NEET-UG Biology Sample Paper-12

Duration: 1 Hour **Maximum Marks: 360**

Instructions

- This paper contains a total of 90 Multiple Choice Questions.
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Q1. Which of the following statements regarding the five-kingdom classification system is incorrect?

(A) Chlamydomonas and Chlorella were excluded from Plantae and placed in Protista.

(B) All prokaryotic organisms were grouped together under Kingdom Monera.

(C) The classification is based primarily on the presence or absence of a well-defined nucleus.

(D) It puts together organisms (like fungi and plants) that were previously separated due to cell wall composition.

Q2. Identify the correct sequence of taxonomic categories in ascending order for the organism Musca domestica:

(A) Musca → Muscidae → Diptera → Insecta → Arthropoda

(B) Musca → Diptera → Muscidae → Insecta → Arthropoda

(C) Musca → Muscidae → Insecta → Diptera → Arthropoda

(D) Arthropoda → Insecta → Diptera → Muscidae → Musca

Q3. In Phaeophyceae (Brown algae), the spores and gametes are pear-shaped and possess:

(A) Two equal, apical flagella.

(B) Two unequal, lateral flagella.

(C) Numerous cilia over the entire body surface.

(D) A single, long posterior flagellum.

Q4. Which of the following features is uniquely characteristic of the Phylum Aschelminths that distinguishes it from Platyhelminthes?

(A) Presence of bilateral symmetry and triploblastic nature.

(B) The presence of a pseudocoelom and a complete alimentary canal.

(C) Use of flame cells for excretion and osmoregulation.

(D) Ability to reproduce sexually with internal fertilization.

Q5. Read the following statements regarding Pteridophytes: (i) The main plant body is a gametophyte. (ii) In majority of pteridophytes, all spores are of similar kinds. (iii) Genera like Selaginella and Salvinia are homosporous. (iv) The development of zygote into young embryos takes place within the female gametophyte. Which of the above statements are correct?

(A) (i) and (ii) only

(B) (ii) and (iv) only

(C) (i), (ii) and (iii)

(D) (iii) and (iv) only

Q6. A virus differs from a viroid in having:

(A) DNA molecules without a protein coat.

(B) RNA molecules with a protein coat.

(C) RNA molecules without a protein coat.

(D) DNA molecules with a protein coat.

Q7. Match the following and choose the correct option:

(a) Operculum – (i) Ctenophora

(b) Parapodia – (ii) Mollusca

(c) Radula – (iii) Osteichthyes

(d) Comb plates – (iv) Annelida

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

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

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

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

Q8. Which of the following organisms is correctly matched with its three characteristics?

(A) Pila: Segmented body, Shell, Radula.

(B) Asterias: Spiny skinned, Water vascular system, Radial symmetry.

(C) Chameleon: Poikilotherm, Dicondylic skull, Three-chambered heart.

(D) Periplaneta: Chitinous exoskeleton, Jointed appendages, Open circulatory system.

Q9. The transverse section of a plant material shows the following anatomical features: (a) Vascular bundles are scattered with no cambium. (b) Water-containing cavities are present within vascular bundles. (c) Hypodermis is sclerenchymatous. The plant material is identified as:

(A) Dicotyledonous stem

(B) Monocotyledonous stem

(C) Dicotyledonous root

(D) Monocotyledonous root

Q10. In the floral formula of a plant belonging to the Family Fabaceae, the androecium is represented as:

(A) $A_{(9)+1}$

(B) A_5

(C) $A_{1+(9)}$

(D) $A_{(10)}$

Q11. Which type of epithelial tissue is primarily responsible for moving particles or mucus in a specific direction over the epithelium, such as in the bronchioles and Fallopian tubes?

(A) Squamous epithelium

(B) Cuboidal epithelium

(C) Ciliated epithelium

(D) Compound epithelium

Q12. Which of the following is correct regarding the anatomy of a cockroach?

(A) The gizzard has an outer layer of longitudinal muscles and inner thick circular muscles.

(B) A ring of 6-8 blind tubules called hepatic caecae is present at the junction of foregut and midgut.

(C) Malpighian tubules are present at the junction of the midgut and hindgut and are 50-60 in number.

(D) The entire foregut is lined with a very thin cuticle.

Q13. The vascular cambium normally gives rise to:

(A) Phelloderm

(B) Primary phloem

(C) Secondary xylem

(D) Periderm

Q14. Which of the following is true regarding the Fluid Mosaic Model of the plasma membrane?

(A) Phospholipids flip-flop frequently, while proteins rarely rotate or move laterally.

(B) The quasi-fluid nature of lipids enables lateral movement of proteins within the overall bilayer.

(C) Carbohydrates are found on the inner cytoplasmic surface attached to integral proteins.

(D) Saturated fatty acid tails increase membrane fluidity at lower temperatures.

Q15. A cell is treated with a drug that inhibits the function of the Golgi apparatus. Which of the following processes will be most immediately affected?

(A) Synthesis of proteins on the Rough Endoplasmic Reticulum.

(B) Glycosylation of lipids and proteins to form glycolipids and glycoproteins.

(C) Generation of ATP via oxidative phosphorylation.

(D) Breakdown of long-chain fatty acids in peroxisomes.

Q16. In the synaptonemal complex, the process of crossing over is initiated at which specific stage of Prophase I?

(A) Leptotene

(B) Zygotene

(C) Pachytene

(D) Diplotene

Q17. Which of the following statements about the Cytoskeleton is incorrect?

(A) Microtubules are composed of tubulin and help in the movement of chromosomes.

(B) Microfilaments are involved in amoeboid movement and cytoplasmic streaming.

(C) The cytoskeleton is found in both prokaryotic and eukaryotic cells with the same chemical composition.

(D) It provides mechanical support, motility, and maintenance of the shape of the cell.

Q18. If a diploid cell has $2n = 16$ chromosomes, how many chromatids and what is the DNA content (C) at the G2 phase compared to the G1 phase ($2C$)?

(A) 16 chromatids and 2C DNA

(B) 32 chromatids and 4C DNA

(C) 16 chromatids and 4C DNA

(D) 32 chromatids and 2C DNA

Q19. Which of the following enzymes is responsible for the "Activation of Amino Acids" during the process of translation?

(A) RNA Polymerase II

(B) Peptidyl transferase

(C) Aminoacyl-tRNA synthetase

(D) DNA Ligase

Q20. The axoneme of a eukaryotic cilium or flagellum has a "9 + 2" arrangement. This means:

(A) Nine pairs of radially arranged peripheral microtubules and two central microtubules.

(B) Nine single peripheral microtubules and two pairs of central microtubules.

(C) Nine peripheral triplets and two central singlets.

(D) Nine central microtubules and two peripheral doublets.

Q21. Identify the secondary metabolite that is a drug (alkaloid) used in the treatment of cancer:

(A) Ricin

(B) Curcumin

(C) Vinblastine

(D) Abrin

Q22. Select the correct match regarding the inclusion bodies found in prokaryotes:

(A) Gas vacuoles — Found in Green and Purple photosynthetic bacteria.

(B) Phosphate granules — Membrane-bound storage structures.

(C) Glycogen granules — Involved in nitrogen fixation.

(D) Centrioles — Help in spindle formation during binary fission.

Q23. In B-DNA, the rise per base pair and the pitch of the helix are respectively:

(A) 0.34 *nm* and 3.4 *nm*

(B) 3.4 *nm* and 34 *nm*

(C) 0.34 Å and 3.4 Å

(D) 20 Å and 34 Å

Q24. In C_4 plants, the primary CO_2 acceptor is PEP (phosphoenolpyruvate), and the first stable product is formed in the:

(A) Mesophyll cell cytoplasm

(B) Bundle sheath cell chloroplast

(C) Mesophyll cell chloroplast

(D) Bundle sheath cell cytoplasm

Q25. Which of the following is the correct reason why Photorespiration does not occur in C_4 plants?

(A) They lack the enzyme RuBisCO entirely.

(B) They have a mechanism that increases the concentration of CO_2 at the enzyme site.

(C) They operate the Calvin cycle in the mesophyll cells only.

(D) Oxygen is not produced during the light reaction in C_4 plants.

Q26. During the "Link Reaction" in aerobic respiration, the conversion of pyruvic acid to acetyl CoA involves:

(A) Oxidative decarboxylation

(B) Substrate-level phosphorylation

(C) Hydrolysis

(D) Reductive amination

Q27. The Respiratory Quotient (RQ) of tripalmitin (a fat) is approximately:

(A) 1.0

(B) 0.9

(C) 0.7

(D) 1.4

Q28. Which plant hormone is responsible for the "Triple Response" in seedlings and is used to ripen fruits commercially?

(A) Abscisic Acid (ABA)

(B) Gibberellic Acid (GA_3)

(C) Ethylene (C_2H_4)

(D) Cytokinin (Zeatin)

Q29. In Cyclic Photophosphorylation, the electron is expelled from P_{700} and moves through several carriers before returning to P_{700}. Which of the following is NOT produced during this process?

(A) ATP

(B) $NADPH + H^+$

(C) Proton gradient

(D) All of the above are produced

Q30. According to the "Munch Mass Flow Hypothesis," phloem sap moves from source to sink due to:

(A) Active transport of water into the sieve tubes.

(B) A hydrostatic pressure gradient created by the loading of sugars.

(C) Gravitational pull acting on the dense sugar solution.

(D) Transpiration pull from the leaves.

Q31. Which element is essential for the photolysis of water during photosynthesis?

(A) Magnesium and Iron

(B) Manganese and Chlorine

(C) Copper and Molybdenum

(D) Zinc and Boron

Q32. A person breathing normally at rest has a Tidal Volume of 500 ml and a Residual Volume of 1200 ml. If their Expiratory Reserve Volume is 1100 ml, what is their Functional Residual Capacity (FRC)?

(A) 1600 ml

(B) 1700 ml

(C) 2300 ml

(D) 2800 ml

Q33. In the human heart, the "Action Potential" generated by the Sino-atrial Node (SAN) is unique because:

(A) It requires external neural stimulus to initiate every heartbeat.

(B) It can generate the maximum number of action potentials, about 70 – 75 min^{-1}.

(C) It causes the direct contraction of the Purkinje fibers before the bundle of His.

(D) It is the only part of the nodal tissue that can conduct electrical impulses.

Q34. Which of the following changes occurs in the sarcomere during the contraction of a skeletal muscle fiber?

(A) The A-band shortens significantly.

(B) The I-band remains constant in length.

(C) The H-zone reduces in width and may disappear.

(D) The Z-lines move further apart to allow expansion.

Q35. The mechanism of concentration of the filtrate (Counter-current mechanism) in the mammalian kidney depends primarily on the specific arrangement of:

(A) Proximal Convoluted Tubule and Distal Convoluted Tubule.

(B) Henle's loop and Vasa recta.

(C) Bowman's capsule and Glomerulus.

(D) Collecting duct and Juxtaglomerular apparatus.

Q36. Which of the following sets of hormones are all "Amino-acid derivatives"?

(A) Insulin and Glucagon

(B) Epinephrine and Norepinephrine

(C) Cortisol and Testosterone

(D) Estradiol and Progesterone

Q37. During the "Ventricular Systole" in a cardiac cycle, which of the following events occur simultaneously?

(A) Closure of Semilunar valves and opening of AV valves.

(B) Closure of AV valves and opening of Semilunar valves.

(C) Atrial systole and Ventricular diastole.

(D) Filling of the ventricles with 70% of the total blood volume.

Q38. A rise in PCO_2 and H^+ concentration, and a decrease in PO_2 at the tissue level, will cause the Oxygen-Hemoglobin dissociation curve to:

(A) Shift to the Left.

(B) Shift to the Right.

(C) Become a straight line.

(D) Become a parabola.

Q39. Which part of the human brain is primarily responsible for "Thermoregulation" and controlling the urge for eating and drinking?

