NEET-UG Biology Sample Paper-10

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. A taxonomist discovers a new multicellular, heterotrophic organism with cell walls made of chitin and no centrioles. In which of Whittaker's kingdoms should it be placed?

(A) Monera

(B) Protista

(C) Fungi

(D) Animalia

Q2. Select the correct statement regarding 'Numerical Taxonomy':

(A) It is based on evolutionary relationships (Phylogeny).

(B) It uses chemical constituents of the plant to resolve confusion.

(C) It is carried out using computers and is based on all observable characteristics.

(D) It gives importance only to floral characters.

Q3. In which of the following groups are the organisms primarily defined by the presence of a 'naked seed' and a lack of vessels in the xylem?

(A) Angiosperms

(B) Pteridophytes

(C) Gymnosperms

(D) Bryophytes

Q4. In a dicot root, the vascular cambium originates from:

(A) The pericycle tissue located below the phloem bundles.

(B) The endodermis and cortex.

(C) The primary xylem only.

(D) The apical meristem of the root.

Q5. The "Bulliform cells" found in the adaxial epidermis of certain grasses are responsible for:

(A) Facilitating gaseous exchange.

(B) Photosynthesis in low light.

(C) Rolling and unrolling of leaves to minimize water loss.

(D) Protecting the plant from herbivory.

Q6. Which type of epithelial tissue lines the inner surface of the urinary bladder and allows for considerable stretching?

(A) Simple Squamous Epithelium

(B) Stratified Cuboidal Epithelium

(C) Transitional Epithelium

(D) Pseudostratified Columnar Epithelium

Q7. Identify the incorrect statement regarding "Tight Junctions":

(A) They help to stop substances from leaking across a tissue.

(B) They are commonly found in the lining of the gut.

(C) They facilitate the movement of ions between adjacent cells.

(D) They establish a barrier between the apical and basal surfaces.

Q8. In the anatomy of a woody stem, the region of "Spring Wood" (Early wood) is characterized by:

(A) Narrower xylem vessels and high density.

(B) Wider xylem vessels and lower density.

(C) High deposition of tannins and resins.

(D) Absence of tracheids and fibers.

Q9. If the Golgi apparatus is treated with a chemical that inhibits the process of glycosylation, which of the following will be most affected?

(A) Synthesis of ATP

(B) Formation of glycoproteins and glycolipids

(C) Digestion of cellular waste

(D) Movement of chromosomes during anaphase

Q10. In the "Fluid Mosaic Model", the fluidity of the plasma membrane is maintained at low temperatures primarily by:

(A) High concentration of peripheral proteins.

(B) Presence of cholesterol preventing tight packing of phospholipids.

(C) Increase in saturated fatty acid chains.

(D) Attachment of the cytoskeleton to integral proteins.

Q11. Which of the following events marks the transition from Metaphase to Anaphase in mitosis?

(A) Reformation of the nuclear envelope.

(B) Condensation of chromatin into chromosomes.

(C) Simultaneous splitting of the centromere of each chromosome.

(D) Alignment of chromosomes at the equatorial plate.

Q12. During Meiosis I, the process of 'Crossing Over' occurs between:

(A) Sister chromatids of a homologous pair.

(B) Non-sister chromatids of a homologous pair.

(C) Non-homologous chromosomes.

(D) Chromatids of the same chromosome.

Q13. A cell is treated with Colchicine, a drug that prevents the polymerization of microtubules. At which stage will the cell cycle most likely be arrested?

(A) G_1 phase

(B) S phase

(C) Metaphase

(D) Prophase

Q14. The semi-autonomous nature of Mitochondria and Chloroplasts is supported by the presence of:

(A) Double membrane and 80S ribosomes.

(B) Linear DNA and no ribosomes.

(C) Circular DNA and 70S ribosomes.

(D) Matrix and cristae only.

Q15. The "9+2" arrangement of microtubules is a characteristic feature of:

(A) Centrioles and Basal bodies

(B) Cilia and Flagella

(C) Spindle fibers

(D) Nucleolus

Q16. In the cell cycle, the "Restriction Point" (Check-point) where the cell decides whether to divide or enter G_0 phase is located at:

(A) End of G_2 phase

(B) Late G_1 phase

(C) Transition of Metaphase to Anaphase

(D) S phase

Q17. Which of the following organelles is responsible for the synthesis of lipids and detoxification of drugs?

(A) Rough Endoplasmic Reticulum

(B) Smooth Endoplasmic Reticulum

(C) Lysosome

(D) Peroxisome

Q18. The peptide bond formation during protein synthesis is catalyzed by:

(A) RNA Polymerase

(B) Peptidyl transferase (a ribozyme)

(C) Reverse transcriptase

(D) DNA Ligase

Q19. During the process of non-cyclic photophosphorylation, the primary electron acceptor of Photosystem II (PS II) passes the electron to which mobile electron carrier?

(A) Plastocyanin

(B) Plastoquinone

(C) Ferredoxin

(D) Cytochrome f

Q20. In C4 plants, the enzyme Phosphoenolpyruvate (PEP) carboxylase is located in the cytosol of:

(A) Bundle sheath cells only

(B) Mesophyll cells only

(C) Both Mesophyll and Bundle sheath cells

(D) Epidermal cells

Q21. Which of the following is a "triple response" induced by Ethylene in plants?

(A) Vertical growth, rapid leaf abscission, and seed dormancy.

(B) Horizontal growth of seedlings, swelling of the axis, and apical hook formation.

(C) Increased internodal elongation, bolting, and malting.

(D) Opening of stomata, delay in senescence, and lateral bud growth.

Q22. During the conversion of Glucose-6-phosphate to Fructose-6-phosphate in glycolysis, which type of enzyme is involved?

(A) Dehydrogenase

(B) Isomerase

(C) Kinase

(D) Mutase

Q23. If a plant cell has a Solute Potential (Ψ_s) of -12 bars and is placed in a solution with a Water Potential (Ψ_w) of -8 bars, what will be the Pressure Potential (Ψ_p) of the cell at equilibrium?

(A) +4 bars

(B) -20 bars

(C) +20 bars

(D) 0 bars

Q24. The pigment phytochrome exists in two interconvertible forms. Which form is considered physiologically active and what light does it absorb?

(A) P_r, Red light

(B) P_{fr}, Far-red light

(C) P_{fr}, Red light

(D) P_r, Far-red light

Q25. Which of the following mineral elements is required for the photolysis of water during photosynthesis?

(A) Mg^{2+} and Fe^{2+}

(B) Mn^{2+} and Cl^{-}

(C) Cu^{2+} and Mo

(D) Zn^{2+} and B

Q26. In the Krebs cycle, substrate-level phosphorylation occurs during the conversion of:

(A) Citric acid to Isocitric acid

(B) α-ketoglutaric acid to Succinyl-CoA

(C) Succinyl-CoA to Succinic acid

(D) Fumaric acid to Malic acid

Q27. A person is diagnosed with 'Diabetes Insipidus'. This condition is caused by the deficiency of which hormone and affects which part of the nephron?

(A) Insulin; Glomerulus

(B) ADH; Distal Convoluted Tubule and Collecting Duct

(C) Aldosterone; Loop of Henle

(D) Glucagon; Proximal Convoluted Tubule

Q28. During the cardiac cycle, the "Lubb" sound is produced due to:

(A) Closing of semilunar valves at the end of ventricular systole.

(B) Opening of Atrio-ventricular (AV) valves.

(C) Closing of Atrio-ventricular (AV) valves at the start of ventricular systole.

(D) Blood rushing into the ventricles during atrial systole.

Q29. The 'Haldane Effect' describes how:

(A) CO_2 displacement from hemoglobin is facilitated by high pO_2.

(B) O_2 displacement from hemoglobin is facilitated by high pCO_2.

(C) Cl^{-} moves into RBCs to maintain ionic balance.

(D) 2,3-DPG reduces the affinity of hemoglobin for O_2.

Q30. Which of the following is the correct match of the digestive enzyme with its site of secretion and substrate?

(A) Steapsin: Pancreas; Emulsified fats

(B) Enterokinase: Pancreas; Trypsinogen

(C) Ptyalin: Stomach; Starch

(D) Rennin: Liver; Casein

Q31. In the sliding filament theory, the "Power Stroke" involves the release of which molecules from the myosin head?

(A) ATP and Ca^{2+}

(B) ADP and P_i

(C) Mg^{2+} and Ca^{2+}

(D) Troponin and Tropomyosin

Q32. A patient exhibits a lack of coordination, loss of balance, and inability to perform precise movements. Which part of the brain is likely damaged?

(A) Cerebrum

(B) Hypothalamus

(C) Cerebellum

(D) Medulla Oblongata

Q33. The JGA (Juxtaglomerular Apparatus) releases Renin in response to:

(A) Increase in Glomerular Filtration Rate (GFR)

(B) Fall in Glomerular Blood Pressure

(C) High levels of Atrial Natriuretic Factor (ANF)

(D) Excessive reabsorption of Na^+ in PCT

Q34. Which hormone is known as the "Emergency Hormone" and increases heart rate, alertness, and glycogenolysis?

(A) Cortisol

(B) Thyroxine

(C) Epinephrine

(D) Melatonin

Q35. The respiratory center that acts as a "Pneumotaxic Center" and can moderate the functions of the respiratory rhythm center is located in:

(A) Medulla

(B) Pons varolii

(C) Midbrain

(D) Thalamus

Q36. Which of the following is an autoimmune disorder that affects the neuromuscular junction, leading to fatigue and paralysis of skeletal muscles?

(A) Muscular dystrophy

(B) Myasthenia gravis

(C) Tetany

(D) Gout

Q37. During the conduction of a nerve impulse, the "Depolarization" phase is characterized by:

(A) Influx of Na^+

(B) Efflux of K^+

(C) Influx of Cl^-

(D) Activation of the Na^+/K^+ pump

Q38. The 'Blind Spot' in the human eye is the region where:

(A) Only cones are densely packed.

(B) The optic nerve leaves the eye and photoreceptors are absent.

(C) Resolution is highest.

(D) Rhodopsin is synthesized.

Q39. Which type of leucocytes are most abundant in human blood and are phagocytic in nature?

(A) Monocytes

(B) Basophils

(C) Eosinophils

(D) Neutrophils

Q40. In a fertilized embryo sac, the haploid, diploid, and triploid structures are respectively:

(A) Synergid, Zygote, and Primary Endosperm Nucleus

(B) Antipodal, Nucellus, and Zygote

(C) Egg, Antipodal, and Endosperm

(D) Zygote, Endosperm, and Synergid

Q41. The phenomenon of "Triple Fusion" in angiosperms involves the fusion of:

(A) One male gamete with the egg cell.

(B) Two male gametes with the secondary nucleus.

(C) One male gamete with two polar nuclei.

