectively in
    (a) antipodal, egg and endosperm
    (b) egg, nuclellus and endosperm
    (c) endosperm, nucellus and antipodals
    (d) antipodals, synergids and integuments.

11. Linked gene do not shows
    (a) independent assortment
    (b) 9 : 3 : 3 : 1 phenotypic ratio
    (c) segregation of genes
    (d) all of these.

12. Which of the following statement(s) is/are incorrect?
(i) Pollen grains represent male gametophyte.
(ii) Vegetative cell is small and floats in the cytoplasm of generative cell.
(iii) Vegetative cell has abundant food reserve and a large irregularly shaped nucleus.
(iv) Formation and differentiation of pollen grains is called microsporogenesis.
(v) The pollen grains members of leguminoseae maintain viability for months
(vi) Pollen grains are poor in nutrients.
(a) (i) and (iv) (b) (ii) and (vi)
(c) (iv) and (v) (d) (v) and (vi)

13. 44 + XO chromosomal abnormality in humans causes
(a) Turner's syndrome
(b) Down's syndrome
(c) Cystic fibrosis
(d) Klinefelter's syndrome.

14. Choose the correct sequence of formation of mature dicot embryo.
(a) zygote → proembryo → globular → heart shaped → mature embryo
(b) proembryo → zygote → heart shaped → globular → mature embryo
(c) proembryo → heart shaped → globular → zygote → mature embryo
(d) zygote → globular → heart shaped → proembryo → mature embryo.

15. Which of the following processes are necessary for the complete development of male gametophyte from pollen mother cell?
(a) One meiotic cell division and two mitotic cell divisions
(b) One meiotic cell division and one mitotic cell division
(c) Two meiotic cell divisions and one mitotic cell division
(d) Two mitotic cell divisions

16. If selfing occurs in the plant having genotype RrYy, then ratio of given genotype will be
RRYY, RrYY, RRYy, RrYy
(a) 1 : 2 : 2 : 4 (b) 1 : 2 : 2 : 1
(c) 1 : 1 : 1 : 1 (d) 2 : 2 : 2 : 1.

17. Match the items in column I with those in column II and select the correct option.

Column-I		Column-II	
1.	Funicle	A.	Small opening of ovule
2.	Integuments	B.	Stalk of ovule
3.	Chalaza	C.	Protective envelopes of ovule
4.	Hilum	D.	Junction part of ovule
5.	Micropyle	E.	Basal part of the ovule

(a) 1-B ; 2-C ; 3-E ; 4-D ; 5-A
(b) 1-A ; 2-C ; 3-B ; 4-D ; 5-E
(c) 1-B ; 2-C ; 3-A ; 4-D ; 5-E
(d) 1-B ; 2-D ; 3-E ; 4-A ; 5-C

18. Apomictic embryos in *Citrus* arise from
(a) synergids (b) nucellus
(c) antipodal cells (d) diploid egg.

19. Find out the mismatch pair.
(a) Turner's syndrome – Females with rudimentary ovaries
(b) Haemophilia – Sex linked dominant trait
(c) Down's syndrome – Trisomy of 21
(d) Klinefelter's syndrome – Gynaecomastia

20. Select the incorrectly matched pair.
(a) Ex-albuminous seed – Groundnut
(b) Albuminous seed – Castor
(c) False fruit – Strawberry
(d) True fruit – Cashew

21. Both husband and wife have normal vision though their fathers were colourblind. The probability of their daughter becoming colourblind is
(a) 0% (b) 25%
(c) 50% (d) 75%.

22. Even after killing the generative cell with a laser beam, the pollen grain of a flowering plant germinates and produces normal pollen tube because
(a) laser beam stimulates pollen germination and pollen tube growth
(b) the laser beam does not damage the region from which pollen tube emerges
(c) the contents of killed generative cell permit germination and pollen tube growth
(d) the vegetative cell has not been damaged.

TRIO

ANSWERS MARCH 2024

The three letter sequence is **P H O**.

TYPHOID

MORPHOLOGY

LYMPHOCYTE

TROPHOBLAST

Winner : Jahnvi Malik, Rohtak (Haryana)

23. In which of the following plants, fruits contain very large number of seeds?
(a) Orchid (b) *Orobanche*
(c) *Striga* (d) All of these

24. If both parents are carriers for thalassemia, which in an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child?
(a) 100% (b) No chance
(c) 50% (d) 25%

25. In some members of which of the following pairs of families, pollen grains retain their viability for months after release?
(a) Rosaceae and leguminosae
(b) Poaceae and rosaceae
(c) Poaceae and leguminosae
(d) Poaceae and solanaceae

26. Incomplete dominance is different from codominance as in former
(a) there is no mixing of effect
(b) the expressed phenotype is combination of two phenotypes and their alleles
(c) hybrid possesses a new phenotype
(d) a quantitative effect is absent.

27. A cucumber has 24 chromosomes in root cells. The number of chromosomes in synergids will be
(a) 24 chromosomes (b) 12 chromosomes
(c) 36 chromosomes (d) 48 chromosomes.