(A) Cerebellum

(B) Medulla oblongata

(C) Corpus callosum

(D) Hypothalamus

Q40. Identify the correct statement regarding the "Resting Membrane Potential" of a neuron:

(A) The axonal membrane is more permeable to Na^+ than to K^+.

(B) The outer surface of the membrane possesses a negative charge.

(C) The Sodium-Potassium pump transports 3 Na^+ outwards for 2 K^+ into the cell.

(D) High concentration of Ca^{2+} ions inside the axoplasm maintains the potential.

Q41. What is the correct sequence of the layers in the wall of the alimentary canal from the outside to the inside?

(A) Serosa → Muscularis → Sub-mucosa → Mucosa

(B) Mucosa → Sub-mucosa → Muscularis → Serosa

(C) Serosa → Sub-mucosa → Muscularis → Mucosa

(D) Muscularis → Serosa → Sub-mucosa → Mucosa

Q42. In the "Organ of Corti", the hair cells act as auditory receptors. These cells are located on the:

(A) Reissner's membrane

(B) Basilar membrane

(C) Tectorial membrane

(D) Tympanic membrane

Q43. Which hormone is secreted by the "Alpha-cells" of the Islets of Langerhans and acts as a hyperglycemic hormone?

(A) Insulin

(B) Glucagon

(C) Somatostatin

(D) Gastrin

Q44. The enzyme "Enterokinase" is responsible for the conversion of:

(A) Casein into Paracasein

(B) Proteins into Polypeptides

(C) Trypsinogen into Trypsin

(D) Pepsinogen into Pepsin

Q45. In a flowering plant, if the microspore mother cell has 24 chromosomes, what will be the number of chromosomes in the endosperm of a seed produced by this plant, assuming normal double fertilization?

(A) 24

(B) 36

(C) 48

(D) 72

Q46. Which of the following represents the correct path of transport of sperms within the male reproductive system?

(A) Rete testis → Efferent ductules → Epididymis → Vas deferens

(B) Rete testis → Epididymis → Efferent ductules → Vas deferens

(C) Efferent ductules → Rete testis → Vas deferens → Epididymis

(D) Epididymis → Efferent ductules → Rete testis → Vas deferens

Q47. The "Filiform apparatus" is a characteristic feature of which part of the angiosperm embryo sac, and what is its primary function?

(A) Antipodal cells; to provide nourishment to the egg.

(B) Synergids; to guide the entry of the pollen tube.

(C) Central cell; to initiate endosperm formation.

(D) Egg cell; to prevent polyspermy.

Q48. In the human female, the "LH surge" typically occurs during the middle of the menstrual cycle. This surge is directly responsible for:

(A) The maintenance of the corpus luteum.

(B) The transformation of the Graafian follicle into the corpus luteum and ovulation.

(C) The primary maturation of the Oogonia into primary oocytes.

(D) The shedding of the endometrial lining (menstruation).

Q49. Identify the correct statement regarding "Cleistogamy" in plants:

(A) It ensures cross-pollination and increases genetic variability.

(B) It requires pollinators like bees or wind to transfer pollen.

(C) It occurs in flowers that never open, ensuring seed set even in the absence of pollinators.

(D) It is a strategy to prevent self-pollination in bisexual flowers.

Q50. During human embryonic development, the "Blastocyst" undergoes implantation. Which part of the blastocyst gives rise to the embryo proper?

(A) Trophoblast

(B) Inner cell mass

(C) Blastocoel cavity

(D) Chorionic villi

Q51. Apomixis is a form of asexual reproduction that mimics sexual reproduction in plants. In many Citrus varieties, apomictic embryos arise from:

(A) The haploid egg cell without fertilization.

(B) The diploid nucellar cells surrounding the embryo sac.

(C) The fusion of two synergid cells.

(D) The reductional division of the megaspore mother cell.

Q52. The secretion of which of the following glands constitutes the "Seminal plasma", which is rich in fructose, calcium, and certain enzymes?

(A) Seminal vesicles and Prostate gland only.

(B) Seminal vesicles, Prostate gland, and Bulbourethral glands.

(C) Testis and Epididymis only.

(D) Prostate gland and Bulbourethral glands only.

Q53. In an angiosperm, the "Functional Megaspore" develops into the embryo sac. Which of the following describes the most common type of embryo sac development (Polygonum type)?

(A) Monosporic, 8-nucleate, and 7-celled.

(B) Bisporic, 8-nucleate, and 8-celled.

(C) Tetrasporic, 7-nucleate, and 7-celled.

(D) Monosporic, 7-nucleate, and 8-celled.

Q54. The hormone "Relaxin" is produced in the human female during later stages of pregnancy by the:

(A) Pituitary gland

(B) Corpus luteum (and later the placenta)

(C) Developing fetus

(D) Uterine myometrium

Q55. In a dihybrid cross involving two genes (A and B) located on the same chromosome, a researcher observes a recombinant frequency of 15%. What is the distance between these two genes on the genetic map?

(A) 150 Centimorgans

(B) 1.5 Centimorgans

(C) 15 Centimorgans

(D) 30 Centimorgans

Q56. Which of the following enzymes is responsible for removing the RNA primers and replacing them with DNA nucleotides during DNA replication in E. coli?

(A) DNA Polymerase III

(B) DNA Polymerase I

(C) DNA Ligase

(D) Helicase

Q57. A man with blood group 'A' (whose mother had blood group 'O') marries a woman with blood group 'AB'. What are the possible blood groups of their offspring?

(A) A and AB only

(B) A, B and AB only

(C) A, B, AB and O

(D) A and B only

Q58. In the Lac operon model, the "Inducer" (Lactose) triggers gene expression by:

(A) Binding to the Promoter to recruit RNA Polymerase.

(B) Binding to the Repressor protein, preventing it from attaching to the Operator.

(C) Binding directly to the Structural genes to initiate transcription.

(D) Inhibiting the activity of the *i*-gene.

Q59. Which of the following observations would most strongly support the "RNA World" hypothesis during the early stages of chemical evolution?

(A) RNA is chemically more stable than DNA and proteins due to the presence of uracil.

(B) Certain RNA molecules (ribozymes) exhibit catalytic properties and can facilitate their own replication.

(C) RNA contains the sugar ribose, which was the only sugar present in the primitive "pre-biotic soup."

(D) All viruses utilize RNA as their primary genetic material to infect host cells.

Q60. Which of the following experimental evidences proved that DNA replication is semi-conservative?

(A) Hershy-Chase experiment using ^{32}P and ^{35}S.

(B) Meselson and Stahl's experiment using ^{15}N and ^{14}N.

(C) Griffith's experiment using Streptococcus pneumoniae.

(D) Avery, MacLeod, and McCarty experiment using DNase.

Q61. In human genetics, "Haemophilia" and "Color Blindness" are both examples of:

(A) Autosomal dominant disorders

(B) Autosomal recessive disorders

(C) X-linked recessive disorders

(D) Y-linked inheritance

Q62. The presence of "Analogous structures" (e.g., wings of a butterfly and wings of a bird) is a result of:

(A) Divergent evolution

(B) Convergent evolution

(C) Adaptive radiation

(D) Shared ancestry

Q63. During the processing of pro-mRNA in eukaryotes, the "Splicing" process involves the removal of:

(A) Exons and joining of Introns.

(B) Introns and joining of Exons.

(C) Poly-A tail and adding a 5' Cap.

(D) Regulatory sequences and adding a Promoter.

Q64. If the sequence of the coding strand of DNA is 5'-ATGCATGC-3', what will be the sequence of the transcribed mRNA?

(A) 5'-UACGUACG-3'

(B) 3'-UACGUACG-5'

(C) 5'-AUGCAUGC-3'

(D) 3'-AUGCAUGC-5'

Q65. Hugo de Vries based his "Mutation Theory" on his observations of the plant Oenothera lamarckiana. He believed that evolution is a:

(A) Gradual and continuous process.

(B) Single-step large mutation (Saltation).

(C) Result of small, directional variations.

(D) Process driven by "Disuse and Use" of organs.

Q66. A point mutation involving the substitution of Glutamic acid by Valine at the sixth position of the beta-globin chain leads to:

(A) Thalassemia

(B) Phenylketonuria

(C) Sickle-cell anemia

(D) Cystic fibrosis

Q67. In the "Human Genome Project" (HGP), the sequence of Chromosome 1 was completed last. In which year was it finished?

(A) 2003

(B) 2004

(C) 2006

(D) 2001

Q68. Industrial Melanism, as observed in the Peppered Moth (Biston betularia) in England, is a classic example of:

(A) Stabilizing selection

(B) Disruptive selection

(C) Directional selection

(D) Artificial selection

Q69. The "Miller-Urey experiment" demonstrated that organic molecules could be formed from inorganic precursors. Which of the following gases was NOT used in their spark-discharge apparatus?

(A) CH_4

(B) NH_3

(C) O_2

(D) H_2

Q70. In the life cycle of Plasmodium, the infectious stage (sporozoites) is formed in the mosquito's body. Specifically, where does the fertilization and further development of the parasite take place?

(A) Salivary glands of the mosquito

(B) Liver cells of the human host

(C) Wall of the mosquito's stomach

(D) RBCs of the human host

Q71. Which of the following lymphoid organs is considered the "graveyard" of RBCs and also acts as a filter of the blood by trapping blood-borne microorganisms?

(A) Thymus

(B) Bone marrow

(C) Spleen

(D) Tonsils

Q72. A patient is suspected to be suffering from Acquired Immuno Deficiency Syndrome (AIDS). Which diagnostic technique is routinely used for detecting HIV antibodies, and which one is used as a confirmatory test?

(A) ELISA (confirmatory) and Western Blot (screening)

(B) PCR (screening) and MRI (confirmatory)

(C) ELISA (screening) and Western Blot (confirmatory)

(D) Widal test (screening) and ELISA (confirmatory)

Q73. Cyclosporin A, an immunosuppressive agent used in organ-transplant patients, is produced by the fungus:

(A) Monascus purpureus

(B) Trichoderma polysporum

(C) Aspergillus niger

(D) Saccharomyces cerevisiae

Q74. In "Mout-breeding" or the MOET (Multiple Ovulation Embryo Transfer) technology, the cow is administered hormones with FSH-like activity to induce follicular maturation. At what stage are the embryos transferred to surrogate mothers?

(A) 2-4 celled stage

(B) 8-32 celled stage

(C) Fully developed fetus

(D) Unfertilized egg stage

Q75. Which of the following is a "narrow spectrum" insecticidal biocontrol agent that is effective against insects and other arthropods without affecting non-target organisms like birds or mammals?

(A) Bacillus thuringiensis

(B) Nucleopolyhedrovirus (Baculoviruses)

(C) Ladybird beetle

(D) Dragonflies

Q76. In the process of "Insertional Inactivation" used in pUC8 vectors, the recombinant DNA is inserted within the coding sequence of an enzyme. This results in the colonies appearing white instead of blue in the presence of X-gal. Name the enzyme involved:

(A) α-amylase

(B) β-galactosidase

(C) DNA ligase

(D) Alkaline phosphatase

Q77. During the "Annealing" step of Polymerase Chain Reaction (PCR), the temperature is lowered to approximately $50 - 60°C$ to allow:

(A) The DNA Polymerase to extend the primers.

(B) The separation of the two DNA strands.

(C) Primers to bind to their complementary sequences on the template DNA.

(D) The denaturation of the Taq polymerase.

Q78. RNA interference (RNAi) is used to make tobacco plants resistant to the nematode Meloidogyne incognita. This mechanism involves the silencing of specific mRNA using:

(A) Single-stranded DNA

(B) Double-stranded RNA

(C) Single-stranded RNA

(D) Double-stranded DNA

Q79. "Humulin" was the first genetically engineered human insulin. It was produced by Eli Lilly in 1983 by:

(A) Extracting pro-insulin from the pancreas of slaughtered pigs.

(B) Joining the A and B chains produced separately in E. coli via disulfide bonds.