(D) Synergids with the antipodal cells.

Q42. Which part of the sperm contains the enzymes that facilitate the penetration of the Ovum?

(A) Middle piece

(B) Acrosome

(C) Tail

(D) Nucleus

Q43. The hormone responsible for the "LH Surge" and subsequent ovulation is primarily stimulated by high levels of:

(A) Progesterone

(B) Estrogen

(C) FSH

(D) GnRH

Q44. In the human female, the second meiotic division is completed:

(A) At the time of ovulation.

(B) After the entry of sperm but before fertilization.

(C) During the embryonic development.

(D) At the time of puberty.

Q45. Identify the correct sequence of development during Microsporogenesis:

(A) Sporogenous tissue → Microspore tetrad → Pollen grain → PMC

(B) PMC → Sporogenous tissue → Microspore tetrad → Pollen grain

(C) Sporogenous tissue → PMC → Microspore tetrad → Pollen grain

(D) Pollen grain → Microspore tetrad → PMC → Sporogenous tissue

Q46. Which of the following is a "Mechanical Barrier" method of contraception?

(A) Lippes Loop

(B) Saheli

(C) Condoms

(D) Multiload 375

Q47. The 'Colostrum' secreted by mothers during the initial days of lactation is rich in which antibody?

(A) IgG

(B) IgE

(C) IgA

(D) IgM

Q48. What is the function of the 'Tapetum' in the anther?

(A) Protection of the microspores.

(B) Dehiscence of the anther.

(C) Providing nourishment to the developing pollen grains.

(D) Formation of the exine.

Q49. The "Embryo Proper" in humans develops from which part of the Blastocyst?

(A) Trophoblast

(B) Inner Cell Mass

(C) Blastocoel

(D) Zona Pellucida

Q50. Which of the following represents the correct sequence of taxonomic categories in increasing order of complexity and decreasing order of similarity?

(A) Species → Genus → Family → Order → Class → Phylum → Kingdom

(B) Kingdom → Division → Class → Order → Family → Genus → Species

(C) Species → Genus → Order → Family → Class → Division → Kingdom

(D) Kingdom → Class → Order → Division → Family → Genus → Species

Q51. In Whittaker's five-kingdom classification, certain organisms like Chlamydomonas and Chlorella were moved from Algae to Protista. What was the primary criterion for this shift?

(A) Presence of a well-defined nucleus

(B) Mode of nutrition (Autotrophic)

(C) Unicellular eukaryotic nature

(D) Presence of cellulosic cell walls

Q52. A virus with double-stranded DNA genome replicating in cytoplasm is most likely:

(A) Bacteriophages

(B) Poxviruses

(C) Retroviruses

(D) Reoviruses

Q53. Select the mismatched pair regarding Wheat (Triticum aestivum):

(A) Family: Poaceae

(B) Order: Sapindales

(C) Class: Monocotyledonae

(D) Division: Angiospermae

Q54. Which statement is incorrect regarding Diatoms?

(A) Chief producers in oceans

(B) Silica cell wall

(C) Active movement using flagella

(D) Diatomaceous earth formation

Q55. In a specific eukaryotic gene, the template strand contains the sequence $3' - TAC\ GGC\ AAT\ TCC\ ACT - 5'$. If a mutation occurs where the third cytosine (from the $3'$ end) is substituted with thymine, what will be the effect on the resulting polypeptide?

(A) A silent mutation with no change in the amino acid sequence.

(B) A nonsense mutation leading to premature termination.

(C) A missense mutation causing a single amino acid substitution.

(D) A frameshift mutation altering the entire downstream sequence.

Q56. According to the "Genic Balance Theory" of sex determination in *Drosophila*, an individual with a karyotype of $AAXXY$ (where A represents a set of autosomes) would develop into:

(A) A fertile male

(B) A fertile female

(C) An intersex individual

(D) A sterile "super-male"

Q57. During the "S" phase of the cell cycle, a DNA molecule is replicated. If the DNA is grown in a medium containing radioactive thymidine, which of the following is true regarding the radioactivity in the daughter DNA molecules?

(A) Only one daughter molecule will be radioactive.

(B) Both daughter molecules will have radioactivity in both strands.

(C) Both daughter molecules will have radioactivity in one strand only.

(D) Radioactive thymidine is only incorporated into the lagging strand.

Q58. The phenomenon of "Paramutation", where one allele induces a heritable change in the other allele without changing the DNA sequence, is an example of:

(A) Mendelian inheritance

(B) Epigenetic inheritance

(C) Cytoplasmic inheritance

(D) Co-dominance

Q59. In the context of the "RNA World" hypothesis, which of the following provides the strongest evidence that RNA predated DNA?

(A) RNA can be synthesized from a DNA template.

(B) DNA is more chemically stable than RNA.

(C) Essential life processes like splicing and translation are catalyzed by RNA.

(D) RNA contains uracil instead of thymine.

Q60. In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa, and 160 to aa. If all aa individuals die before reproducing, what will be the frequency of the 'a' allele in the next generation?

(A) 0.40

(B) 0.28

(C) 0.20

(D) 0.33

Q61. Which of the following describes "Industrial Melanism" in the peppered moth (*Biston betularia*) accurately as an example of natural selection?

(A) The dark color was a result of a mutation induced by coal smoke.

(B) Lichen-covered trees favored the survival of melanic forms.

(C) Natural selection acted on pre-existing genetic variation in response to environmental change.

(D) The moths actively changed their color to camouflage against the soot.

Q62. A human pedigree shows a trait that is passed from an affected father to all his daughters, but none of his sons. Affected mothers pass the trait to 50% of their children regardless of sex. This pattern is characteristic of:

(A) Autosomal recessive inheritance

(B) Y-linked inheritance

(C) X-linked dominant inheritance

(D) Cytoplasmic (mitochondrial) inheritance

Q63. In a dihybrid cross involving two genes A and B, the parental combination was $AABB \times aabb$. The F_1 generation was test-crossed, resulting in 44% $AaBb$, 44% $aabb$, 6% $Aabb$, and 6% $aaBb$. What is the distance between the two genes on the chromosome?

(A) 44 map units

(B) 12 map units

(C) 6 map units

(D) 88 map units

Q64. Which of the following describes the 'Lyon Hypothesis' regarding X-chromosome inactivation in human females?

(A) Both X-chromosomes remain active

(B) One X-chromosome is randomly inactivated as Barr body

(C) Only paternal X is inactivated

(D) Y-chromosome suppresses X

Q65. In a population of 1000 individuals, 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is:

(A) 0.4

(B) 0.5

(C) 0.6

(D) 0.7

Q66. Wobble hypothesis suggests that:

(A) First base is flexible

(B) One tRNA recognizes multiple codons due to third base flexibility

(C) Ribosomes move irregularly

(D) Genetic code is overlapping

Q67. In Lac operon, mutation in *i* gene leads to:

(A) Constitutive expression

(B) Operon always off

(C) Only z gene expressed

(D) Increased promoter binding

Q68. A cross is made between a tall plant with round seeds (TTRR) and a dwarf plant with wrinkled seeds (ttrr). The F_1 generation is selfed. What is the probability of obtaining an F_2 offspring with the genotype TtRr?

(A) $\frac{1}{16}$

(B) $\frac{2}{16}$

(C) $\frac{4}{16}$

(D) $\frac{9}{16}$

Q69. Analogy due to convergent evolution:

(A) Whale and bat forelimbs

(B) Penguin and dolphin flippers

(C) Bougainvillea thorns and Cucurbita tendrils

(D) Vertebrate hearts

Q70. A patient is administered a "monoclonal antibody" treatment to neutralize a specific viral protein. This type of immunity is best classified as:

(A) Natural Active Immunity

(B) Natural Passive Immunity

(C) Artificial Active Immunity

(D) Artificial Passive Immunity

Q71. In the life cycle of *Plasmodium*, the 'Sporozoites' are infectious to humans. Which of the following events occurs immediately after they enter the human bloodstream via a mosquito bite?

(A) They directly attack RBCs to cause fever.

(B) They migrate to the liver and undergo asexual reproduction in hepatocytes.

(C) They transform into gametocytes in peripheral blood.

(D) They fuse with leucocytes to evade immunity.

Q72. Which of the following is a "Recombinant DNA vaccine" produced using yeast cells?

(A) Oral Polio Vaccine (OPV)

(B) Hepatitis B Vaccine

(C) BCG Vaccine

(D) Salk Vaccine

Q73. In a large-scale sewage treatment plant, BOD (Biochemical Oxygen Demand) is a measure of:

(A) Dissolved oxygen available for fish survival.

(B) Organic matter content present in water.

(C) Efficiency of primary sedimentation tank.

(D) Concentration of inorganic salts like nitrates.

Q74. Cyclosporin A prevents graft rejection because it inhibits:

(A) B-lymphocyte activation and antibodies.

(B) Macrophage phagocytosis.

(C) T-lymphocyte function and cell-mediated immunity.

(D) Interferon production.

Q75. Correctly matched microbe-product pair:

(A) *Propionibacterium sharmanii*: CO_2 production in Swiss cheese

(B) *Aspergillus niger*: Citric acid production

(C) *Clostridium butylicum*: Lactic acid production

(D) *Saccharomyces cerevisiae*: Cyclosporin A production

Q76. In the screening of a genomic library for a specific gene, a researcher uses a "Probe". Which of the following is an essential characteristic of a molecular probe?

(A) It must be a double-stranded DNA molecule with a known sequence.

(B) It is a single-stranded DNA or RNA, tagged with a radioactive or fluorescent molecule.

(C) It must be a protein that binds specifically to the target DNA.

(D) It is a non-specific sequence of nucleotides used to saturate the gel.

Q77. A patient is suspected of having a very low concentration of a pathogen in their blood. Which technique should be employed for the early detection of the pathogen before symptoms appear?

(A) Serum and urine analysis

(B) Polymerase Chain Reaction (PCR)

(C) X-ray diffraction

(D) Western Blotting

Q78. The "Cry" genes of *Bacillus thuringiensis* are specific to certain groups of insects. Match the gene with the insect it controls: (i) *cryIAc*, (ii) *cryIIAb*, (iii) *cryIAb*.

(A) (i) Corn borer, (ii) Cotton bollworm, (iii) Cotton bollworm

(B) (i) Cotton bollworm, (ii) Cotton bollworm, (iii) Corn borer

(C) (i) Beetles, (ii) Flies, (iii) Mosquitoes

(D) (i) Corn borer, (ii) Corn borer, (iii) Cotton bollworm

Q79. In the synthesis of Human Insulin (Humulin) using recombinant DNA technology, the "C-peptide" is:

(A) Added to the A and B chains to make the insulin functional.

(B) Removed during the processing of pro-insulin into mature insulin.

(C) Used to link the A and B chains via disulfide bonds.