28. 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 antipodal 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.

29. Observe the sex determination in the following columns and select the correct option.

Column-I		Column-II	
(A)	Male heterogamety	(1)	Human XY
(B)	Female heterogamety	(2)	Hen ZW
(C)	Male homogamety	(3)	*Drosophila* XY
		(4)	Grasshopper XO
		(5)	Birds ZZ

	A	B	C
(a)	3, 4	1	2
(b)	3, 4	2	1
(c)	2, 4	1	3
(d)	1, 3, 4	2	5

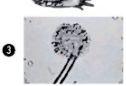
30. In a plant, red fruit (R) is dominant over yellow fruit (r) and tallness (T) is dominant over shortness (t). A plant with RRTt genotype is crossed with plant of rrtt genotype. The progeny is
(a) all red fruit, 25% tall (b) all red fruit, 50% tall
(c) all red fruit, 75% tall (d) all red fruit and tall.

31. The recombination frequency between the genes a & *c* is 5%, *b* & *c* is 15%, *b* & *d* is 9%, *a* & *b* is 20%, *c* & *d* is 24% and *a* & *d* is 29%. What will be the sequence of these genes on a linear chromosome ?
(a) *a, d, b, c* (b) *d, b, a, c*
(c) *a, b, c, d* (d) *a, c, b, d*

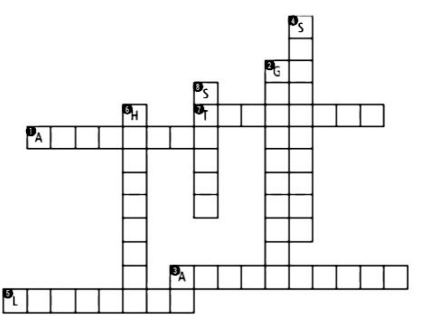
THINK BIO

Readers can send their responses at ***editor@mtg.in*** *or post us with complete address by 10th of every month. Winners' name and answers will be published in next issue.*

Across

Fill the grid with terms related to given images.



Down




32. Match column I with column II and select the correct option from the given codes.

Column-I		Column-II	
A.	Dihybrid test cross	(i)	9 : 3 : 3 : 1
B.	Law of segregation	(ii)	Dihybrid cross
C.	Law of independent assortment	(iii)	1 : 1 : 1 : 1
D.	ABO blood group in man	(iv)	Purity of gametes
		(v)	Multiple allelism

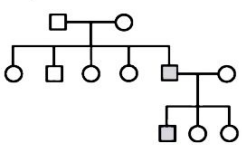
(a) A-(iii), B-(iv), C-(ii), D-(v)
(b) A-(i), B-(iv), C-(ii), D-(v)
(c) A-(iii), B-(ii), C-(iv), D-(v)
(d) A-(ii), B-(v), C-(iii), D-(i)

33. Which statement is incorrect for polygenic inheritance?
(a) Polygenic traits are controlled by three or more genes.
(b) Environment has no effect on phenotypic expression.
(c) It control quantitative traits.
(d) Both (b) and (c)

34. At the time of shedding, the number of nuclei present in an angiosperm's pollen grain is
(a) one (b) one or two
(c) two or three (d) always two.

35. A colourblind man (X^cY) has a colourblind sister (X^cX^c) and a normal brother (XY). What is genotype of father and mother respectively?
(a) X^cY, X^cX^c (b) XY, X^cX
(c) XY, X^cX^c (d) X^cY, X^cX

36. In the following pedigree chart, the mutant trait is shaded. The gene responsible for the trait is



(a) dominant and sex linked
(b) dominant and autosomal
(c) recessive and sex linked
(d) recessive and autosomal.

37. The plant parts which consist of two generations-one within the other
(1) pollen grains inside the anther
(2) germinated pollen grain with two male gametes
(3) seed inside the fruit
(4) embryo sac inside the ovule
(a) (1) only (b) (1), (2), and (3)
(c) (3) and (4) (d) (1) and (4).

38. Select the incorrect statement.
(a) If both parents have blood group O then their children cannot have blood groups A, B or AB.
(b) If a man homozygous for blood group B marries a woman with blood group O, then all their children will have blood group B.
(c) If a man with blood group AB marries a woman with same blood group then all their children will have AB blood group only.
(d) If both parents are homozygous for blood group A then their children will also have blood group A only.

39. Read the given statements and select the correct option.
Statement 1 : Sickle cell anaemia is an example of point mutation.
Statement 2 : In sickle cell anemia, RBCs become sickle shape.
(a) Both statements 1 and 2 are correct.
(b) Statement 1 is correct but statement 2 is incorrect.
(c) Statement 1 is incorrect but statement 2 is correct.
(d) Both statements 1 and 2 are incorrect.

40. A type of flower where complete autogamy is ensured is that
(a) the flower open and exposes the anther and stigma
(b) an open flower where homogamy occurs
(c) the cleistogamous flower
(d) chasmogamous flower.

☺☺

Key is published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.