(C) Deleting the C-peptide from the human pancreas using restriction enzymes.

(D) Using yeast cells to secrete a complete 51-amino acid single chain.

Q80. A transgenic "Golden Rice" variety has been developed to overcome the deficiency of:

(A) Vitamin C

(B) Vitamin A (Beta-carotene)

(C) Essential fatty acids

(D) Iron and Zinc

Q81. Which specific "Cry" genes are responsible for controlling the "Corn Borer" insect?

(A) cryIAc and cryIIAb

(B) cryIAb

(C) cryIAb and cryIAc

(D) cryIIAb and cryIIAc

Q82. In the "Bioreactor" used for large-scale production of recombinant proteins, the purpose of the "Sparger" is:

(A) To maintain constant temperature and pH.

(B) To bubble air into the medium to increase oxygen availability.

(C) To mix the contents of the reactor thoroughly.

(D) To remove the waste products at regular intervals.

Q83. Which enzyme is used to dissolve the fungal cell wall during the isolation of DNA?

(A) Lysozyme

(B) Cellulase

(C) Chitinase

(D) Ribonuclease

Q84. The "Gause's Competitive Exclusion Principle" states that:

(A) Two closely related species competing for the same resources can coexist indefinitely.

(B) Superior species will always share resources with inferior ones.

(C) Two species competing for the same limiting resources cannot coexist; the inferior one will be eliminated.

(D) Evolution always leads to resource partitioning to avoid competition.

Q85. What is the "Eutrophication" of a water body?

(A) The process of oxygen enrichment in deep water.

(B) The natural aging of a lake by nutrient enrichment (Nitrogen and Phosphorus).

(C) The thermal pollution caused by industrial discharge.

(D) The decrease in Biological Oxygen Demand (BOD) due to overgrowth of algae.

Q86. In the context of ecological succession, which of the following is a characteristic of "Pioneer species" in a primary succession on bare rock?

(A) They are usually large woody trees with deep root systems.

(B) They have the ability to lichenize and secrete acids to dissolve rock.

(C) They are late-successional species that require high nutrient availability.

(D) They consist of shade-tolerant herbs that stabilize the soil.

Q87. In the "Phosphorus Cycle," the natural reservoir of phosphorus is:

(A) Atmosphere

(B) Ocean water

(C) Rocks (Phosphate rocks)

(D) Living organisms

Q88. The "Montreal Protocol" was signed in 1987 (effective in 1989) to control the emission of:

(A) Greenhouse gases

(B) Ozone-depleting substances

(C) Non-biodegradable plastics

(D) Radioactive waste

Q89. Which zone of the biosphere reserve allows limited human activity for research and education, but no commercial exploitation?

(A) Core zone

(B) Buffer zone

(C) Transition zone

(D) Manipulation zone

Q90. The concentration of a toxicant (like DDT) increases at successive trophic levels in a food chain. This phenomenon is known as:

(A) Biogeochemical cycling

(B) Biomagnification

(C) Biodegradation

(D) Biopiracy

Detailed Solutions

Q1.

Solution

Concept: The five-kingdom classification by Whittaker is based on cellular organization, nutrition, reproduction, and evolutionary relationships. It separates prokaryotes, unicellular eukaryotes, fungi, plants, and animals into distinct kingdoms.

Solution: In Whittaker's five-kingdom system, classification is primarily based on cellular organization (prokaryotic vs eukaryotic), mode of nutrition, and evolutionary relationships. Chlamydomonas and Chlorella were shifted from Plantae to Protista due to unicellular eukaryotic nature. All prokaryotes are grouped under Monera. However, the system is not based primarily only on presence or absence of a nucleus; it considers multiple criteria. Hence, the incorrect statement is that classification is based primarily on nucleus presence alone, as it is only one of several factors.

Final Answer: Classification is based primarily on presence or absence of a well-defined nucleus

Answer: (C)

Q2.

Solution

Concept: Taxonomic hierarchy arranges organisms from species (lowest rank) to kingdom (highest rank), showing increasing inclusiveness and decreasing similarity.

Solution: Taxonomic categories are arranged in ascending order of complexity as species, genus, family, order, class, phylum, and kingdom. For *Musca domestica*, correct ascending order starts from species level *Musca*, followed by family Muscidae, order Diptera, class Insecta, and phylum Arthropoda. Other options incorrectly mix ranks or reverse hierarchy. The correct ascending sequence moves from most specific (species/genus) to broader groups (kingdom). Therefore, the correct arrangement is Musca → Muscidae → Diptera → Insecta → Arthropoda.

Final Answer: Musca → Muscidae → Diptera → Insecta → Arthropoda

Answer: (A)

Q3.

Solution

Concept: Phaeophyceae (brown algae) possess biflagellate reproductive cells with two unequal lateral flagella adapted for movement in aquatic environments.

Solution: Members of Phaeophyceae, such as brown algae, produce motile spores and gametes that are typically pear-shaped and biflagellate. These flagella are unequal in length and inserted laterally on the cell body. One flagellum is smooth (whiplash type), and the other is tinsel type with hairs, aiding in locomotion and orientation in water. They are not apical, not ciliated, and not single-flagellated organisms. Therefore, the correct characteristic is two unequal, lateral flagella.

Final Answer: Two unequal, lateral flagella

Answer: (B)

Q4.

Solution

Concept: Aschelminths (Nematoda) are distinguished from Platyhelminthes by the presence of a pseudocoelom and a complete digestive system with separate mouth and anus.

Solution: Aschelminths, or nematodes, are triploblastic, bilaterally symmetrical organisms with a pseudocoelom derived from blastocoel. They possess a complete alimentary canal with separate mouth and anus, allowing unidirectional food movement. In contrast, Platyhelminthes are acoelomate and have an incomplete digestive system. Flame cells are found in Platyhelminthes, not nematodes. Therefore, the unique distinguishing feature of Aschelminths is the presence of pseudocoelom and complete alimentary canal.

Final Answer: Presence of pseudocoelom and a complete alimentary canal

Answer: (B)

Q5.

Solution

Concept: In pteridophytes, the dominant phase is sporophyte, and fertilization requires water. Development of embryo occurs within the female gametophyte.

Solution: In pteridophytes, the dominant plant body is the sporophyte, not gametophyte, so statement (i) is incorrect. Most pteridophytes produce similar spores (homosporous), so (ii) is correct. Genera like Selaginella and Salvinia are heterosporous, so (iii) is incorrect. The zygote develops into embryo within the female gametophyte, making (iv) correct. Therefore, only statements (ii) and (iv) are correct.

Final Answer: (ii) and (iv) only

Answer: (B)

Q6.

Solution

Concept: Viruses contain either DNA or RNA enclosed in a protein coat (capsid), whereas viroids are simpler infectious agents composed only of RNA without a protein coat.

Solution: Viruses are acellular infectious particles consisting of genetic material (either DNA or RNA) enclosed within a protein coat called capsid. Viroids, on the other hand, are the simplest infectious agents composed only of a small circular RNA molecule without any protein coat. Therefore, the key difference is the presence of a protein coat in viruses, which is absent in viroids. Thus, viruses differ from viroids by having RNA or DNA enclosed in a protein coat.

Final Answer: RNA molecules with a protein coat

Answer: (B)

Q7.

Solution

Concept: Different animal groups have characteristic anatomical features used in taxonomy, such as radula in molluscs, operculum in fish, parapodia in annelids, and comb plates in ctenophores.

Solution: Operculum is a bony flap covering gills in Osteichthyes (bony fish). Parapodia are lateral appendages found in annelids like Nereis. Radula is a rasping feeding organ in molluscs. Comb plates are characteristic of ctenophores used for locomotion. Thus, the correct matching is operculum–Osteichthyes, parapodia–Annelida, radula–Mollusca, comb plates–Ctenophora.

Final Answer: $(a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)$

Answer: (A)

Q8.

Solution

Concept: Each animal group has specific diagnostic features such as body organization, skeleton type, and circulatory system used for classification.

Solution: Pila is a mollusc with shell and radula but not segmented body, so option 1 is incorrect. Asterias is an echinoderm with spiny skin, radial symmetry, and water vascular system, making option 2 correct. Chameleon is a reptile, not dicondylic skull class, and has a three-chambered heart, but classification details are mismatched. Periplaneta (cockroach) correctly shows chitinous exoskeleton, jointed appendages, and open circulatory system. Therefore, both Asterias and Periplaneta are correctly matched, but the best complete correct option is Periplaneta.

Final Answer: Periplaneta: Chitinous exoskeleton, jointed appendages, open circulatory system

Answer: (D)

Q9.

Solution

Concept: Monocot stems are characterized by scattered vascular bundles, absence of cambium, sclerenchymatous hypodermis, and presence of water-containing cavities in some cases, distinguishing them from dicot stems and roots.

Solution: The given anatomical features indicate a monocot stem. In monocotyledonous stems, vascular bundles are scattered throughout the ground tissue and are closed, meaning cambium is absent, so secondary growth does not occur. The hypodermis is typically sclerenchymatous, providing mechanical support. In some monocots like maize, large water-containing cavities (protoxylem lacunae) are also present within vascular bundles. These features are absent in dicot stems, which have vascular bundles arranged in a ring with cambium. Roots do not show such scattered bundles. Therefore, the plant material is identified as a monocotyledonous stem.

Final Answer: Monocotyledonous stem

Answer: (B)

Q10.

Solution

Concept: The family Fabaceae (Papilionaceae) shows a characteristic floral structure including a distinctive androecium arrangement.

Floral Features of Fabaceae:

- Calyx: 5, gamosepalous
- Corolla: 5, papilionaceous
- Androecium: diadelphous (9 + 1)
- Gynoecium: monocarpellary

Androecium Structure:

- 10 stamens are present
- 9 stamens are fused into a bundle
- 1 stamen remains free

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Explanation:

- This arrangement is called

  diadelphous condition

- It is a key identifying feature of Fabaceae family

$$\text{9 fused stamens} \longrightarrow \text{1 free stamen}$$

$$\text{Diadelphous (9+1)}$$

Final Answer: $\boxed{A_{(9)+1}}$

Answer: (A)

Q11.

Solution

Concept: Ciliated epithelium contains hair-like cilia that beat rhythmically to move substances such as mucus or ova in a specific direction along epithelial surfaces.

Solution: Ciliated epithelium is a specialized type of simple epithelium that contains numerous cilia on the apical surface of cells. These cilia perform coordinated rhythmic movements to transport materials such as mucus in the respiratory tract or ova in the Fallopian tubes. This directional movement helps in clearing debris and facilitating transport. Squamous epithelium is mainly protective, cuboidal epithelium is secretory and absorptive, and compound epithelium provides protection but does not move substances. Therefore, ciliated epithelium is responsible for directional movement of particles.

Final Answer: Ciliated epithelium

Answer: (C)

Q12.

Solution

Concept: Cockroach anatomy includes specialized structures such as gizzard, hepatic caeca, Malpighian tubules, and cuticle lining, each with specific functions in digestion and excretion.

Solution: In cockroach anatomy, the gizzard (proventriculus) contains chitinous teeth and is responsible for grinding food, but its muscle arrangement statement is incorrect. Hepatic caeca are 6-8 blind tubules present at the foregut-midgut junction and aid in digestion, making this statement correct. Malpighian tubules are present at the midgut-hindgut junction but are usually 100 or more, not 50-60, so that statement is incorrect. The foregut is lined with cuticle, but not the entire foregut uniformly thin as stated. Therefore, the correct statement is the presence of hepatic caeca.

Final Answer: Hepatic caeca are blind tubules at foregut-midgut junction

Answer: (B)

Q13.

Solution

Concept: Vascular cambium is a lateral meristem responsible for secondary growth, producing secondary xylem inward and secondary phloem outward.