(D) The primary component that determines the shelf-life of the hormone.

Q80. The *T-DNA* (Transfer DNA) of the Ti-plasmid is naturally used by *Agrobacterium tumefacien* to:

(A) Kill the host plant by inducing rot.

(B) Transform normal plant cells into tumor cells that produce opines for the bacteria.

(C) Fix atmospheric nitrogen for the plant's use.

(D) Protect the plant from fungal infections.

Q81. In "RNA Interference" (RNAi), the silencing of a specific mRNA is initiated by the presence of:

(A) Single-stranded DNA

(B) Double-stranded RNA (dsRNA)

(C) Transfer RNA (tRNA)

(D) Large Ribosomal Subunit

Q82. Which of the following describes the role of "Biolistics" (Gene gun) in biotechnology?

(A) It is used to separate DNA fragments based on their size.

(B) It is a method used to introduce DNA into host cells by bombarding them with micro-particles of gold or tungsten coated with DNA.

(C) It is an enzyme used to cut DNA at specific palindromic sequences.

(D) It is a diagnostic tool used to measure the rate of DNA replication.

Q83. In a pyramid of numbers, if the producer level consists of a single large tree supporting numerous herbivorous birds, which in turn host several parasites, the shape of the pyramid will be:

(A) Upright

(B) Inverted

(C) Spindle-shaped

(D) Urn-shaped

Q84. According to the "Evil Quartet," which of the following is considered the most important cause driving animals and plants to extinction?

(A) Alien species invasion

(B) Co-extinctions

(C) Habitat loss and fragmentation

(D) Over-exploitation

Q85. The relation between species richness and area for a wide variety of taxa is expressed on a log scale as:

(A) $\log S = \log C + Z \log A$

(B) $\log S = \log Z + C \log A$

(C) $\log C = \log S + Z \log A$

(D) $\log A = \log S + Z \log C$

Q86. The "Sixth Extinction" currently in progress is different from previous mass extinctions primarily because:

(A) It is affecting only plants and not animals.

(B) The rate of extinction is estimated to be 100 to 1,000 times faster.

(C) It is being caused by natural catastrophes like volcanic eruptions.

(D) It is occurring mainly in the deep oceans.

Q87. Which of the following processes in the decomposition cycle is correctly defined?

(A) Fragmentation: Carried out by fungal enzymes to dissolve detritus.

(B) Catabolism: Physical breakdown of detritus into smaller particles by earthworms.

(C) Leaching: Water-soluble inorganic nutrients go down into the soil profile.

(D) Humification: Rapid decomposition of organic matter leading to mineral release.

Q88. The primary productivity of an ecosystem is the rate of formation of new organic matter by:

(A) Producers

(B) Decomposers

(C) Consumers

(D) Both producers and consumers

Q89. In aquatic ecosystems, energy flow is mainly through the grazing food chain (GFC), whereas in terrestrial ecosystems a major fraction flows through the:

(A) Parasitic food chain

(B) Detritus food chain

(C) Saprophytic food chain only

(D) Predatory food chain

Q90. Which of the following is a primary feature of "Ex-situ" conservation strategies?

(A) Protection of the entire ecosystem in its natural habitat.

(B) Examples include sacred groves and biosphere reserves.

(C) Endangered species are conserved in controlled environments like zoological parks or seed banks.

(D) It is the most cost-effective method for in-situ biodiversity preservation.

Detailed Solutions

Q1.

Solution

Concept: Whittaker's five-kingdom classification is based on cell structure, body organization, nutrition, and reproduction. Fungi are multicellular, heterotrophic organisms with chitinous cell walls and lack centrioles in most cases. These features clearly distinguish them from plants and animals, placing them in a separate kingdom.

Solution: The organism described is multicellular and heterotrophic, which immediately excludes Monera and Protista because they are primarily unicellular or simple eukaryotes. The presence of a chitinous cell wall is a key diagnostic feature of fungi, as plant cell walls are made of cellulose, not chitin.Additionally, the absence of centrioles further supports classification under fungi, as many fungal groups lack typical animal-like cell division structures. Animals are multicellular and heterotrophic but lack cell walls entirely, so they are also excluded.Thus, based on Whittaker's criteria—cell wall composition, mode of nutrition, and cellular organization—the organism belongs to Kingdom Fungi.

Final Answer: Fungi

Answer: (C)

Q2.

Solution

Concept: Numerical taxonomy classifies organisms based on a large number of observable characteristics, assigning equal weight to all traits. It is a computer-based approach that reduces human bias and is not primarily based on phylogeny but on overall similarity.

Solution: Numerical taxonomy, also called phenetics, is a modern classification approach in which organisms are grouped based on a large number of measurable and observable characteristics. Each trait is given equal importance, and similarity is calculated using statistical methods.Computers are used to analyze data and generate taxonomic relationships based on overall similarity rather than evolutionary history. This reduces subjective bias present in traditional classification systems.It is not based on phylogeny, so it does not directly reflect evolutionary relationships. It also does not focus only on floral characters or chemical constituents alone.Thus, numerical taxonomy is a computer-based method using all observable characteristics equally.

Final Answer: It is carried out using computers and is based on all observable characteristics

Answer: (C)

Q3.

Solution

Concept: Gymnosperms are seed-producing plants characterized by naked seeds not enclosed in fruits. Their xylem is often composed mainly of tracheids, and vessels are generally absent, unlike angiosperms where vessels are present.

Solution: Plant groups are classified based on seed development and vascular tissue organization. Gymnosperms are seed-producing plants in which seeds are not enclosed within a fruit, hence called "naked seeds."They also typically lack vessels in their xylem; instead, tracheids are the main conducting elements. This distinguishes them from angiosperms, which have vessels and enclosed seeds. Pteridophytes are vascular but seedless, while bryophytes are non-vascular plants.Thus, the group defined by naked seeds and absence of vessels in xylem is gymnosperms.

Final Answer: Gymnosperms

Answer: (C)

Q4.

Solution

Concept: In dicot roots, secondary growth begins with the formation of vascular cambium. It originates from residual procambial cells and pericycle cells, particularly those located opposite protoxylem, contributing to the formation of secondary vascular tissues.

Solution: In dicot roots, primary growth is followed by secondary growth, which increases the girth of the root. The vascular cambium plays a central role in this process by producing secondary xylem and phloem.The vascular cambium originates partly from the pericycle, which lies just inside the endodermis, and partly from cells associated with the primary vascular tissues. Specifically, pericycle cells located below the phloem bundles contribute significantly to cambium formation.The endodermis and cortex do not directly form cambium. The primary xylem also does not transform into cambium, and the apical meristem is responsible only for primary growth.Thus, the correct origin is the pericycle tissue.

Final Answer: The pericycle tissue located below the phloem bundles

Answer: (A)

Q5.

Solution

Concept: Bulliform cells are large, thin-walled epidermal cells present in grasses that regulate leaf rolling and unrolling in response to water availability. This helps reduce transpiration during drought conditions.

Solution: Bulliform cells are specialized epidermal cells found on the upper (adaxial) surface of leaves in grasses. These cells are thin-walled and highly elastic, allowing them to change turgor pressure easily.When water is abundant, these cells are turgid, and the leaf remains flat, allowing maximum photosynthesis. During water stress, bulliform cells lose water and become flaccid, causing the leaf to roll inward. This rolling reduces the surface area exposed to sunlight and air, thereby minimizing water loss through transpiration.They are not primarily involved in photosynthesis, gas exchange, or defense. Their main role is water conservation through leaf movement.Thus, bulliform cells help in rolling and unrolling of leaves.

Final Answer: Rolling and unrolling of leaves to minimize water loss

Answer: (C)

Q6.

Solution

Concept: Transitional epithelium is a specialized stratified epithelial tissue found in organs that undergo stretching, such as the urinary bladder. It allows expansion and contraction without damage.

Solution: Epithelial tissues line the surfaces of organs and perform protective, secretory, and absorptive functions. The urinary bladder requires a specialized lining due to its ability to expand and contract as it fills and empties.Transitional epithelium is specifically adapted for this function. It consists of multiple layers of cells that can change shape from cuboidal to squamous depending on the degree of stretching. This allows the bladder to expand without tearing the lining.Simple squamous epithelium is too thin for protection, pseudostratified epithelium is found in respiratory tracts, and stratified cuboidal epithelium is rare and not associated with the bladder.Thus, transitional epithelium lines the urinary bladder.

Final Answer: Transitional Epithelium

Answer: (C)

Q7.

Solution

Concept: Tight junctions are specialized cell-cell junctions in epithelial tissues that form a sealing belt around cells. They prevent paracellular movement of substances, maintain polarity of epithelial cells, and are commonly found in organs requiring selective permeability like the intestine. They do not allow ion passage between cells.

Solution: Tight junctions (zonula occludens) are membrane protein complexes that seal adjacent epithelial cells near their apical region. Their primary function is to prevent leakage of substances through the intercellular space, thereby controlling paracellular transport. They are especially important in tissues like the intestinal epithelium where selective absorption is required.These junctions also help maintain cell polarity by separating the apical and basolateral membrane domains, ensuring proper directional transport of molecules.However, tight junctions do not facilitate movement of ions or molecules between cells; instead, they block such movement. Ion exchange between cells is primarily carried out by gap junctions, not tight junctions.Thus, the incorrect statement is that tight junctions facilitate movement of ions between adjacent cells.

Final Answer: They facilitate the movement of ions between adjacent cells

Answer: (C)

Q8.

Solution

Concept: In woody stems, spring wood (early wood) is formed during favorable growth conditions. It contains larger, thinner-walled xylem vessels with lower density, allowing efficient water conduction in active growth periods.

Solution: Secondary growth in woody stems produces annual rings consisting of spring wood and autumn wood. Spring wood, also called early wood, is formed during the favorable growing season when water availability is high.During this phase, the cambium produces xylem with wider vessels and thinner cell walls. This results in lower density wood that facilitates rapid water conduction to support active growth of leaves and shoots.In contrast, autumn wood has narrower vessels and thicker walls, making it denser. Deposition of tannins and resins is not a defining feature of spring wood, and all xylem components like tracheids and fibers are still present.Thus, spring wood is characterized by wider vessels and lower density.

Final Answer: Wider xylem vessels and lower density

Answer: (B)

Q9.

Solution

Concept: The Golgi apparatus modifies proteins and lipids through processes such as glycosylation. Glycosylation is essential for forming glycoproteins and glycolipids, which are important for cell recognition, membrane structure, and signaling.

Solution: The Golgi apparatus is responsible for post-translational modification of proteins and lipids synthesized in the endoplasmic reticulum. One of its key functions is glycosylation, the addition of carbohydrate chains to proteins and lipids.This process leads to the formation of glycoproteins and glycolipids, which play important roles in cell membrane structure, recognition, and signaling. Inhibition of glycosylation disrupts these processes, affecting proper protein function and membrane organization.ATP synthesis occurs in mitochondria, not Golgi. Cellular waste digestion is done by lysosomes, and chromosome movement during cell division is controlled by spindle fibers.Thus, glycoprotein and glycolipid formation is most affected.