Solution: The vascular cambium is a lateral meristem present in dicot stems and roots. It actively divides to produce secondary tissues. It forms secondary xylem towards the inner side, which contributes to wood formation, and secondary phloem towards the outer side, which assists in food transport. It does not directly form periderm or phelloderm; these are derived from cork cambium. Primary phloem is formed by primary meristem, not vascular cambium. Therefore, the correct product of vascular cambium is secondary xylem.

Final Answer: Secondary xylem

Answer: (C)

Q14.

Solution

Concept: The Fluid Mosaic Model describes the plasma membrane as a dynamic structure with lipids and proteins capable of lateral movement, giving it a fluid character.

Solution: According to the Fluid Mosaic Model, the plasma membrane consists of a phospholipid bilayer with embedded proteins that can move laterally within the membrane. The lipid bilayer provides a quasi-fluid environment, allowing mobility of proteins and lipids, which is essential for membrane functions such as transport and signaling. Carbohydrates are present on the outer surface, not inner cytoplasmic side. Saturated fatty acids decrease fluidity at low temperatures. Therefore, the correct statement is that lipid fluidity enables lateral movement of proteins within the membrane.

Final Answer: Fluid lipids allow protein movement in membrane

Answer: (B)

Q15.

Solution

Concept: The Golgi apparatus is responsible for post-translational modification of proteins and lipids, including glycosylation, packaging, and secretion.

Solution: The Golgi apparatus plays a central role in processing and packaging biomolecules. One of its key functions is glycosylation, where carbohydrates are added to proteins and lipids to form glycoproteins and glycolipids. These modified molecules are essential for membrane structure and cell recognition. If Golgi function is inhibited, glycosylation processes are immediately affected, leading to disruption in secretion and membrane assembly. Protein synthesis occurs in ribosomes, ATP production in mitochondria, and fatty acid breakdown in peroxisomes, so these are not directly affected. Therefore, glycosylation is most immediately affected.

Final Answer: Glycosylation of lipids and proteins to form glycoproteins and glycolipids

Answer: (B)

Q16.

Solution

Concept: Crossing over during meiosis occurs in Prophase I, specifically during pachytene stage when homologous chromosomes are fully synapsed and genetic exchange takes place.

Solution: Meiosis Prophase I is divided into leptotene, zygotene, pachytene, diplotene, and diakinesis stages. During leptotene, chromosomes begin condensation. In zygotene, synapsis begins and synaptonemal complex starts forming. Crossing over, which involves exchange of genetic material between homologous chromosomes, occurs during pachytene when synapsis is complete. Diplotene involves chiasmata formation and separation of homologs. Therefore, crossing over is initiated and occurs in pachytene stage.

Final Answer: Pachytene

Answer: (C)

Q17.

Solution

Concept: The cytoskeleton consists of microtubules, microfilaments, and intermediate filaments in eukaryotic cells, providing structural support, intracellular transport, and motility. It is absent in prokaryotes in the same organized form.

Solution: The cytoskeleton is a dynamic network of protein filaments present in eukaryotic cells. It includes microtubules (made of tubulin), microfilaments (actin), and intermediate filaments. Microtubules help in chromosome movement during cell division, while microfilaments are involved in amoeboid movement and cytoplasmic streaming. The cytoskeleton maintains cell shape, provides mechanical support, and aids in intracellular transport. However, prokaryotes do not possess a true cytoskeleton identical to eukaryotes; although some protein homologs exist, the structure and composition are not the same. Hence, the incorrect statement is that cytoskeleton exists in both prokaryotic and eukaryotic cells with the same chemical composition.

Final Answer: Cytoskeleton is present in both prokaryotes and eukaryotes

Answer: (C)

Q18.

Solution

Concept: During the cell cycle, DNA replication occurs in S-phase, leading to changes in DNA content and chromatids without changing chromosome number.

Given:

- Diploid cell: $2n = 16$
- G_1 phase DNA content = $2C$

Key Ideas:

- Chromosome number remains constant: $2n = 16$
- After S-phase (G_2), each chromosome has two sister chromatids

Step 1: Chromatids in G_2 phase

- Each of 16 chromosomes forms 2 chromatids
- Total chromatids = $16 \times 2 = 32$

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Step 2: DNA content in G_2 phase

- DNA is replicated once in S-phase
- G_2 DNA content = double of G_1
- Therefore: $4C$

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Comparison:

- G_1: $2C$, 16 chromosomes (single chromatids)
- G_2: $4C$, 16 chromosomes (32 chromatids)

$$G_1 \longrightarrow G_2$$

16 chromosomes, $2C$ 32 chromatids, $4C$

Final Answer: 32 chromatids and $4C$ DNA

Answer: (B)

Q19.

Solution

Concept: During translation, amino acids are activated and attached to tRNA molecules by specific enzymes called aminoacyl-tRNA synthetases.

Solution: In protein synthesis, the first step of translation involves activation of amino acids. This process is catalyzed by aminoacyl-tRNA synthetase enzymes, which attach specific amino acids to their corresponding tRNA molecules using ATP energy. This forms aminoacyl-tRNA, which then participates in polypeptide chain elongation. RNA polymerase II is involved in transcription, peptidyl transferase forms peptide bonds, and DNA ligase functions in DNA replication and repair. Therefore, aminoacyl-tRNA synthetase is responsible for amino acid activation.

Final Answer: Aminoacyl-tRNA synthetase

Answer: (C)

Q20.

Solution

Concept: The axoneme of cilia and flagella in eukaryotes has a characteristic 9 + 2 arrangement of microtubules essential for motility.

Solution: The axoneme of eukaryotic cilia and flagella consists of nine peripheral microtubule doublets arranged in a circle surrounding two central single microtubules. This is known as the 9 + 2 arrangement. The peripheral doublets are connected by dynein arms and radial spokes, enabling bending movement. This structure is essential for locomotion in protozoa and movement of fluids in multicellular organisms. Hence, the correct description is nine peripheral microtubule doublets and two central microtubules.

Final Answer: Nine peripheral doublets and two central microtubules

Answer: (A)

Q21.

Solution

Concept: Secondary metabolites such as alkaloids are plant-derived compounds used in medicine, including anticancer drugs like vinblastine.

Solution: Secondary metabolites are organic compounds not directly involved in growth but have important ecological and medicinal roles. Vinblastine is an alkaloid obtained from the plant Catharanthus roseus and is widely used in cancer chemotherapy. It inhibits microtubule formation and arrests cell division. Ricin and abrin are toxic proteins, while curcumin has anti-inflammatory properties but is not a primary anticancer alkaloid drug. Therefore, vinblastine is the correct anticancer alkaloid.

Final Answer: Vinblastine

Answer: (C)

Q22.

Solution

Concept: Prokaryotic inclusion bodies are non-membranous storage structures used for storing nutrients like phosphate, glycogen, and gas regulation.

Solution: Inclusion bodies in prokaryotes serve as storage sites for nutrients and gases. Gas vacuoles help in buoyancy in aquatic photosynthetic bacteria such as cyanobacteria and purple bacteria. Phosphate granules are non-membranous storage structures and not membrane-bound. Glycogen granules store energy but are not involved in nitrogen fixation. Centrioles are absent in prokaryotes. Therefore, gas vacuoles found in photosynthetic bacteria are correctly matched.

Final Answer: Gas vacuoles — Found in Green and Purple photosynthetic bacteria

Answer: (A)

Q23.

Solution

Concept: B-DNA is the most common form of DNA found under physiological conditions. It has a characteristic right-handed double helical structure with specific geometric parameters.

Key Structural Features of B-DNA:

- Distance between two successive base pairs (rise per base pair) = 3.4 Å
- Number of base pairs per turn = 10
- Pitch of helix = 10×3.4 Å= 34 Å

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Important Conversions:

- 1 nm = 10 Å
- Rise per base pair = 3.4 Å = 0.34 nm

$$\text{Base pair rise} \longrightarrow \text{Helix pitch}$$

$$3.4 \text{ Å}$$

$$34 \text{ Åper turn}$$

Final Answer: 0.34 nm and 3.4 nm

Answer: (A)

Q24.

Solution

Concept: In C_4 plants, CO_2 fixation occurs in mesophyll cells where PEP carboxylase forms a 4-carbon compound, which is then transported to bundle sheath cells.

Solution: In C_4 plants like maize, the initial CO_2 fixation occurs in mesophyll cell cytoplasm. Phosphoenolpyruvate (PEP) combines with CO_2 to form a 4-carbon compound such as oxaloacetate, which is then converted to malate or aspartate. These compounds are transported to bundle sheath cells, where decarboxylation occurs and CO_2 enters the Calvin cycle. Thus, the first stable product formation occurs in mesophyll cell cytoplasm.

Final Answer: Mesophyll cell cytoplasm

Answer: (A)

Q25.

Solution

Concept: C_4 plants suppress photorespiration by concentrating CO_2 around RuBisCO in bundle sheath cells using a CO_2 pump mechanism involving C_4 acids, reducing oxygenase activity of RuBisCO.

Solution: Photorespiration occurs when RuBisCO binds oxygen instead of carbon dioxide, leading to wasteful loss of fixed carbon. In C_3 plants, this is common under high temperature and low CO_2. C_4 plants have a special Kranz anatomy and a CO_2 concentrating mechanism. CO_2 is initially fixed in mesophyll cells into 4-carbon compounds and transported to bundle sheath cells, where CO_2 is released in high concentration near RuBisCO. This prevents oxygen from binding to RuBisCO, thereby minimizing photorespiration. C_4 plants do not lack RuBisCO, nor do they restrict Calvin cycle only to mesophyll cells. Oxygen evolution occurs normally. Hence, CO_2 concentration at enzyme site is the correct reason.

Final Answer: They have a mechanism that increases the concentration of CO_2 at the enzyme site

Answer: (B)

Q26.

Solution

Concept: The link reaction connects glycolysis to the Krebs cycle and involves oxidative decarboxylation of pyruvate to form acetyl-CoA in mitochondria.

Solution: During aerobic respiration, pyruvate produced in glycolysis enters the mitochondrial matrix. Here, it undergoes oxidative decarboxylation, meaning removal of a carbon atom as CO_2 and simultaneous oxidation. Coenzyme A attaches to the resulting acetyl group, forming acetyl-CoA. NAD^+ is reduced to NADH in the process. This step is called the link reaction as it connects glycolysis with the Krebs cycle. No ATP is directly formed in this step, and it does not involve hydrolysis or substrate-level phosphorylation. Therefore, the correct process is oxidative decarboxylation.

Final Answer: Oxidative decarboxylation

Answer: (A)

Q27.

Solution

Concept: Respiratory Quotient (RQ) is the ratio of CO_2 produced to O_2 consumed. Fats have low RQ due to high hydrogen content and greater oxygen requirement for oxidation.

Solution: The respiratory quotient (RQ) is defined as:

$$RQ = \frac{CO_2\ produced}{O_2\ consumed}$$

For carbohydrates, RQ is 1.0, but for fats like tripalmitin, oxidation requires more oxygen relative to CO_2 produced. This is because fats are more reduced molecules. For tripalmitin, the RQ value is approximately 0.7, which is characteristic of lipids. Proteins have intermediate values. Hence, the correct answer is 0.7.

Final Answer: 0.7

Answer: (C)

Q28.

Solution

Concept: Ethylene is a gaseous plant hormone responsible for the triple response in seedlings and also plays a key role in fruit ripening and senescence.

Solution: Ethylene (C_2H_4) is a gaseous plant hormone that regulates several physiological processes. In seedlings, it causes the triple response: inhibition of stem elongation, thickening of the stem, and horizontal growth. Ethylene is also widely used commercially to accelerate fruit ripening in fruits like bananas and tomatoes. Abscisic acid is a stress hormone, gibberellins promote growth, and cytokinins promote cell division. Therefore, ethylene is the correct hormone responsible for triple response and fruit ripening.

Final Answer: Ethylene (C_2H_4)

Answer: (C)

Q29.

Solution

Concept: Cyclic photophosphorylation is a light-dependent reaction occurring in Photosystem I where electrons cycle back to the reaction center (P_{700}).

Key Features:

- Involves only Photosystem I
- Electron returns to P_{700} after passing through electron transport chain
- Produces ATP but not NADPH

Process Overview:

- Light excites electron in P_{700}
- Electron moves through ferredoxin, cytochromes, and plastoquinone
- Returns back to P_{700}
- Proton gradient is generated across thylakoid membrane

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Products of Cyclic Photophosphorylation:

- ATP is produced
- Proton gradient is established
- NADPH + H^+ is NOT produced

Reason:

- Electrons return to P_{700} instead of reducing $NADP^+$

$$P_{700} \longrightarrow \text{ETC} \longrightarrow P_{700}$$

ATP formed

No NADPH

Final Answer: $\boxed{NADPH + H^+}$

Answer: (B)

Q30.

Solution

Concept: Munch mass flow hypothesis explains translocation of sugars in phloem due to osmotic pressure differences between source and sink regions.

Solution: According to Munch's hypothesis, sugars are actively loaded into sieve tubes at the source (leaves), increasing solute concentration. This causes water to enter from xylem by osmosis, generating high turgor or hydrostatic pressure. At the sink (roots or storage organs), sugars are removed, lowering pressure. This creates a pressure gradient that drives mass flow of phloem sap. The movement is not due to gravity or transpiration pull but due to pressure differences. Therefore, hydrostatic pressure gradient is the correct reason.

Final Answer: A hydrostatic pressure gradient created by loading of sugars

Answer: (B)

Q31.

Solution

Concept: Photolysis of water in photosynthesis occurs in Photosystem II and requires manganese and chloride ions as essential cofactors.

Solution: During the light reaction of photosynthesis, water molecules are split in Photosystem II in a process called photolysis. This reaction releases oxygen, protons, and electrons. The oxygen-evolving complex associated with PSII requires manganese ions (Mn^{2+}) and chloride ions (Cl^-) as essential cofactors for efficient splitting of water. Magnesium and iron are involved in chlorophyll and electron transport, but not photolysis. Hence, manganese and chlorine are essential for water splitting.

Final Answer: Manganese and Chlorine

Answer: (B)

Q32.

Solution

Concept: Functional Residual Capacity (FRC) is the volume of air remaining in the lungs after normal expiration. It is the sum of Expiratory Reserve Volume (ERV) and Residual Volume (RV), independent of Tidal Volume.

Solution: Functional Residual Capacity (FRC) represents the amount of air left in the lungs after a normal tidal expiration. It helps maintain continuous gas exchange between breaths and prevents alveolar collapse. FRC is calculated as:

$$FRC = ERV + RV$$

Given ERV = 1100 ml and RV = 1200 ml,

$$FRC = 1100 + 1200 = 2300\ ml$$

Tidal volume is not included in FRC calculation because it represents air exchanged during normal breathing, not the remaining lung volume. Therefore, the correct functional residual capacity is 2300 ml.

Final Answer: $2300\ ml$

Answer: (C)

Q33.

Solution

Concept: The Sino-atrial Node (SAN) acts as the natural pacemaker of the heart due to its ability to spontaneously generate rhythmic electrical impulses at the highest rate among cardiac tissues.

Solution: The SAN is located in the right atrium and is responsible for initiating the heartbeat. It exhibits autorhythmicity, meaning it can generate spontaneous action potentials without external neural stimulation. It typically generates impulses at a rate of 70–75 per minute, which sets the normal heart rate. These impulses spread to the atria and then to the AV node, bundle of His, and Purkinje fibers. SAN is not dependent on nervous input and does not directly cause contraction of Purkinje fibers before conduction through the His bundle. Therefore, its unique feature is the highest intrinsic firing rate.

Final Answer: It can generate the maximum number of action potentials, about 70–75 min^{-1}

Answer: (B)

Q34.

Solution

Concept: Muscle contraction follows the sliding filament theory, where actin and myosin filaments slide past each other, altering sarcomere regions without changing filament lengths.

Solution: During skeletal muscle contraction, actin (thin filaments) slide over myosin (thick filaments), leading to shortening of the sarcomere. The A-band, which represents the length of myosin filaments, remains constant. The I-band (actin-only region) and H-zone (myosin-only central region) both decrease in size, with the H-zone often disappearing during full contraction. Z-lines move closer together, not further apart. Therefore, the correct change is reduction of H-zone width. Other options are incorrect because they contradict filament sliding behavior.

Final Answer: The H-zone reduces in width and may disappear

Answer: (C)

Q35.

Solution

Concept: The counter-current mechanism in the kidney depends on the arrangement of Henle's loop and vasa recta, which create and maintain osmotic gradients in the medulla.

Solution: The concentration of urine in mammals is achieved through the counter-current mechanism. This involves the loop of Henle and the vasa recta running parallel in opposite directions. The descending and ascending limbs of Henle's loop create a gradient of solute concentration, while the vasa recta preserves this gradient by counter-current exchange. This mechanism allows efficient reabsorption of water and solutes, concentrating the filtrate. Other structures like PCT, DCT, Bowman's capsule, and collecting duct play roles in filtration and modification but not in generating the counter-current gradient.

Final Answer: Henle's loop and Vasa recta

Answer: (B)

Q36.

Solution

Concept: Amino-acid derived hormones are synthesized from tyrosine or tryptophan and include catecholamines like epinephrine and norepinephrine.

Solution: Hormones are classified into peptide, steroid, and amino acid derivatives. Amino acid-derived hormones include catecholamines such as epinephrine and norepinephrine, which are synthesized from the amino acid tyrosine. Insulin and glucagon are peptide hormones. Cortisol, testosterone, estradiol, and progesterone are steroid hormones derived from cholesterol. Therefore, only epinephrine and norepinephrine are amino-acid derivatives among the given options.

Final Answer: Epinephrine and Norepinephrine

Answer: (B)

Q37.

Solution

Concept: During ventricular systole, the ventricles contract, AV valves close to prevent backflow, and semilunar valves open to allow blood ejection into major arteries.

Solution: Ventricular systole is the phase in which ventricles contract after atrial systole. As ventricular pressure rises, the atrioventricular (AV) valves close, producing the first heart sound (lub), preventing backflow into atria. When pressure exceeds that in the aorta and pulmonary artery, semilunar valves open, allowing blood ejection. Atrial systole occurs earlier, and ventricular diastole occurs later. Therefore, the correct simultaneous events are closure of AV valves and opening of semilunar valves.**Final Answer:** Closure of AV valves and opening of Semilunar valves

Answer: (B)

Q38.

Solution

Concept: The oxygen-hemoglobin dissociation curve shifts based on factors like CO_2, H^+ concentration, temperature, and oxygen levels, described by the Bohr effect.

Solution: An increase in CO_2 and H^+ concentration and a decrease in PO_2 at tissues indicate metabolically active tissues. These conditions reduce hemoglobin's affinity for oxygen, facilitating oxygen release. This phenomenon is known as the Bohr effect. It causes the oxygen-hemoglobin dissociation curve to shift to the right, meaning more oxygen is released at the same partial pressure. This adaptation ensures efficient oxygen delivery to tissues requiring high metabolic activity. A left shift would indicate increased affinity, which is opposite of the requirement here.

Final Answer: Shift to the Right

Answer: (B)

Q39.

Solution

Concept: The hypothalamus is the main regulatory center for homeostasis in the human brain, controlling temperature regulation, hunger, thirst, and endocrine functions via the pituitary gland.

Solution: The hypothalamus is a small but highly important region of the forebrain that maintains internal body balance (homeostasis). It regulates thermoregulation by acting as the body's thermostat, detecting changes in blood temperature and initiating responses like sweating or shivering. It also contains hunger and thirst centers that control feeding and drinking behavior. Other brain regions such as the cerebellum control coordination, medulla regulates involuntary functions like breathing, and corpus callosum connects brain hemispheres. Therefore, thermoregulation and appetite control are functions of the hypothalamus.

Final Answer: Hypothalamus

Answer: (D)

Q40.

Solution

Concept: Resting membrane potential is maintained by ion gradients and selective permeability, mainly due to K^+ leakage and Na^+/K^+ pump activity.

Solution: The resting membrane potential of a neuron is typically around -70 mV, with the inside of the cell being negatively charged relative to the outside. This is mainly due to higher permeability to potassium ions (K^+) compared to sodium ions (Na^+), allowing K^+ to leak out. The sodium-potassium pump actively transports 3 Na^+ ions out of the cell and 2 K^+ ions into the cell, helping maintain the gradient. The outer surface is not negative, and Ca^{2+} is not responsible for maintaining resting potential. Therefore, the correct statement is the Na^+/K^+ pump ratio.

Final Answer: The Sodium-Potassium pump transports 3 Na^+ outwards for 2 K^+ into the cell

Answer: (C)

Q41.

Solution

Concept: The wall of the alimentary canal consists of four layers arranged from outermost to innermost: serosa, muscularis, submucosa, and mucosa.

Solution: The gastrointestinal tract wall is organized into four layers. The outermost layer is serosa, a protective connective tissue layer. Below it lies the muscularis layer responsible for peristalsis, followed by the submucosa which contains blood vessels and nerves. The innermost layer is the mucosa, which is involved in secretion and absorption. This arrangement ensures efficient digestion and transport of food. Therefore, the correct sequence from outside to inside is serosa, muscularis, submucosa, and mucosa.

Final Answer: Serosa $\rightarrow$ Muscularis $\rightarrow$ Sub-mucosa $\rightarrow$ Mucosa

Answer: (A)

Q42.

Solution

Concept: The Organ of Corti is the sensory organ of hearing located in the cochlea, where hair cells rest on the basilar membrane.

Solution: The Organ of Corti contains specialized hair cells that act as mechanoreceptors for sound perception. These hair cells are situated on the basilar membrane within the cochlear duct. Sound vibrations cause movement of the basilar membrane, which bends hair cell stereocilia against the tectorial membrane, generating nerve impulses. Reissner's membrane separates fluid compartments, and the tympanic membrane is the eardrum. Therefore, hair cells are located on the basilar membrane.

Final Answer: Basilar membrane

Answer: (B)

Q43.

Solution

Concept: Glucagon is a peptide hormone secreted by alpha cells of the islets of Langerhans and raises blood glucose levels.

Solution: The pancreas contains islets of Langerhans composed of alpha, beta, and delta cells. Alpha cells secrete glucagon, a hyperglycemic hormone that increases blood glucose levels by stimulating glycogen breakdown in the liver and gluconeogenesis. Beta cells secrete insulin, which lowers blood glucose. Somatostatin inhibits both insulin and glucagon, while gastrin is a digestive hormone. Therefore, glucagon is the correct hyperglycemic hormone.

Final Answer: Glucagon

Answer: (B)

Q44.

Solution

Concept: Enterokinase is an intestinal enzyme that activates trypsinogen into trypsin, initiating protein digestion in the small intestine.

Solution: Enterokinase (also called enteropeptidase) is secreted by the intestinal mucosa in the duodenum. Its primary function is to convert inactive trypsinogen, secreted by the pancreas, into active trypsin. Trypsin then activates other pancreatic enzymes such as chymotrypsin and carboxypeptidase, aiding protein digestion. Pepsinogen is activated in the stomach by HCl, not enterokinase. Therefore, enterokinase activates trypsinogen into trypsin.

Final Answer: Trypsinogen into Trypsin

Answer: (C)

Q45.

Solution

Concept: In angiosperms, double fertilization leads to formation of a diploid zygote and a triploid endosperm.

Given:

- Microspore mother cell (MMC) = diploid = $2n = 24$

Step 1: Determine haploid number

$$n = \frac{24}{2} = 12$$

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Step 2: Endosperm formation

- Endosperm is formed by fusion of:
  - One male gamete (n)
  - Two polar nuclei ($n + n$)
- Therefore, endosperm is triploid: $3n$

Step 3: Calculation

$$3n = 3 \times 12 = 36$$

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$$\text{Male gamete (n)} \longrightarrow \text{Polar nuclei (2n)}$$

$$\text{Endosperm (3n)}$$

$$\text{36 chromosomes}$$

Final Answer: 36

Answer: (B)

Q46.