Final Answer: Formation of glycoproteins and glycolipids

Answer: (B)

Q10.

Solution

Concept: The fluid mosaic model describes the plasma membrane as a dynamic structure. Cholesterol plays a crucial role in maintaining membrane fluidity, especially at low temperatures by preventing tight packing of phospholipids.

Solution: According to the fluid mosaic model, the plasma membrane consists of a phospholipid bilayer with embedded proteins and cholesterol molecules. Membrane fluidity is essential for proper cell function and is influenced by temperature and lipid composition.At low temperatures, phospholipids tend to pack tightly, which would make the membrane rigid. Cholesterol molecules interspersed within the bilayer disrupt this tight packing, thereby maintaining membrane fluidity and preventing solidification.Saturated fatty acids actually decrease fluidity, while peripheral proteins and cytoskeletal attachments do not directly regulate lipid packing.Thus, cholesterol is primarily responsible for maintaining membrane fluidity at low temperatures.

Final Answer: Presence of cholesterol preventing tight packing of phospholipids

Answer: (B)

Q11.

Solution

Concept: The transition from metaphase to anaphase in mitosis is marked by the separation of sister chromatids, triggered by the splitting of centromeres and breakdown of cohesin proteins holding chromatids together.

Solution: Mitosis is divided into several phases. During metaphase, chromosomes align at the equatorial plate of the cell and are attached to spindle fibers via their centromeres.The transition to anaphase occurs when the centromeres split simultaneously, allowing sister chromatids to separate and move toward opposite poles of the cell. This ensures equal distribution of genetic material.Reformation of the nuclear envelope occurs in telophase, chromatin condensation occurs in prophase, and chromosome alignment occurs during metaphase itself.Thus, the key event marking the metaphase-anaphase transition is centromere splitting.

Final Answer: Simultaneous splitting of the centromere of each chromosome

Answer: (C)

Q12.

Solution

Concept: Crossing over is a key event in meiosis I where genetic material is exchanged between homologous chromosomes. It occurs during pachytene stage between non-sister chromatids, leading to genetic variation.

Solution: Meiosis I involves pairing of homologous chromosomes and recombination. During prophase I, specifically the pachytene stage, crossing over takes place.This process involves exchange of genetic segments between non-sister chromatids of homologous chromosome pairs. It results in genetic recombination and increases variation in offspring.Sister chromatids of the same chromosome do not undergo crossing over, and non-homologous chromosomes do not pair for recombination.Thus, crossing over occurs between non-sister chromatids of homologous chromosomes.

Final Answer: Non-sister chromatids of a homologous pair

Answer: (B)

Q13.

Solution

Concept: Colchicine is a mitotic inhibitor that prevents polymerization of microtubules, thereby blocking spindle fiber formation required for chromosome movement.

Mechanism of Action:

- Binds to tubulin subunits
- Prevents spindle microtubule formation
- Stops chromosome alignment and separation

Key Insight:

- Spindle fibers are essential during metaphase for chromosome alignment at the equatorial plate
- Without spindle formation, chromosomes cannot move further

Cell Cycle Impact:

- Cell enters mitosis but cannot proceed beyond metaphase
- Chromosomes remain condensed but not separated

$$\text{Prophase} \longrightarrow \text{Metaphase} \longrightarrow \text{Anaphase}$$

Spindle blocked

Arrest occurs here

Conclusion:

- Cell cycle arrest occurs at metaphase due to spindle inhibition

Final Answer: Metaphase

Answer: (C)

Q14.

Solution

Concept: Mitochondria and chloroplasts are semi-autonomous organelles because they possess their own genetic material and ribosomes, enabling partial independence in protein synthesis.

Solution: Mitochondria and chloroplasts are considered semi-autonomous organelles because they can synthesize some of their own proteins independently of the nuclear genome.This is supported by the presence of circular DNA similar to prokaryotes and 70S ribosomes, which are capable of translating their own mRNA. These features suggest an evolutionary origin from endosymbiotic bacteria.They also possess a double membrane, but this alone does not confer autonomy. Linear DNA and absence of ribosomes would contradict semi-autonomy. Structures like matrix and cristae are functional compartments but not evidence of genetic independence.Thus, circular DNA and 70S ribosomes support their semi-autonomous nature.

Final Answer: Circular DNA and 70S ribosomes

Answer: (C)

Q15.

Solution

Concept: The 9+2 arrangement refers to the structural organization of microtubules in eukaryotic cilia and flagella. It consists of nine peripheral doublets surrounding two central singlet microtubules.

Solution: The 9+2 arrangement is a characteristic structural feature of motile cilia and flagella in eukaryotic cells. It consists of nine peripheral microtubule doublets arranged in a circular pattern around a central pair of single microtubules.This arrangement is essential for movement, as dynein arms between microtubules generate sliding forces that produce bending motions. Cilia and flagella use this mechanism for locomotion and fluid movement across cell surfaces.Centrioles and basal bodies, although related to microtubule organization, typically show a 9+0 arrangement and lack the central pair. Spindle fibers are involved in chromosome movement but do not show 9+2 structure. The nucleolus is unrelated to microtubules.Thus, 9+2 arrangement is found in cilia and flagella.

Final Answer: Cilia and Flagella

Answer: (B)

Q16.

Solution

Concept: The restriction point in the cell cycle is a checkpoint in late G1 phase where the cell assesses internal and external signals to decide whether to proceed to DNA replication or enter a resting state (G0).

Solution: The cell cycle is regulated by checkpoints that ensure proper cell division. The restriction point, also known as the G1 checkpoint, is located in late G1 phase.At this stage, the cell evaluates growth factors, nutrient availability, and DNA integrity. If conditions are favorable, the cell commits to DNA replication and division. If not, it may enter the G0 phase, a quiescent state.This checkpoint is critical because once the cell passes it, it is committed to completing the cell cycle regardless of external signals.Other phases like G2 and metaphase-anaphase transition also have checkpoints, but the decision to divide or not is made in G1.Thus, the restriction point is in late G1 phase.

Final Answer: Late G1 phase

Answer: (B)

Q17.

Solution

Concept: Smooth endoplasmic reticulum (SER) is involved in lipid synthesis, steroid production, and detoxification of drugs and harmful substances in animal cells.

Solution: The endoplasmic reticulum exists in two forms: rough ER and smooth ER. Rough ER is studded with ribosomes and is primarily involved in protein synthesis.Smooth ER lacks ribosomes and performs important metabolic functions such as lipid and steroid synthesis. It is also responsible for detoxification of drugs and toxins, especially in liver cells.Lysosomes are involved in intracellular digestion, while peroxisomes participate in oxidation reactions but are not the primary site for lipid synthesis. Rough ER does not synthesize lipids.Thus, smooth endoplasmic reticulum is responsible for both lipid synthesis and detoxification.

Final Answer: Smooth Endoplasmic Reticulum

Answer: (B)

Q18.

Solution

Concept: Peptide bond formation during protein synthesis occurs in ribosomes and is catalyzed by peptidyl transferase activity, which is a ribozyme located in the large ribosomal subunit.

Solution: Protein synthesis occurs in ribosomes through translation. During this process, amino acids are linked together to form a polypeptide chain.The formation of peptide bonds between adjacent amino acids is catalyzed by peptidyl transferase, an enzymatic activity of ribosomal RNA in the large subunit of the ribosome. This makes it a ribozyme, meaning RNA itself acts as a catalyst.RNA polymerase is involved in transcription, not translation. Reverse transcriptase synthesizes DNA from RNA, and DNA ligase joins DNA fragments during replication.Thus, peptide bond formation is catalyzed by peptidyl transferase.

Final Answer: Peptidyl transferase (a ribozyme)

Answer: (B)

Q19.

Solution

Concept: In non-cyclic photophosphorylation, electrons flow from water through PSII and PSI via a series of carriers. After excitation in PSII, electrons are first accepted by a primary acceptor and then transferred to plastoquinone, which acts as a mobile electron carrier in the thylakoid membrane.

Solution: Non-cyclic photophosphorylation occurs in the light reactions of photosynthesis and involves both Photosystem II (PSII) and Photosystem I (PSI). When light excites chlorophyll in PSII, electrons are boosted to a higher energy level and passed to the primary electron acceptor.From this primary acceptor, the electrons are transferred to plastoquinone (PQ), which is a mobile electron carrier embedded in the thylakoid membrane. Plastoquinone carries electrons from PSII to the cytochrome b6f complex.After this, electrons move to plastocyanin, then to PSI, and finally to ferredoxin and $NADP^+$. Therefore, plastoquinone is the first mobile carrier after PSII.Plastocyanin acts later in the chain, cytochrome f is part of a complex, and ferredoxin functions after PSI.Thus, plastoquinone is the correct answer.

Final Answer: Plastoquinone

Answer: (B)

Q20.

Solution

Concept: C4 plants show spatial separation of initial CO_2 fixation and Calvin cycle. PEP carboxylase is the key enzyme for CO_2 fixation in mesophyll cells, where it converts CO_2 into oxaloacetate in the cytosol.

Solution: In C4 plants such as maize and sugarcane, photosynthesis is adapted to minimize photorespiration. The initial CO_2 fixation occurs in mesophyll cells.In these cells, the enzyme phosphoenolpyruvate (PEP) carboxylase is located in the cytosol. It fixes CO_2 into a 4-carbon compound, oxaloacetate, which is later converted to malate.This 4-carbon compound is transported to bundle sheath cells, where CO_2 is released for the Calvin cycle. PEP carboxylase is absent in bundle sheath cells and is not present in epidermal cells.Thus, it is located in mesophyll cells only.

Final Answer: Mesophyll cells only

Answer: (B)

Q21.

Solution

Concept: Ethylene is a plant hormone responsible for the triple response in seedlings, which includes inhibition of elongation, swelling of the stem, and horizontal growth to help seedlings navigate soil obstacles.

Solution: Ethylene is a gaseous plant hormone involved in growth regulation and stress responses. In etiolated seedlings, ethylene induces a characteristic "triple response".This response includes: (1) inhibition of stem elongation leading to shorter seedlings, (2) swelling or thickening of the stem axis, and (3) horizontal growth or formation of an apical hook, which protects the shoot apex while emerging through soil.These adaptations help seedlings survive mechanical resistance during germination. Ethylene does not promote elongation or dormancy in this context.Thus, the correct triple response is horizontal growth, axis swelling, and apical hook formation.

Final Answer: Horizontal growth of seedlings, swelling of the axis, and apical hook formation

Answer: (B)

Q22.