Solution

Concept: Sperm transport in the male reproductive system follows a well-defined anatomical pathway starting from the site of sperm production in the seminiferous tubules. The movement involves sequential passage through connecting ducts that progressively mature and transport sperm toward the exterior. Proper understanding of this pathway is important in reproductive biology.

Solution: Sperms are produced in the seminiferous tubules of the testes. From here, they first enter the rete testis, a network that collects sperm from seminiferous tubules. They then pass through efferent ductules, which transport sperm to the epididymis. In the epididymis, sperms undergo maturation and gain motility. Finally, mature sperms are transported via the vas deferens toward the ejaculatory duct during ejaculation. This sequential pathway ensures proper maturation and transport of sperm cells. Any deviation from this order is incorrect as it disrupts sperm maturation and transport efficiency.

Final Answer: Rete testis → Efferent ductules → Epididymis → Vas deferens

Answer: (A)

Q47.

Solution

Concept: The filiform apparatus is a specialized structure found in the synergid cells of the embryo sac in angiosperms. It plays a key role in guiding the pollen tube toward the egg apparatus during fertilization, ensuring successful delivery of male gametes.

Solution: The filiform apparatus is located at the micropylar end of synergid cells in the embryo sac. It consists of finger-like wall ingrowths that increase absorption and secretion. Its main function is to guide the pollen tube into the synergid cell, facilitating the release of male gametes near the egg cell. It also helps in nutrient transfer and communication between pollen tube and embryo sac. Among all cells of the embryo sac, only synergids possess this structure, making them essential for fertilization. Without it, pollen tube guidance would be inefficient.

Final Answer: Synergids; to guide the entry of the pollen tube

Answer: (B)

Q48.

Solution

Concept: The LH surge is a critical hormonal event in the human menstrual cycle that triggers ovulation and transforms the ruptured follicle into a hormone-secreting structure. It is essential for successful reproduction and is regulated by feedback mechanisms involving estrogen and pituitary hormones.

Solution: During the mid-menstrual cycle, rising estrogen levels from the mature Graafian follicle stimulate a positive feedback mechanism on the hypothalamus and pituitary gland, resulting in a sudden LH surge. This LH surge causes the rupture of the Graafian follicle, releasing the ovum (ovulation). It also induces luteinization of the remaining follicular cells, forming the corpus luteum, which secretes progesterone. This progesterone maintains the endometrium for possible implantation. The LH surge does not directly cause menstruation or oogonia development but is central to ovulation and corpus luteum formation.

Final Answer: Transformation of Graafian follicle into corpus luteum and ovulation

Answer: (B)

Q49.

Solution

Concept: Cleistogamy is a reproductive adaptation in certain plants where flowers remain closed, ensuring self-pollination. It is an evolutionary strategy that guarantees seed production even in the absence of pollinators or favorable environmental conditions.

Solution: In cleistogamous flowers, pollination occurs without the flower opening. Since the floral parts remain enclosed, pollen grains directly reach the stigma of the same flower. This ensures self-pollination and reliable seed set. It is commonly seen in plants like Viola and Oxalis. While it reduces genetic variability due to selfing, it guarantees reproduction even when pollinators are absent. This is advantageous in harsh or unpredictable environments. Cleistogamy is not dependent on wind or insects and does not promote cross-pollination, unlike chasmogamous flowers.

Final Answer: Flowers that never open, ensuring seed set without pollinators

Answer: (C)

Q50.

Solution

Concept: The blastocyst stage in human embryonic development consists of two main components: the trophoblast and the inner cell mass. The inner cell mass is responsible for forming the embryo proper, while other structures contribute to supportive fetal tissues.

Solution: After fertilization and cleavage, the morula transforms into a blastocyst. The blastocyst consists of an outer trophoblast layer and an inner cell mass (ICM) attached to one side. The trophoblast forms the placenta and supporting structures, whereas the inner cell mass differentiates into the embryo proper, giving rise to all body tissues and organs. The blastocoel is a fluid-filled cavity, and chorionic villi are derived later from trophoblast for maternal-fetal exchange. Thus, only the inner cell mass contributes directly to embryo formation.

Final Answer: Inner cell mass

Answer: (B)

Q51.

Solution

Concept: Apomixis is a form of asexual reproduction in plants where seeds are formed without fertilization. In citrus and several other species, apomictic embryos often arise from somatic nucellar cells surrounding the embryo sac.

Solution: In citrus plants, apomixis commonly occurs through nucellar embryony. Here, diploid nucellar cells, which are part of the ovule tissue surrounding the embryo sac, develop directly into embryos without undergoing meiosis or fertilization. These embryos are genetically identical to the parent plant, ensuring clonal propagation. This mechanism is highly useful in horticulture as it maintains desirable traits across generations. It is different from sexual reproduction, where fertilization and genetic recombination occur. Other options such as egg cell development or synergid fusion are not involved in nucellar embryony.

Final Answer: Diploid nucellar cells surrounding the embryo sac

Answer: (B)

Q52.

Solution

Concept: Seminal plasma is the fluid component of semen that provides nutrition, protection, and medium for sperm transport. It is contributed by accessory glands, each adding specific substances essential for sperm viability and motility.

Solution: Seminal plasma is composed mainly of secretions from seminal vesicles, prostate gland, and bulbourethral glands. Seminal vesicles contribute fructose, which provides energy to sperm. The prostate gland secretes citrate, calcium, and enzymes that enhance sperm motility and survival. Bulbourethral glands secrete mucus-like fluid that lubricates the urethra and neutralizes acidity. The testes and epididymis primarily produce and store sperm, not seminal plasma. Therefore, the combined secretions of these three accessory glands form the seminal fluid essential for successful fertilization.

Final Answer: Seminal vesicles, Prostate gland, and Bulbourethral glands

Answer: (B)

Q53.

Solution

Concept: In angiosperms, the embryo sac (female gametophyte) most commonly develops from a single functional megaspore through monosporic development known as the Polygonum type. It is characterized by three rounds of mitotic division leading to an 8-nucleate structure that organizes into 7 cells.

Solution: The Polygonum type is the most common embryo sac development pattern in angiosperms. It begins when only one of the four megaspores remains functional while the other three degenerate, making it monosporic development. The functional megaspore undergoes three successive mitotic divisions to produce eight nuclei. These nuclei organize into seven cells: three antipodal cells at the chalazal end, two synergids and one egg cell at the micropylar end, and one central cell containing two polar nuclei. Thus, the mature embryo sac is 8-nucleate and 7-celled. This arrangement is highly efficient for double fertilization.

Final Answer: Monosporic, 8-nucleate, and 7-celled

Answer: (A)

Q54.

Solution

Concept: Relaxin is a peptide hormone involved in pregnancy and childbirth. It is primarily produced by the corpus luteum in early pregnancy and later by the placenta. It helps in preparing the female reproductive system for parturition by relaxing pelvic ligaments and softening the cervix.

Solution: In human females, relaxin is secreted mainly by the corpus luteum during early pregnancy. As pregnancy progresses, the placenta also becomes a significant source of relaxin. This hormone plays an important role in facilitating childbirth by loosening the pelvic ligaments, widening the cervix, and reducing uterine contractions. These effects ensure easier passage of the fetus during delivery. The pituitary gland, fetus, and uterine myometrium do not directly produce relaxin. Therefore, its primary source is the corpus luteum and later the placenta, making it essential for successful parturition.

Final Answer: Corpus luteum (and later the placenta)

Answer: (B)

Q55.

Solution

Concept: Genetic linkage and recombination frequency are used to determine the distance between two genes on a chromosome. One percent recombination corresponds to one map unit or one centimorgan (cM).

Solution: In a dihybrid cross where two genes are linked on the same chromosome, recombination occurs due to crossing over during meiosis. The recombination frequency is calculated as the percentage of recombinant offspring. Since 1% recombination equals 1 centimorgan, a recombination frequency of 15% indicates that the genes are 15 map units apart. This distance reflects the likelihood of crossing over between the two loci. A higher recombination frequency means genes are farther apart, while lower frequency indicates tighter linkage.

Final Answer: 15 Centimorgans

Answer: (C)

Q56.

Solution

Concept: DNA replication in prokaryotes involves several enzymes working in coordination. RNA primers are required for initiation but must be removed and replaced with DNA nucleotides to ensure continuity of the newly synthesized strand.

Solution: In *E. coli*, DNA Polymerase III is the main enzyme responsible for elongation of the DNA strand. However, it cannot remove RNA primers. DNA Polymerase I plays a crucial role in removing RNA primers using its 5' to 3' exonuclease activity and simultaneously filling the resulting gaps with DNA nucleotides. Finally, DNA ligase seals the nicks between fragments to complete the strand. Helicase is involved in unwinding DNA, not primer removal. Therefore, DNA Polymerase I is responsible for replacing RNA primers with DNA.

Final Answer: DNA Polymerase I

Answer: (B)

Q57.

Solution

Concept: ABO blood group inheritance is determined by multiple alleles with codominance and recessive traits. The genotype of parents determines possible offspring blood groups based on allele combinations.

Solution: The man has blood group A, but since his mother had blood group O, his genotype must be I^Ai. The woman with blood group AB has genotype I^AI^B. Possible gametes from the man are I^A and i, while from the woman are I^A and I^B. Offspring combinations include I^AI^A (A), I^AI^B (AB), I^Ai (A), and I^Bi (B). Therefore, possible blood groups of offspring are A, B, and AB, but not O because neither parent provides two recessive alleles.

Final Answer: A, B and AB only

Answer: (B)

Q58.

Solution

Concept: In the lac operon system, gene expression is regulated by an inducible mechanism. The inducer inactivates the repressor protein, allowing transcription of structural genes involved in lactose metabolism.

Solution: The lac operon in bacteria is regulated by the presence or absence of lactose. In the absence of lactose, the repressor protein binds to the operator, preventing transcription. When lactose (inducer) is present, it binds to the repressor protein, causing a conformational change that prevents it from binding to the operator. This allows RNA polymerase to access the promoter and transcribe structural genes such as lacZ, lacY, and lacA. The inducer does not bind directly to DNA or structural genes. Thus, lactose induces gene expression by inactivating the repressor.

Final Answer: Binding to the repressor protein, preventing it from attaching to the operator

Answer: (B)

Q59.

Solution

Concept: The RNA World hypothesis proposes that early life forms used RNA as both genetic material and catalytic molecule before the evolution of DNA and proteins. Evidence supporting this idea includes the discovery of ribozymes, which demonstrate that RNA can store information and catalyze biochemical reactions.

Solution: The RNA World hypothesis suggests that RNA preceded DNA and proteins in early evolution because it can perform dual functions: genetic information storage and enzymatic catalysis. The strongest evidence supporting this hypothesis is the discovery of ribozymes, RNA molecules that possess catalytic activity. Some ribozymes can catalyze reactions such as RNA splicing and even self-replication under laboratory conditions. This demonstrates that RNA could have supported early metabolic and replication processes without proteins. In contrast, DNA lacks catalytic ability, and proteins lack genetic storage capability. The idea that RNA was chemically more stable or that viruses prove RNA primacy is incorrect. Therefore, the ability of RNA to act as both genetic material and enzyme provides the most compelling evidence for the RNA World hypothesis.

Final Answer: Ribozymes are catalytic RNAs

Answer: (B)

Q60.

Solution

Concept: DNA replication was proven to be semi-conservative, meaning each daughter DNA molecule contains one parental strand and one newly synthesized strand.

Key Experimental Evidence:

- The **Meselson and Stahl experiment** demonstrated semi-conservative replication.
- They used isotopes of nitrogen:
  - Heavy nitrogen: ^{15}N
  - Light nitrogen: ^{14}N

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Experimental Approach:

- E. coli grown in ^{15}N medium (heavy DNA)
- Shifted to ^{14}N medium
- DNA density analyzed using centrifugation

Result:

- First generation showed hybrid DNA (^{15}N + ^{14}N)
- Supported semi-conservative replication model

Parent DNA (^{15}N) ~~——————~~ Hybrid DNA

Replication

Semi-conservative

Final Answer: Meselson and Stahl's experiment using ^{15}N and ^{14}N

Answer: (B)

Q61.

Solution

Concept: Haemophilia and color blindness are inherited genetic disorders located on genes present on the X chromosome. Their inheritance pattern is sex-linked, specifically showing recessive expression in males due to the presence of only one X chromosome.

Solution: Both haemophilia and red-green color blindness are classic examples of X-linked recessive disorders. These conditions are caused by recessive alleles located on the X chromosome. Males (XY) are more frequently affected because a single recessive allele on their only X chromosome is sufficient to express the disease. Females (XX) are usually carriers unless both X chromosomes carry the defective allele. These disorders are not autosomal or Y-linked because their genes are not located on autosomes or the Y chromosome. Their inheritance shows a characteristic crisscross pattern from carrier mothers to affected sons.

Final Answer: X-linked recessive disorders

Answer: (C)

Q62.

Solution

Concept: Analogous structures arise when different organisms evolve similar functional features independently, without sharing a recent common ancestor. This process reflects adaptation to similar environmental pressures rather than shared ancestry.

Solution: Wings of birds and butterflies are structurally different but serve the same function of flight. Such similarities in function but differences in origin and structure are called analogous structures. These arise due to convergent evolution, where unrelated species independently evolve similar adaptations in response to similar environmental challenges. For example, insect wings are extensions of the exoskeleton, while bird wings are modified forelimbs with bones and feathers. Divergent evolution leads to homologous structures, not analogous ones. Thus, analogous organs strongly support convergent evolution.

Final Answer: Convergent evolution

Answer: (B)

Q63.

Solution

Concept: In eukaryotic gene expression, pre-mRNA undergoes processing steps including splicing, where non-coding sequences are removed to form mature mRNA capable of translation.

Solution: Splicing is a crucial step in eukaryotic mRNA processing where introns, which are non-coding regions, are removed from the pre-mRNA transcript. The remaining coding regions, known as exons, are joined together to form mature mRNA. This process is carried out by the spliceosome complex. Splicing ensures that only meaningful genetic information is translated into proteins. Removal of exons would prevent protein synthesis, making option A incorrect. Poly-A tail addition and 5' capping are separate processes and not part of splicing.

Final Answer: Introns and joining of Exons

Answer: (B)

Q64.

Solution

Concept: During transcription, mRNA is synthesized using the coding strand of DNA. The mRNA sequence is identical to the coding strand except that thymine (T) is replaced by uracil (U).

Given:

- Coding strand: 5'-ATGCATGC-3'

Key Rule:

- mRNA has same sequence as coding strand
- Replace T $\rightarrow$ U

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Step: mRNA sequence

- A $\rightarrow$ A
- T $\rightarrow$ U
- G $\rightarrow$ G
- C $\rightarrow$ C

$$\text{mRNA: } 5' - AUGCAUGC - 3'$$

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$$\text{DNA coding strand} \longrightarrow \text{mRNA}$$

$$\text{T} \rightarrow \text{U}$$

Transcription

Final Answer: $\boxed{5' - AUGCAUGC - 3'}$

Answer: (C)

Q65.

Solution

Concept: Hugo de Vries proposed Mutation Theory based on sudden and discontinuous variations called mutations. He suggested that evolution occurs through large, sudden changes rather than gradual accumulation of small variations.

Solution: Hugo de Vries observed sudden heritable changes in Oenothera lamarckiana and concluded that evolution is driven by mutations. According to his Mutation Theory, new species arise through large, sudden changes called saltations. These mutations are random and discontinuous, leading to rapid evolutionary change. This contrasts with Darwin's theory of gradual evolution through small variations. Therefore, de Vries proposed that evolution is not slow and continuous but occurs in large steps due to mutations.

Final Answer: Single-step large mutation (Saltation)

Answer: (B)

Q66.

Solution

Concept: Sickle-cell anemia is a genetic disorder caused by a point mutation in the beta-globin gene, leading to a single amino acid substitution that affects hemoglobin structure and function.

Solution: Sickle-cell anemia results from a point mutation in the beta-globin chain of hemoglobin where glutamic acid is replaced by valine at the sixth position. This substitution changes the chemical properties of hemoglobin, causing it to polymerize under low oxygen conditions and distort red blood cells into a sickle shape. These abnormal cells have reduced oxygen-carrying capacity and tend to block blood vessels, leading to various symptoms. This disorder is inherited in an autosomal recessive manner and is distinct from thalassemia, phenylketonuria, and cystic fibrosis.

Final Answer: Sickle-cell anemia

Answer: (C)

Q67.

Solution

Concept: The Human Genome Project (HGP) aimed to map and sequence all human chromosomes. Chromosome 1, being the largest and most complex, was one of the last to be fully sequenced and completed in the early 21st century.

Solution: The Human Genome Project officially declared completion of the reference human genome sequence in 2003. However, certain difficult regions, including parts of Chromosome 1, were finalized later. The complete sequencing of Chromosome 1 was finished in 2004 as part of the finishing phase of the project. This chromosome is the largest human chromosome and contains a large number of genes, making its sequencing technically challenging. Thus, its completion marked a significant milestone in genomics research.

Final Answer: 2004

Answer: (B)

Q68.

Solution

Concept: Industrial melanism is an evolutionary phenomenon where darker individuals become more common in polluted environments due to natural selection favoring better camouflage against predators.

Solution: The case of the Peppered Moth (Biston betularia) in England is a classic example of directional selection. During the Industrial Revolution, pollution darkened tree trunks, making dark-colored moths less visible to predators compared to light-colored ones. As a result, dark moths had a survival advantage and increased in frequency. This shift in population traits toward one extreme phenotype represents directional selection. Stabilizing selection maintains intermediate traits, while disruptive selection favors both extremes. Artificial selection is driven by humans, not natural environmental pressure.

Final Answer: Directional selection

Answer: (C)

Q69.

Solution

Concept: The Miller-Urey experiment simulated early Earth's reducing atmosphere to test the chemical origin of life. It used gases like methane, ammonia, hydrogen, and water vapor, but excluded oxygen because it would prevent the formation of organic molecules.

Solution: The Miller-Urey experiment was designed to recreate conditions of primitive Earth, which was believed to have a reducing atmosphere. The experimental setup included methane (CH_4), ammonia (NH_3), hydrogen (H_2), and water vapor. These gases were subjected to continuous electric sparks to simulate lightning, leading to the formation of simple organic compounds like amino acids. Oxygen (O_2) was deliberately excluded because it is highly reactive and would oxidize newly formed organic molecules, preventing their accumulation. The results supported the idea that life's building blocks could form abiotically under early Earth conditions.

Final Answer: O_2

Answer: (C)

Q70.

Solution

Concept: The life cycle of Plasmodium involves both human and mosquito hosts. Sexual reproduction occurs in the mosquito, while asexual reproduction occurs in humans. Fertilization and development into infective stages occur in the mosquito gut.

Solution: When a female Anopheles mosquito ingests gametocytes from an infected human, sexual reproduction of Plasmodium begins in its midgut. Male and female gametes fuse to form a zygote, which develops into an ookinete. The ookinete penetrates the gut wall and forms an oocyst on the outer surface. Within the oocyst, multiple divisions occur to produce sporozoites. These sporozoites migrate to the salivary glands of the mosquito, making it infectious. Therefore, fertilization and further development occur in the mosquito's stomach wall (midgut region), not in humans or salivary glands.

Final Answer: Wall of the mosquito's stomach

Answer: (C)

Q71.

Solution

Concept: The spleen is a secondary lymphoid organ that filters blood, removes aged or damaged red blood cells, and plays an important role in immune surveillance against blood-borne pathogens.

Solution: The spleen is often referred to as the "graveyard of RBCs" because it removes old and damaged red blood cells from circulation. Macrophages in the spleen phagocytose these cells and recycle their components, such as iron. In addition to this, the spleen acts as a blood filter by trapping and destroying blood-borne microorganisms, thereby contributing to immune defense. It also stores platelets and lymphocytes. The thymus is involved in T-cell maturation, bone marrow in blood cell formation, and tonsils in trapping pathogens from air and food, but only the spleen performs both RBC destruction and blood filtration.

Final Answer: Spleen

Answer: (C)

Q72.

Solution

Concept: HIV diagnosis involves a two-step process: initial screening using a sensitive test to detect antibodies, followed by a confirmatory test with higher specificity to eliminate false positives.

Solution: The detection of HIV infection is commonly carried out using ELISA (Enzyme-Linked Immunosorbent Assay) as a screening test. ELISA is highly sensitive and helps in initial detection of HIV antibodies in the patient's blood. However, due to the possibility of false positives, a confirmatory test is required. Western Blot is used as the confirmatory test because it detects specific viral proteins with high accuracy. PCR may also detect viral genetic material but is not the standard routine screening method. Therefore, ELISA is used for screening and Western Blot for confirmation of HIV infection.

Final Answer: ELISA (screening) and Western Blot (confirmatory)

Answer: (C)

Q73.

Solution

Concept: Cyclosporin A is a secondary metabolite produced by certain fungi and is widely used as an immunosuppressant to prevent graft rejection in organ transplantation by inhibiting T-cell activation.

Solution: Cyclosporin A is an important immunosuppressive drug used in organ transplantation to prevent rejection of the transplanted organ. It works by suppressing the immune response, particularly T-cell activation, thereby reducing graft rejection. This compound is naturally produced by the fungus *Trichoderma polysporum*. It has revolutionized transplant medicine by significantly increasing graft survival rates. Other fungi like *Monascus purpureus* produce statins, *Aspergillus niger* produces citric acid, and *Saccharomyces cerevisiae* is used in fermentation but does not produce cyclosporin A.

Final Answer: Trichoderma polysporum

Answer: (B)

Q74.

Solution

Concept: MOET (Multiple Ovulation Embryo Transfer) is a biotechnology technique used in animal breeding where embryos are collected at an early developmental stage and transferred into surrogate mothers for further development.

Solution: In MOET technology, a superior female animal is hormonally induced to produce multiple ova using FSH-like hormones. After fertilization, embryos develop in the donor's reproductive tract for a few days. These embryos are then collected at an early stage, typically the 8–32 cell stage, before implantation occurs naturally. At this stage, embryos are small, viable, and can be safely transferred into surrogate mothers for further development. This technique helps in rapid multiplication of genetically superior livestock. Transferring too early or too late reduces success rates.

Final Answer: 8-32 celled stage

Answer: (B)

Q75.

Solution

Concept: Biological control agents are used in pest management to target specific insect pests without harming non-target organisms. Baculoviruses, especially nucleopolyhedroviruses, are highly specific and safe biocontrol agents.

Solution: Nucleopolyhedroviruses (NPVs), belonging to the baculovirus group, are effective biocontrol agents used in agriculture. They specifically infect and kill insect larvae, particularly lepidopteran pests, without affecting beneficial insects, birds, mammals, or plants. This high host specificity makes them ideal for environmentally safe pest control. Unlike chemical pesticides, they do not cause ecological damage. Bacillus thuringiensis also acts as a biocontrol agent but is more broadly used, while ladybird beetles and dragonflies are predators rather than microbial insecticidal agents. Hence, NPVs represent a narrow-spectrum, highly specific biocontrol tool.

Final Answer: Nucleopolyhedrovirus (Baculoviruses)

Answer: (B)

Q76.

Solution

Concept: In blue-white screening using pUC vectors, insertional inactivation helps identify recombinant colonies based on color change.