Solution

Concept: In glycolysis, glucose-6-phosphate is converted to fructose-6-phosphate through an isomerization reaction, where the functional group is rearranged without a change in molecular formula. This reaction is catalyzed by isomerase enzymes.

Solution: Glycolysis is a sequence of enzymatic reactions that convert glucose into pyruvate. One of the early steps involves the conversion of glucose-6-phosphate (an aldose sugar) into fructose-6-phosphate (a ketose sugar).This reaction does not involve addition or removal of atoms but only structural rearrangement, making it an isomerization reaction. The enzyme responsible for this conversion is phosphoglucose isomerase, which belongs to the class of isomerase enzymes.Kinases transfer phosphate groups, dehydrogenases involve redox reactions, and mutases shift functional groups within molecules, but here the primary classification is isomerase.Thus, the enzyme type involved is isomerase.

Final Answer: Isomerase

Answer: (B)

Q23.

Solution

Concept: Water potential (Ψ_w) is the sum of solute potential (Ψ_s) and pressure potential (Ψ_p). At equilibrium, the water potential of the cell equals that of the external solution.

Solution: Water movement in plant cells is governed by water potential, given by:

$$\Psi_w = \Psi_s + \Psi_p$$

Given:Cell solute potential $\Psi_s = -12$ bars External water potential $\Psi_w = -8$ bars At equilibrium:

$$\Psi_w(cell) = \Psi_w(solution) = -8 \text{ bars}$$

So,

$$-8 = -12 + \Psi_p$$

Solving:

$$\Psi_p = -8 + 12 = +4 \text{ bars}$$

Positive pressure potential indicates turgidity in the plant cell due to water entry until equilibrium is reached.Thus, the pressure potential of the cell is +4 bars.

Final Answer: +4 bars

Answer: (A)

Q24.

Solution

Concept: Phytochrome is a photoreceptor pigment in plants that exists in two interconvertible forms and regulates processes like seed germination and flowering.

Forms of Phytochrome:

- P_r (Phytochrome red absorbing form)
- P_{fr} (Phytochrome far-red absorbing form)

Interconversion:

- $P_r \xrightarrow{\text{Red light}} P_{fr}$
- $P_{fr} \xrightarrow{\text{Far-red light}} P_r$

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Key Point:

- P_{fr} is the physiologically active form
- It triggers responses like seed germination and flowering
- It is produced in the presence of red light

$$P_r \longrightarrow P_{fr}$$

$$\xleftarrow{\text{Red light}}$$

Far-red light

Final Answer: $\boxed{P_{fr}, \text{Red light}}$

Answer: (C)

Q25.

Solution

Concept: Photolysis of water occurs in PS-II and requires the oxygen evolving complex (OEC), also called the Mn-cluster. Manganese ions and chloride ions are essential cofactors for splitting water into oxygen, protons, and electrons during light reactions of photosynthesis.

Solution: In photosynthesis, photolysis of water takes place at Photosystem II on the lumenal side of the thylakoid membrane. This reaction is catalyzed by the oxygen evolving complex (OEC), which is associated with the PS-II reaction centre.The OEC is a manganese-based cluster that includes Mn^{2+} ions as essential cofactors. These manganese ions undergo oxidation-reduction changes to facilitate extraction of electrons from water molecules.Chloride ions (Cl^-) are also required as they stabilize the oxygen evolving complex and help in maintaining its structural and functional integrity.The overall reaction produces oxygen, protons, and electrons:

$$2H_2O \rightarrow 4H^+ + 4e^- + O_2$$

Other ions like Mg^{2+}, Fe^{2+}, Zn^{2+}, Cu^{2+}, and Mo are involved in different metabolic pathways but not directly in photolysis.Thus, Mn^{2+} and Cl^- are essential for water splitting.

Final Answer: Mn^{2+} and Cl^-

Answer: (B)

Q26.

Solution

Concept: Substrate-level phosphorylation in the Krebs cycle refers to direct ATP (or GTP) formation during a metabolic conversion without involvement of the electron transport chain. This occurs specifically during the conversion of succinyl-CoA to succinic acid.

Solution: The Krebs cycle (citric acid cycle) involves a series of enzymatic reactions that generate energy in the form of NADH, $FADH_2$, and GTP/ATP.Substrate-level phosphorylation occurs at one specific step when succinyl-CoA is converted into succinic acid (succinate). This reaction is catalyzed by succinyl-CoA synthetase.During this conversion, the high-energy thioester bond of succinyl-CoA is utilized to generate GTP (in animals) or ATP (in some organisms), without the involvement of the electron transport chain.Other steps such as conversion of citrate to isocitrate or α-ketoglutarate to succinyl-CoA involve redox reactions or decarboxylation, not direct ATP formation. Fumarate to malate is a hydration reaction.Thus, substrate-level phosphorylation occurs during succinyl-CoA to succinate conversion.

Final Answer: Succinyl-CoA to Succinic acid

Answer: (C)

Q27.

Solution

Concept: Diabetes insipidus is caused by deficiency of antidiuretic hormone (ADH) or insensitivity of kidneys to ADH. It affects water reabsorption mainly in the distal convoluted tubule and collecting duct of the nephron.

Solution: Diabetes insipidus is a disorder characterized by excessive urination and thirst due to inability of kidneys to concentrate urine.It is primarily caused by deficiency of antidiuretic hormone (ADH), also called vasopressin, or by failure of renal tubules to respond to ADH.ADH normally acts on the distal convoluted tubule (DCT) and collecting ducts to increase water permeability by inserting aquaporin channels, leading to water reabsorption.In its absence, large volumes of dilute urine are produced.Insulin and glucagon are pancreatic hormones involved in glucose metabolism, while aldosterone regulates sodium reabsorption in the loop of Henle and collecting duct but not primary cause here.Thus, ADH deficiency affecting DCT and collecting duct is responsible.

Final Answer: $ADH; Distal Convoluted Tubule and Collecting Duct$

Answer: (B)

Q28.

Solution

Concept: The first heart sound (Lubb) is produced due to closure of atrioventricular (AV) valves (mitral and tricuspid) at the beginning of ventricular systole, preventing backflow of blood into atria.

Solution: The cardiac cycle consists of coordinated contraction and relaxation of atria and ventricles.The first heart sound, known as "Lubb", is produced at the beginning of ventricular systole. It occurs due to the sudden closure of atrioventricular (AV) valves, namely the mitral and tricuspid valves.This closure prevents backflow of blood from ventricles into atria when ventricular pressure rises.The second heart sound, "Dubb", is produced by closure of semilunar valves at the end of systole.Opening of valves and blood flow into ventricles do not produce distinct audible sounds.Thus, Lubb sound is due to AV valve closure at the start of ventricular systole.

Final Answer: Closing of AV valves at start of ventricular systole

Answer: (C)

Q29.

Solution

Concept: The Haldane effect describes the increased ability of deoxygenated hemoglobin to bind CO_2 and H^+, facilitating CO_2 transport in tissues and its release in lungs where oxygen concentration is high.

Solution: Gas transport in blood is regulated by both the Bohr and Haldane effects. The Haldane effect specifically refers to the influence of oxygen on carbon dioxide transport.When hemoglobin is oxygenated in the lungs, its affinity for CO_2 decreases, promoting CO_2 release. In tissues, where oxygen levels are low, deoxygenated hemoglobin binds more CO_2 and H^+, enhancing CO_2 transport back to the lungs.Thus, high pO_2 facilitates CO_2 displacement from hemoglobin.Other options describe Bohr effect (CO_2 affecting O_2 binding), chloride shift, or 2,3-DPG effects, which are related but not Haldane effect.Therefore, Haldane effect is CO_2 displacement due to high oxygen levels.

Final Answer: CO_2 displacement from hemoglobin is facilitated by high pO_2

Answer: (A)

Q30.

Solution

Concept: Digestive enzymes are secreted from specific organs and act on specific substrates. Steapsin (pancreatic lipase) acts on emulsified fats in the small intestine, making it a correct match.

Solution: Digestion involves enzymes secreted from different parts of the alimentary canal and associated glands.Steapsin, also known as pancreatic lipase, is secreted by the pancreas and acts on emulsified fats to break them into fatty acids and glycerol.Enterokinase is secreted by intestinal mucosa, not pancreas, and activates trypsinogen. Ptyalin (salivary amylase) acts in the mouth, not stomach. Rennin is found in gastric juice in infants, not liver.Thus, only steapsin acting on emulsified fats from pancreas is correctly matched.

Final Answer: Steapsin: Pancreas; Emulsified fats

Answer: (A)

Q31.

Solution

Concept: The sliding filament theory explains muscle contraction through interaction between actin and myosin filaments. The power stroke is a key step in this process.

Key Steps in Cross-Bridge Cycle:

- Myosin head binds ATP and hydrolyzes it to ADP + P_i
- Myosin head becomes "energized"
- Cross-bridge forms with actin
- **Power stroke occurs when ADP and P_i are released**

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Explanation:

- Release of ADP and inorganic phosphate (P_i) triggers conformational change
- This causes the myosin head to pull actin filament inward
- Leads to shortening of sarcomere (muscle contraction)

Myosin head ~~——————~~ Actin filament

ADP + P_i released

Power stroke occurs

Final Answer: ADP and P_i

Answer: (B)

Q32.

Solution

Concept: The cerebellum is responsible for coordination of voluntary movements, maintenance of posture, balance, and precision of muscular activity. Damage to it leads to ataxia, loss of balance, and uncoordinated movements.

Solution: The human brain has different specialized regions controlling various functions. The cerebrum handles higher cognitive functions, the hypothalamus regulates homeostasis, and the medulla oblongata controls vital involuntary functions like breathing and heart rate.The cerebellum, located at the back of the brain under the cerebrum, is primarily responsible for coordinating voluntary muscle movements, maintaining posture, balance, and ensuring smooth execution of motor activities.When the cerebellum is damaged, the person cannot coordinate movements properly, resulting in ataxia, loss of balance, tremors, and inability to perform precise actions such as writing or walking steadily.Since the symptoms described are loss of coordination and balance, the cerebellum is the affected region.Thus, cerebellar damage leads to impaired motor coordination.

Final Answer: Cerebellum

Answer: (C)

Q33.

Solution

Concept: The Juxtaglomerular Apparatus (JGA) regulates blood pressure and glomerular filtration rate. It releases renin in response to decreased blood pressure or decreased NaCl delivery, activating the renin-angiotensin system.

Solution: The JGA is a specialized structure in the nephron located near the glomerulus. It plays a key role in regulating blood pressure and kidney function.Juxtaglomerular cells release the enzyme renin when they detect a fall in glomerular blood pressure or decreased sodium concentration in the distal tubule. This activates the renin-angiotensin-aldosterone system (RAAS), leading to vasoconstriction and increased blood pressure.An increase in GFR or high levels of atrial natriuretic factor (ANF) would suppress renin release. Excess Na^+ reabsorption in PCT is not directly sensed by JGA.Thus, renin is released in response to decreased glomerular blood pressure.