Principle:

- The lacZ gene encodes the enzyme β-galactosidase
- This enzyme breaks down X-gal to produce a blue color
- When foreign DNA is inserted, lacZ is disrupted (inactivated)
- Result: white colonies indicate recombinant DNA

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Key Idea:

- Functional enzyme $\rightarrow$ Blue colonies
- Inactivated enzyme $\rightarrow$ White colonies

lacZ active ~~——————~~ ~~B~~lue colonies

lacZ inactivat~~ed~~ ~~——————~~ ~~W~~hite colonies

Enzyme involved:

- β-galactosidase is responsible for X-gal cleavage

Final Answer: β-galactosidase

Answer: (B)

Q77.

Solution

Concept: PCR is a cyclic process involving denaturation, annealing, and extension. The annealing step allows primers to bind to complementary sequences on the single-stranded DNA template at a temperature lower than denaturation.

Solution: Polymerase Chain Reaction (PCR) involves three key steps. In denaturation, DNA strands separate at high temperature. During annealing, the temperature is lowered to about 50–60°C, allowing short oligonucleotide primers to bind (anneal) to their complementary sequences on the single-stranded DNA templates. This step is crucial for specificity because primers determine the region to be amplified. In the extension step, Taq DNA polymerase synthesizes new DNA strands by adding nucleotides to the primers. Therefore, annealing specifically refers to primer binding, not DNA synthesis or strand separation.

Final Answer: Primers to bind to their complementary sequences on the template DNA

Answer: (C)

Q78.

Solution

Concept: RNA interference (RNAi) is a gene-silencing mechanism in which double-stranded RNA triggers the degradation of complementary mRNA, preventing protein synthesis and providing resistance against pathogens.

Solution: RNA interference (RNAi) is a post-transcriptional gene regulation mechanism where double-stranded RNA (dsRNA) plays a central role. In genetically engineered tobacco plants resistant to the nematode *Meloidogyne incognita*, dsRNA corresponding to essential nematode genes is introduced into the plant. When the nematode feeds on the plant, the dsRNA is processed into small interfering RNAs (siRNAs), which guide the degradation of complementary mRNA in the parasite. This silences vital genes in the nematode, leading to its death or reduced infectivity. Single-stranded DNA or RNA cannot initiate this pathway effectively.

Final Answer: Double-stranded RNA

Answer: (B)

Q79.

Solution

Concept: Humulin was the first recombinant human insulin produced using genetic engineering. It involved separate synthesis of insulin chains in bacteria followed by their assembly into functional insulin.

Solution: Humulin, developed by Eli Lilly in 1983, was the first genetically engineered human insulin. The insulin gene was synthesized and expressed in *E. coli* bacteria in two separate forms corresponding to the A and B chains of insulin. These polypeptide chains were purified individually and then chemically joined together using disulfide bonds to form active insulin. This method avoided the use of animal pancreas-derived insulin and ensured a human-identical product. The C-peptide is naturally removed in insulin maturation but was not the basis of production here. Yeast-based complete single-chain secretion came later in biotechnology advancements.

Final Answer: Joining the A and B chains produced separately in E. coli via disulfide bonds

Answer: (B)

Q80.

Solution

Concept: Golden Rice is a genetically modified crop designed to produce beta-carotene (provitamin A) in the edible part of rice to combat vitamin A deficiency.

Solution: Golden Rice is a transgenic variety of rice engineered to produce beta-carotene in the endosperm, which is normally absent in rice grains. Beta-carotene is a precursor of Vitamin A, and its deficiency leads to night blindness and other health issues. The genes responsible for beta-carotene biosynthesis were introduced into rice using genetic engineering techniques. This biofortification approach helps address malnutrition, especially in developing countries where rice is a staple food. It does not address deficiencies of Vitamin C, iron, zinc, or essential fatty acids.

Final Answer: Vitamin A (Beta-carotene)

Answer: (B)

Q81.

Solution

Concept: Bt crops use specific Cry proteins from *Bacillus thuringiensis* that are toxic to particular insect pests. Different Cry genes target different insect groups such as Lepidoptera, Coleoptera, and Diptera.

Solution: Corn borer is a lepidopteran pest that damages maize crops. To control it, genetically modified Bt maize incorporates specific Cry genes from *Bacillus thuringiensis*. The Cry proteins bind to the gut receptors of the insect larvae, causing cell lysis and death. The genes cryIAc and cryIIAb are effective against lepidopteran pests like corn borers. These genes ensure targeted pest control without harming beneficial insects or other organisms. Other combinations may target different insect groups but are not specifically optimized for corn borer control.

Final Answer: cryIAc and cryIIAb

Answer: (A)

Q82.

Solution

Concept: A bioreactor is a large-scale vessel used for culturing microorganisms or cells under controlled conditions. It includes components like impellers, sensors, and spargers for optimal growth and product formation.

Solution: In a bioreactor used for recombinant protein production, the sparger plays a crucial role in supplying oxygen. It introduces sterile air or oxygen into the culture medium in the form of fine bubbles, increasing the surface area for gas exchange. This ensures sufficient oxygen availability for aerobic microbial growth and protein synthesis. Other components like impellers are responsible for mixing, while sensors regulate pH and temperature. Waste removal is not the function of a sparger. Thus, the sparger is essential for maintaining aerobic conditions in the bioreactor.

Final Answer: To bubble air into the medium to increase oxygen availability

Answer: (B)

Q83.

Solution

Concept: During DNA isolation, cell walls must be broken down using specific enzymes depending on the organism type. Fungal cell walls contain chitin, requiring a specific enzyme for digestion.

Solution: Fungal cell walls are primarily composed of chitin, a tough polysaccharide. During DNA isolation, these walls must be degraded to release cellular contents. Chitinase is the enzyme specifically used to break down chitin in fungal cell walls. Lysozyme acts on bacterial cell walls, cellulase acts on plant cell walls, and ribonuclease degrades RNA rather than cell walls. Therefore, chitinase is the correct enzyme for fungal cell wall digestion during DNA extraction procedures.

Final Answer: Chitinase

Answer: (C)

Q84.

Solution

Concept: Gause's Competitive Exclusion Principle explains the outcome of competition between two species occupying the same ecological niche and competing for identical limiting resources.

Solution: Gause's Competitive Exclusion Principle states that two species competing for exactly the same resources cannot coexist indefinitely in the same habitat. Eventually, one species will have a competitive advantage and eliminate or exclude the other due to superior adaptation or efficiency. This principle highlights the importance of niche differentiation in maintaining biodiversity. It does not suggest perpetual coexistence or guaranteed resource sharing. Evolution may sometimes lead to niche partitioning, but the core principle focuses on exclusion under identical resource competition conditions.

Final Answer: One species outcompetes the other for same resources

Answer: (C)

Q85.

Solution

Concept: Eutrophication is an ecological process in which water bodies receive excess nutrients, mainly nitrogen and phosphorus, leading to excessive algal growth and gradual degradation of water quality over time.

Solution: Eutrophication refers to the natural or accelerated aging of a water body such as a lake due to enrichment with nutrients like nitrogen and phosphorus. These nutrients often enter through agricultural runoff, sewage discharge, or industrial effluents. Increased nutrient availability promotes excessive growth of algae and phytoplankton, commonly known as algal blooms. When these organisms die and decompose, they consume dissolved oxygen, leading to hypoxic conditions that harm aquatic life. Over time, eutrophication reduces water quality, biodiversity, and depth of the lake due to sediment accumulation. It is therefore considered a form of water pollution linked to nutrient enrichment rather than oxygen enrichment or thermal pollution.

Final Answer: The natural aging of a lake by nutrient enrichment (Nitrogen and Phosphorus)

Answer: (B)

Q86.

Solution

Concept: In primary succession on bare rock, pioneer species are the first organisms to colonize an inhospitable environment. They initiate soil formation and modify the habitat for later successional stages.

Solution: Pioneer species in primary succession are typically organisms like lichens and mosses that can survive on bare rock without soil. Lichens are especially important because they have a symbiotic relationship between algae and fungi. They secrete organic acids that chemically weather the rock, breaking it down into smaller particles and contributing to soil formation. This process creates conditions suitable for the growth of later species such as grasses and shrubs. Pioneer species are small, hardy, and adapted to extreme conditions, unlike late-successional species which require well-developed soil and stable environments.

Final Answer: They have the ability to lichenize and secrete acids to dissolve rock

Answer: (B)

Q87.

Solution

Concept: The phosphorus cycle is a sedimentary biogeochemical cycle in which phosphorus circulates mainly through rocks, soil, water, and living organisms without a significant gaseous phase.

Solution: Unlike carbon and nitrogen cycles, the phosphorus cycle does not have a major atmospheric component. The primary natural reservoir of phosphorus is phosphate-containing rocks. Through weathering and erosion, phosphates are released into soil and water, where they are absorbed by plants and transferred through food chains. Eventually, phosphorus returns to sediments and forms new rocks over geological time scales. Living organisms and oceans act as temporary storage pools, but rocks remain the largest and most stable reservoir of phosphorus in nature.

Final Answer: Rocks (Phosphate rocks)

Answer: (C)

Q88.

Solution

Concept: The Montreal Protocol is an international environmental agreement aimed at protecting the ozone layer by phasing out substances that cause its depletion, particularly chlorofluorocarbons (CFCs).

Solution: The Montreal Protocol, signed in 1987 and implemented in 1989, is a global treaty designed to control and gradually eliminate the production and use of ozone-depleting substances. These include chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and other chemicals that break down ozone molecules in the stratosphere. The ozone layer is essential for protecting Earth from harmful ultraviolet radiation. The protocol is considered highly successful in reducing atmospheric concentrations of these substances. It does not deal with greenhouse gases, plastics, or radioactive waste, but specifically targets ozone depletion.

Final Answer: Ozone-depleting substances

Answer: (B)

Q89.

Solution

Concept: Biosphere reserves are ecologically significant areas divided into core, buffer, and transition zones, each allowing different levels of human activity and conservation priorities.

Solution: A biosphere reserve is structured into three zones. The core zone is strictly protected with no human activity. The transition zone allows human settlement and economic activities. The buffer zone lies between these two and permits limited human activities such as research, education, and eco-friendly practices without commercial exploitation. This zone helps reduce the impact on the core area while supporting scientific studies and conservation awareness. Therefore, the buffer zone is specifically designed for controlled human interaction focused on research and education.

Final Answer: Buffer zone

Answer: (B)

Q90.

Solution

Concept: Biomagnification refers to the increasing concentration of non-biodegradable toxic substances in organisms at successive trophic levels in a food chain.

Solution: Biomagnification is the process by which certain toxic substances, such as DDT or mercury, become increasingly concentrated as they move up the food chain. These substances are non-biodegradable and accumulate in the tissues of organisms. At each trophic level, predators consume many contaminated prey organisms, leading to higher concentrations of the toxin in their bodies. This poses serious ecological and health risks, especially to top carnivores and humans. Unlike biogeochemical cycling or biodegradation, biomagnification specifically refers to increasing toxin concentration across trophic levels.

Final Answer: Biomagnification

Answer: (B)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	A	3	B	4	B	5	B
6	B	7	A	8	D	9	B	10	A
11	C	12	B	13	C	14	B	15	B
16	C	17	C	18	B	19	C	20	A
21	C	22	A	23	A	24	A	25	B
26	A	27	C	28	C	29	B	30	B
31	B	32	C	33	B	34	C	35	B
36	B	37	B	38	B	39	D	40	C
41	A	42	B	43	B	44	C	45	B
46	A	47	B	48	B	49	C	50	B
51	B	52	B	53	A	54	B	55	C
56	B	57	B	58	B	59	B	60	B
61	C	62	B	63	B	64	C	65	B
66	C	67	B	68	C	69	C	70	C
71	C	72	C	73	B	74	B	75	B
76	B	77	C	78	B	79	B	80	B
81	A	82	B	83	C	84	C	85	B
86	B	87	C	88	B	89	B	90	B