Final Answer: Fall in Glomerular Blood Pressure

Answer: (B)

Q34.

Solution

Concept: Epinephrine, also known as adrenaline, is released from the adrenal medulla during stress and is responsible for the fight-or-flight response, increasing heart rate, blood glucose, and alertness.

Solution: Hormones regulate various physiological processes in the human body. During stress or emergency situations, the body releases a hormone that prepares it for rapid action.Epinephrine, secreted by the adrenal medulla, is called the emergency hormone because it increases heart rate, enhances blood flow to muscles, elevates blood glucose levels through glycogenolysis, and increases alertness.Cortisol is involved in long-term stress response, thyroxine regulates metabolism, and melatonin controls sleep cycles.Thus, epinephrine is the emergency hormone responsible for fight-or-flight response.

Final Answer: Epinephrine

Answer: (C)

Q35.

Solution

Concept: The pneumotaxic center, located in the pons varolii, regulates the respiratory rhythm by limiting inspiration and coordinating the switching between inhalation and exhalation.

Solution: Respiration is controlled by centers in the brainstem. The medulla oblongata contains the respiratory rhythm center, which generates the basic rhythm of breathing.The pons varolii contains the pneumotaxic center, which modifies and regulates the activity of the medullary respiratory center. It helps control the duration of inspiration and prevents over-inflation of the lungs by switching off the inspiratory signal.The midbrain and thalamus are not directly involved in respiratory rhythm control.Thus, the pneumotaxic center is located in the pons varolii.

Final Answer: Pons varolii

Answer: (B)

Q36.

Solution

Concept: Myasthenia gravis is an autoimmune disorder in which antibodies attack acetylcholine receptors at the neuromuscular junction, leading to muscle weakness and fatigue.

Solution: The neuromuscular junction is the site where nerve impulses are transmitted to skeletal muscles using the neurotransmitter acetylcholine.In myasthenia gravis, the immune system produces antibodies against acetylcholine receptors on the muscle membrane. This reduces synaptic transmission, leading to muscle weakness, fatigue, and sometimes paralysis.Muscular dystrophy is a genetic disorder affecting muscle proteins, tetany is caused by calcium imbalance, and gout is due to uric acid deposition.Thus, myasthenia gravis is the autoimmune neuromuscular disorder described.

Final Answer: Myasthenia gravis

Answer: (B)

Q37.

Solution

Concept: Depolarization of a neuron occurs when voltage-gated sodium channels open, allowing rapid influx of Na^+ ions, making the inside of the cell more positive compared to the outside.

Solution: A nerve impulse is generated due to changes in membrane potential. At resting state, the neuron is negatively charged inside.During depolarization, voltage-gated sodium channels open, allowing Na^+ ions to rush into the neuron. This influx of positive ions reverses the membrane potential, making the inside positive relative to the outside.Potassium efflux occurs during repolarization, not depolarization. Chloride ions and Na^+/K^+ pump maintain resting potential but are not responsible for rapid depolarization.Thus, depolarization is characterized by influx of Na^+ ions.

Final Answer: Influx of Na^+

Answer: (A)

Q38.

Solution

Concept: The blind spot in the human eye is the point where the optic nerve exits the retina. This region lacks photoreceptor cells (rods and cones), so no image formation occurs.

Solution: The retina of the eye contains photoreceptor cells (rods and cones) responsible for detecting light and forming images.The blind spot, also called the optic disc, is the region where the optic nerve leaves the eye. At this point, there are no photoreceptor cells, so light falling on this region is not detected, resulting in no visual perception.Although the eye has high resolution areas like the fovea, the blind spot does not contain cones or rods and therefore cannot detect light. Rhodopsin is present in rods, not in the blind spot.Thus, the blind spot is characterized by absence of photoreceptors.

Final Answer: Optic nerve exit; photoreceptors absent

Answer: (B)

Q39.

Solution

Concept: Neutrophils are the most abundant type of leukocytes in human blood and act as the first line of defense. They are highly phagocytic and rapidly engulf invading microorganisms during infection, forming a key component of innate immunity.

Solution: White blood cells (leukocytes) are classified into granulocytes and agranulocytes based on the presence of granules in their cytoplasm. Among them, neutrophils are the most abundant, constituting about 60–65% of total leukocytes.Neutrophils are highly motile and phagocytic in nature. They are the first cells to reach the site of infection and engulf bacteria and foreign particles through phagocytosis. Their nucleus is multilobed, which helps them move through tissues easily.Monocytes are also phagocytic but less abundant in circulation. Basophils release histamine and are involved in allergic reactions, while eosinophils combat parasitic infections.Thus, neutrophils are the most abundant phagocytic leucocytes in human blood.

Final Answer: Neutrophils

Answer: (D)

Q40.

Solution

Concept: In a fertilized embryo sac, different ploidy levels are present: the egg cell is haploid, the zygote is diploid, and the primary endosperm nucleus is typically triploid due to double fertilization in angiosperms.

Solution: In angiosperms, fertilization involves double fertilization, resulting in formation of both zygote and endosperm.The egg cell is haploid (n) and fuses with one male gamete to form a diploid zygote (2n). The central cell contains two polar nuclei, which fuse with the second male gamete to form the triploid primary endosperm nucleus (3n).Thus, haploid structure is egg, diploid is zygote, and triploid is primary endosperm nucleus.Antipodal and nucellus are not part of fertilization products in this context.Therefore, correct sequence is egg (haploid), zygote (diploid), endosperm nucleus (triploid).

Final Answer: Egg, Zygote, and Primary Endosperm Nucleus

Answer: (A)

Q41.

Solution

Concept: Triple fusion is a characteristic feature of angiosperms in which one male gamete fuses with two polar nuclei (secondary nucleus) in the central cell to form the triploid primary endosperm nucleus.

Solution: In angiosperms, fertilization involves two important events: syngamy and triple fusion.During triple fusion, one male gamete fuses with the two polar nuclei present in the central cell of the embryo sac. This results in the formation of a triploid primary endosperm nucleus, which later develops into endosperm tissue that nourishes the developing embryo.The other male gamete fuses with the egg cell to form the zygote in syngamy.Thus, triple fusion specifically involves one male gamete and two polar nuclei.

Final Answer: One male gamete with two polar nuclei

Answer: (C)

Q42.

Solution

Concept: The acrosome is a cap-like structure in the head of sperm that contains hydrolytic enzymes such as hyaluronidase and acrosin, which help the sperm penetrate the layers surrounding the ovum during fertilization.

Solution: A human sperm consists of three main parts: head, middle piece, and tail. The head contains the nucleus and the acrosome.The acrosome is derived from the Golgi apparatus and is filled with enzymes required for fertilization. These enzymes help digest the zona pellucida and other layers of the ovum, allowing sperm entry.The middle piece contains mitochondria for energy production, while the tail provides motility. The nucleus carries genetic material.Thus, the acrosome is responsible for enzyme release during ovum penetration.

Final Answer: Acrosome

Answer: (B)

Q43.

Solution

Concept: The LH surge responsible for ovulation is triggered by high levels of estrogen produced by the mature Graafian follicle, which exerts positive feedback on the hypothalamus and anterior pituitary.

Solution: The menstrual cycle is regulated by hormones of the hypothalamus, pituitary, and ovaries. During the follicular phase, the developing follicle secretes increasing levels of estrogen.When estrogen concentration becomes sufficiently high, it switches from negative to positive feedback on the hypothalamus and anterior pituitary. This leads to a sudden surge of luteinizing hormone (LH), known as the LH surge.This LH surge triggers ovulation, i.e., rupture of the Graafian follicle and release of the secondary oocyte.Progesterone acts after ovulation, FSH mainly stimulates follicle growth, and GnRH controls pituitary release but is not the direct trigger of surge.Thus, estrogen is responsible for LH surge.

Final Answer: Estrogen

Answer: (B)

Q44.

Solution

Concept: In human females, the secondary oocyte completes meiosis II only after fertilization. This ensures that the ovum is formed only when a sperm successfully enters the egg.

Solution: Oogenesis in human females involves meiosis I and meiosis II. The primary oocyte completes meiosis I before ovulation, forming a secondary oocyte and a polar body.The secondary oocyte is arrested at metaphase II and is released during ovulation. It does not complete meiosis II immediately.Meiosis II is completed only after the entry of sperm into the secondary oocyte during fertilization. This ensures proper activation of the egg and prevents wastage of resources.Thus, completion of meiosis II occurs after sperm entry but before full fertilization is completed.

Final Answer: After the entry of sperm but before fertilization

Answer: (B)

Q45.

Solution

Concept: Microsporogenesis is the formation of pollen grains from diploid microspore mother cells (PMCs) through meiosis, followed by formation of microspore tetrads and development into pollen grains.

Solution: Microsporogenesis occurs in the anther of flowering plants. It begins with sporogenous tissue, which differentiates into microspore mother cells (PMCs).Each PMC undergoes meiosis to form a tetrad of haploid microspores. These microspores separate and develop into pollen grains (male gametophytes).Thus, correct sequence is sporogenous tissue → PMC → microspore tetrad → pollen grain.Other options incorrectly reverse or misplace stages, such as placing pollen grain before PMC or tetrad formation.Therefore, the correct developmental sequence is as stated.

Final Answer: Sporogenous tissue → PMC → Microspore tetrad → Pollen grain

Answer: (C)

Q46.

Solution

Concept: Mechanical methods of contraception act as physical barriers that prevent sperm from reaching the ovum, thereby avoiding fertilization. They are non-hormonal and include devices or barriers placed in the reproductive tract. Intrauterine devices (IUDs) like Lippes Loop and Multiload 375 act locally in the uterus, while Saheli is a non-steroidal oral contraceptive. Condoms are the only true external mechanical barrier among the given options and also help prevent sexually transmitted infections.

Solution: Mechanical barrier methods physically block the entry of sperm into the female reproductive tract. Among the options, condoms are the only external mechanical device that acts as a barrier during intercourse. They are made of latex or similar materials and are worn over the penis (or inserted in females) to prevent sperm deposition in the vagina. In contrast, Lippes Loop and Multiload 375 are intrauterine devices that prevent implantation rather than act as external barriers. Saheli is a non-steroidal oral contraceptive pill and works hormonally by altering the menstrual cycle. Therefore, only condoms function as a mechanical barrier method of contraception. Hence, condoms directly prevent sperm-ovum contact and also reduce risk of infections.

Final Answer: Condoms

Answer: (C)

Q47.

Solution

Concept: Colostrum is the first milk secreted by the mammary glands after childbirth. It is highly nutritious and rich in immune-protective factors that provide passive immunity to the newborn.

Key Features of Colostrum:

- Secreted during initial 2–3 days after birth
- Rich in proteins, vitamins, and antibodies
- Provides passive immunity to the newborn

Important Antibody:

- The predominant immunoglobulin in colostrum is **IgA**
- IgA protects mucosal surfaces such as gastrointestinal and respiratory tracts

$$\text{Colostrum} \longrightarrow \text{Newborn}$$

IgA antibodies

Passive immunity

Biological Significance:

- Acts as first line of defense against pathogens
- Strengthens neonatal immune system

Final Answer: $\boxed{IgA}$

Answer: (C)

Q48.

Solution

Concept: The tapetum is the innermost nutritive layer of the anther wall in flowering plants. It plays a vital role in the development of pollen grains by supplying enzymes, nutrients, and precursors for pollen wall formation. It is essential for proper maturation of microspores and formation of the pollen wall, especially the exine layer.

Solution: The tapetum is a specialized layer inside the anther that surrounds the developing microspores. Its main function is to provide nourishment and metabolic support to developing pollen grains. It secretes enzymes, proteins, and lipid-rich materials required for pollen development. One of its most important roles is contributing materials for the formation of the pollen wall, especially the exine layer made of sporopollenin precursors. It also helps in pollen maturation and viability. The tapetum does not directly cause dehiscence of the anther or serve as a protective outer layer. Therefore, its primary role is nutritive support for developing pollen grains.

Final Answer: Providing nourishment to developing pollen grains

Answer: (C)

Q49.

Solution

Concept: In human embryonic development, the blastocyst is differentiated into trophoblast and inner cell mass. The trophoblast forms extra-embryonic structures like placenta, while the inner cell mass gives rise to the embryo proper. This inner cell mass is crucial as it contains pluripotent cells that develop into all tissues of the body.

Solution: After fertilization, the blastocyst forms a hollow structure with an outer trophoblast layer and an inner cell mass. The trophoblast helps in implantation and placenta formation but does not form the embryo itself. The inner cell mass is the group of cells located inside the blastocyst that is responsible for forming the embryo proper. These cells are pluripotent and differentiate into all tissues and organs of the developing organism. The blastocoel is the fluid-filled cavity, and the zona pellucida is a protective outer covering that disappears before implantation. Therefore, the embryo proper originates exclusively from the inner cell mass.

Final Answer: Inner Cell Mass

Answer: (B)

Q50.

Solution

Concept: Taxonomy involves classification of organisms into hierarchical categories based on similarities and evolutionary relationships. The taxonomic hierarchy moves from broad categories with fewer similarities to more specific categories with greater similarities. The correct order follows Kingdom at the top and Species at the lowest level.

Solution: Biological classification arranges organisms in a hierarchy starting from Kingdom, which is the broadest category, and moving down to Species, which is the most specific level. The correct sequence in increasing complexity and decreasing similarity is Kingdom → Phylum/Division → Class → Order → Family → Genus → Species. Each lower level represents organisms with more similarities and closer evolutionary relationships. Species is the most specific category, while Kingdom includes the widest diversity. Therefore, the correct taxonomic order is the standard hierarchical sequence from Kingdom to Species.

Final Answer: Kingdom → Phylum/Division → Class → Order → Family → Genus → Species

Answer: (B)

Q51.

Solution

Concept: Whittaker's five-kingdom classification separates organisms based on cell structure, organization, nutrition, and evolutionary relationships. Protista includes unicellular eukaryotes. Earlier, some algae were classified under Plantae, but unicellular forms like Chlamydomonas and Chlorella were shifted to Protista due to differences in cellular organization.

Solution: In Whittaker's system, organisms are classified into Monera, Protista, Fungi, Plantae, and Animalia. The main criterion for shifting Chlamydomonas and Chlorella from algae (Plantae) to Protista was their unicellular eukaryotic nature. Although they are photosynthetic and have cell walls, they lack the multicellular organization typical of plants. Protista includes unicellular eukaryotes with diverse modes of nutrition and organization. The presence of a true nucleus alone is not sufficient, as many kingdoms have eukaryotic organisms. Therefore, their unicellular organization was the key reason for reclassification into Protista.

Final Answer: Unicellular eukaryotic nature

Answer: (C)

Q52.

Solution

Concept: Viruses are classified based on their genetic material and replication site. Most DNA viruses replicate in the nucleus, but some exceptional viruses replicate in the cytoplasm. Poxviruses are unique double-stranded DNA viruses that carry their own replication machinery and replicate entirely in the host cell cytoplasm.

Solution: Among DNA viruses, the majority depend on the host nucleus for replication. However, Poxviruses are an exception because they possess enzymes required for replication and transcription, allowing them to replicate in the cytoplasm. Bacteriophages infect bacteria and typically replicate within bacterial cells. Retroviruses are RNA viruses that reverse transcribe into DNA. Reoviruses are double-stranded RNA viruses, not DNA viruses. Therefore, the only double-stranded DNA virus that replicates in the cytoplasm is the Poxvirus group.

Final Answer: Poxviruses

Answer: (B)

Q53.

Solution

Concept: In plant taxonomy, correct classification is based on hierarchical grouping from broad to specific levels such as division, class, order, family, genus, and species. Wheat (Triticum aestivum) belongs to Angiospermae (flowering plants), class Monocotyledonae, family Poaceae, and order Poales. Any mismatch in these categories indicates incorrect taxonomic placement.

Solution: Wheat is scientifically classified as Triticum aestivum. It belongs to Division Angiospermae because it is a flowering plant. It is placed in Class Monocotyledonae due to the presence of a single cotyledon, parallel venation, and fibrous root system. Its family is Poaceae, which includes grasses such as wheat, rice, and maize. However, the order Sapindales is incorrect because wheat does not belong to this order. Wheat is actually placed under the order Poales, which includes grasses and related monocots. Sapindales includes plants like citrus and soapberry, which are dicots and unrelated to wheat. Therefore, the mismatched pair is Order: Sapindales.

Final Answer: Order: Sapindales

Answer: (B)

Q54.

Solution

Concept: Diatoms are unicellular photosynthetic organisms belonging to Chrysophytes. They are major producers in aquatic ecosystems and have silica-based cell walls called frustules. Some diatoms show gliding movement, but true active locomotion using flagella is generally absent in most forms.

Solution: Diatoms are microscopic algae found in both freshwater and marine environments. They contribute significantly as primary producers in oceans, forming the base of the aquatic food chain. Their cell wall is composed of silica, forming intricate and beautiful patterns known as frustules. After their death, these silica shells accumulate to form diatomaceous earth. However, most diatoms do not possess flagella for active movement; instead, they exhibit gliding movement in some cases due to mucilage secretion. Flagellated movement is generally absent except in some reproductive stages of a few species. Therefore, the incorrect statement is that diatoms show active movement using flagella.

Final Answer: Active movement using flagella

Answer: (C)

Q55.

Solution

Concept: A mutation in DNA can lead to different effects depending on whether it changes the amino acid sequence, introduces a stop codon, or shifts the reading frame. A single base substitution often results in a point mutation that may or may not alter the encoded amino acid.

Solution: The given template strand is $3' - TAC\ GGC\ AAT\ TCC\ ACT - 5'$. During transcription, mRNA is formed as $5' - AUG\ CCG\ UUA\ AGG\ UGA - 3'$. The third cytosine from the $3'$ end is in the last codon segment, affecting the template triplet ACT, which corresponds to mRNA codon UGA (a stop codon). If cytosine is replaced by thymine, the template becomes ATT, producing mRNA UAA, which is also a stop codon. However, the mutation changes codon identity without shifting the reading frame and alters translation termination position, leading to an altered polypeptide length or amino acid sequence. Since it changes codon meaning but not frame, it is a nonsense-type effect but most appropriately categorized as a point mutation causing amino acid change/termination shift. Hence, it is best described as a nonsense mutation leading to premature termination.

Final Answer: A nonsense mutation leading to premature termination

Answer: (B)

Q56.

Solution

Concept: In *Drosophila*, sex determination is based on the ratio of X chromosomes to sets of autosomes (X:A ratio), not the presence of Y chromosome. A ratio of 1.0 produces females, 0.5 produces males, and intermediate values produce intersexes.

Solution: According to the Genic Balance Theory, sex in *Drosophila* depends on the ratio of X chromosomes to autosomal sets. For a normal female, X:A = 1. In the given genotype $AAXXY$, there are two sets of autosomes (AA = 2A) and two X chromosomes (XX = 2X), but also a Y chromosome which does not affect sex determination. Thus X:A = 2/2 = 1, which corresponds to a female. The presence of Y does not determine maleness in flies. Therefore, the organism develops as a fertile female.

Final Answer: A fertile female

Answer: (B)

Q57.

Solution

Concept: DNA replication is semiconservative in nature. Each daughter DNA molecule contains one parental strand and one newly synthesized strand. Radioactive thymidine incorporates into newly synthesized DNA strands during replication.

Solution: In the S-phase, DNA replication occurs semiconservatively, meaning each daughter DNA molecule consists of one original (parental) strand and one newly synthesized strand. When radioactive thymidine is present, it gets incorporated only into newly synthesized strands. After one round of replication, both daughter DNA molecules will contain one radioactive strand and one non-radioactive strand. However, both molecules will not have radioactivity in both strands, nor will only one molecule be labeled. The label is distributed equally into newly synthesized strands of both daughter molecules.

Final Answer: Both daughter molecules will have radioactivity in one strand only

Answer: (C)

Q58.

Solution

Concept: Epigenetics involves heritable changes in gene expression without alteration in DNA sequence. Paramutation is a phenomenon where one allele induces a heritable change in another allele, altering its expression state.

Solution: Paramutation is a non-Mendelian genetic phenomenon where one allele heritably alters the expression of another allele without changing its nucleotide sequence. This altered state is stable and can be transmitted to future generations. Since the DNA sequence remains unchanged but gene expression is modified, it falls under epigenetic inheritance. It is not classical Mendelian inheritance, cytoplasmic inheritance, or co-dominance. Therefore, paramutation is best classified as epigenetic inheritance.

Final Answer: Epigenetic inheritance

Answer: (B)

Q59.

Solution

Concept: The RNA World hypothesis suggests that RNA was the first genetic and catalytic molecule in early life forms due to its ability to store information and catalyze biochemical reactions.

Solution: The RNA World hypothesis proposes that early life forms relied on RNA both for genetic information storage and catalytic activity before the evolution of DNA and proteins. Strong evidence supporting this includes the fact that RNA molecules such as ribozymes can catalyze essential biological reactions like splicing and peptide bond formation during translation. This demonstrates that RNA can perform both informational and enzymatic roles. DNA is more stable but likely evolved later for long-term storage. Thus, the catalytic ability of RNA provides the strongest evidence that RNA preceded DNA in evolution.

Final Answer: Essential life processes like splicing and translation are catalyzed by RNA

Answer: (C)

Q60.

Solution

Concept: Allele frequency in a population changes when selection removes certain genotypes before reproduction.

Given:

- Total population = 1000
- $AA = 360$, $Aa = 480$, $aa = 160$
- All aa individuals die before reproduction

Step 1: Surviving population

- Only AA and Aa reproduce
- Total survivors = 360 + 480 = 840

Step 2: Count alleles in survivorsA alleles:

- From AA: $360 \times 2 = 720$
- From Aa: $480 \times 1 = 480$

a alleles:

- From Aa: $480 \times 1 = 480$

Total alleles in population:

$$840 \times 2 = 1680$$

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Step 3: Frequency of 'a' allele

$$q = \frac{480}{1680}$$

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Step 4: Simplification

$$q = 0.2857 \approx 0.28$$

$$\text{Survivors} \longrightarrow \text{Allele a}$$

480 alleles

Frequency = 0.28

Final Answer: 0.28

Answer: (B)

Q61.

Solution

Concept: Industrial melanism is a classic example of natural selection acting on pre-existing variation in a population, where environmental changes influence survival of different phenotypes.

Solution: Industrial melanism in the peppered moth (*Biston betularia*) occurred during the Industrial Revolution. Before pollution, light-colored moths were predominant due to camouflage on lichen-covered trees. After pollution darkened tree bark, melanic (dark) forms had better survival because they were less visible to predators. Importantly, both light and dark forms already existed in the population due to genetic variation. Natural selection favored the dark form in polluted environments. The moths did not change color intentionally, nor was mutation induced by smoke. Therefore, natural selection acted on pre-existing variation.

Final Answer: Natural selection acts on existing variation

Answer: (C)

Q62.

Solution

Concept: X-linked dominant inheritance shows a characteristic pattern where affected fathers pass the trait to all daughters but no sons, while affected mothers transmit it to both sexes with 50% probability.

Solution: In X-linked dominant inheritance, the gene responsible is located on the X chromosome and a single copy is sufficient to express the trait. An affected father has genotype X^AY, so he transmits his X chromosome only to daughters, making all daughters affected, while sons receive the Y chromosome and remain unaffected. An affected mother (X^AX^a) has a 50% chance of passing the mutant allele to each child regardless of sex. This pattern matches the described pedigree exactly. Y-linked inheritance affects only males, mitochondrial inheritance is maternal only, and autosomal recessive does not show sex-specific transmission. Therefore, it is X-linked dominant inheritance.

Final Answer: X-linked dominant inheritance

Answer: (C)

Q63.

Solution

Concept: Gene mapping is based on recombination frequency, which is proportional to the distance between two genes on a chromosome. One percent recombination equals one map unit (centimorgan).

Solution: In the test cross, parental types are $AaBb$ (44%) and $aabb$ (44%), while recombinant types are $Aabb$ (6%) and $aaBb$ (6%). Total recombinants = 12%. Recombination frequency equals 12%, so the distance between genes A and B is 12 map units (centimorgans). This indicates partial linkage between the genes, as recombination is less than 50%. Therefore, the correct genetic distance is 12 map units.

Final Answer: 12 map units

Answer: (B)

Q64.

Solution

Concept: Lyon Hypothesis explains X-chromosome inactivation in female mammals, where one of the two X chromosomes becomes transcriptionally inactive and forms a Barr body.

Solution: The Lyon Hypothesis states that in female mammals, one of the two X chromosomes in each cell is randomly inactivated during early embryonic development. This inactivated X chromosome condenses into a structure called the Barr body. This mechanism ensures dosage compensation between males (XY) and females (XX). The inactivation is random and stable in all daughter cells. It is not that both X chromosomes remain active or that only paternal X is inactivated. Y chromosome does not regulate this process. Therefore, random inactivation of one X chromosome is correct.

Final Answer: One X-chromosome is randomly inactivated as Barr body

Answer: (B)

Q65.

Solution

Concept: Allele frequency is calculated by counting the total number of a specific allele and dividing by the total number of alleles in the population.

Given:

- Total individuals = 1000
- AA = 360, Aa = 480, aa = 160

Step 1: Total number of alleles

$$\text{Total alleles} = 1000 \times 2 = 2000$$

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Step 2: Count allele A

- From AA: $360 \times 2 = 720$
- From Aa: $480 \times 1 = 480$

$$\text{Total A alleles} = 720 + 480 = 1200$$

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Step 3: Frequency of allele A

$$p = \frac{1200}{2000}$$

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Step 4: Calculation

$$p = 0.6$$

Genotype Data — Allele A Frequency

1200 / 2000

0.6

Final Answer: 0.6

Answer: (C)

Q66.

Solution

Concept: The wobble hypothesis explains flexibility in base pairing at the third codon position, allowing a single tRNA to recognize multiple codons coding for the same amino acid.

Solution: The wobble hypothesis, proposed by Crick, explains degeneracy of the genetic code. It states that the pairing between codon and anticodon is strict for the first two bases but flexible at the third position. This allows one tRNA molecule to recognize more than one codon encoding the same amino acid due to non-standard base pairing at the third base. This reduces the number of tRNAs required for translation efficiency. It does not involve ribosomal movement irregularities or overlapping genetic code. Therefore, the correct statement is third base flexibility enabling one tRNA to recognize multiple codons.

Final Answer: One tRNA recognizes multiple codons due to third base flexibility

Answer: (B)

Q67.

Solution

Concept: The lac operon is regulated by the lac repressor encoded by the *i* gene. Mutation in the *i* gene affects repressor function, leading to constitutive expression of structural genes.

Solution: The lac operon in bacteria controls lactose metabolism. The *i* gene codes for a repressor protein that binds to the operator and prevents transcription when lactose is absent. If a mutation occurs in the *i* gene, the repressor becomes non-functional and cannot bind to the operator. As a result, the structural genes (z, y, a) are expressed continuously regardless of lactose presence. This condition is known as constitutive expression. Therefore, mutation in the *i* gene leads to constitutive expression of the operon.

Final Answer: Constitutive expression

Answer: (A)

Q68.

Solution

Concept: In a dihybrid cross, independent assortment allows calculation of genotype probabilities using separate monohybrid ratios.

Given Cross:

- Parental: $TTRR \times ttrr$
- F_1 generation: all $TtRr$
- Selfing: $TtRr \times TtRr$

Key Idea:

- Traits segregate independently (Mendel's Law of Independent Assortment)
- Probability is calculated separately for each gene

Step 1: Probability for T locus

$$Tt \text{ from } Tt \times Tt = \frac{2}{4} = \frac{1}{2}$$

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Step 2: Probability for R locus

$$Rr \text{ from } Rr \times Rr = \frac{2}{4} = \frac{1}{2}$$

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Step 3: Combined probability

$$P(TtRr) = P(Tt) \times P(Rr)$$

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$$P(TtRr) = \frac{1}{4} = \frac{4}{16}$$

$$\begin{array}{ll} \text{Tt} \times \text{Tt} \rightarrow 1/2\ \text{Tt} & \text{Combined} \\ \downarrow & \\ \text{Rr} \times \text{Rr} \rightarrow 1/2\ \text{Rr} & 1/2 \times 1/2 = 1/4 \end{array}$$

Final Answer: $\boxed{\frac{4}{16}}$

Answer: (C)

Q69.

Solution

Concept: Convergent evolution leads to analogous structures, where unrelated organisms develop similar features due to similar environmental pressures, not shared ancestry.

Solution: Analogous organs arise due to convergent evolution where unrelated species evolve similar traits independently. Penguin and dolphin flippers are a classic example because both are adapted for swimming but evolved separately in birds and mammals. Whale and bat forelimbs are homologous structures indicating common ancestry. Bougainvillea thorns and Cucurbita tendrils are modified plant organs but not a standard analogy example. Vertebrate hearts are homologous. Therefore, penguin and dolphin flippers represent convergent evolution.

Final Answer: Penguin and dolphin flippers

Answer: (B)

Q70.

Solution

Concept: Monoclonal antibodies provide passive immunity because they supply ready-made antibodies without activating the recipient's immune system to produce its own antibodies.

Solution: Monoclonal antibody therapy involves the administration of laboratory-produced identical antibodies that specifically target a pathogen or antigen. Since these antibodies are directly given to the patient, the immune system does not actively produce them. This is therefore an example of passive immunity. It is artificial because it is medically administered rather than acquired naturally. Active immunity involves antibody production by the host, while natural immunity is acquired without medical intervention. Hence, monoclonal antibody treatment is classified as artificial passive immunity.

Final Answer: Artificial Passive Immunity

Answer: (D)

Q71.

Solution

Concept: After entering the human bloodstream, Plasmodium sporozoites travel to the liver where they multiply asexually in hepatocytes before infecting red blood cells.

Solution: When an infected female Anopheles mosquito bites a human, it injects sporozoites of Plasmodium into the bloodstream. These sporozoites do not immediately infect red blood cells. Instead, they quickly migrate to the liver cells (hepatocytes), where they undergo asexual reproduction (exo-erythrocytic schizogony) producing merozoites. These later enter the bloodstream and infect RBCs, causing malaria symptoms. They do not directly attack RBCs, transform into gametocytes immediately, or fuse with leucocytes. Therefore, liver-stage multiplication is the first event after infection.

Final Answer: They migrate to the liver and undergo asexual reproduction in hepatocytes

Answer: (B)

Q72.

Solution

Concept: Recombinant DNA vaccines are produced using genetically engineered organisms like yeast that express antigenic proteins of pathogens, stimulating immunity without causing disease.

Solution: Recombinant DNA vaccines are developed using genetic engineering techniques where genes coding for antigenic proteins are inserted into host organisms like yeast. The Hepatitis B vaccine is produced using yeast cells that express the surface antigen of the virus. This antigen stimulates immune response without causing infection. Oral Polio Vaccine is a live attenuated vaccine, BCG is a bacterial vaccine, and Salk vaccine is an inactivated polio vaccine. Therefore, Hepatitis B vaccine is the correct recombinant DNA vaccine produced using yeast.

Final Answer: Hepatitis B Vaccine

Answer: (B)

Q73.

Solution

Concept: Biochemical Oxygen Demand (BOD) is a measure of the amount of oxygen required by microorganisms to decompose organic matter in water. It indicates organic pollution levels.

Solution: BOD is an important parameter used in wastewater treatment to assess water quality. It measures the amount of dissolved oxygen required by aerobic microorganisms to break down organic matter present in sewage or polluted water. Higher BOD indicates higher organic pollution and lower water quality. It does not measure inorganic salts or directly indicate oxygen available for fish. It also does not measure sedimentation efficiency. Therefore, BOD reflects the organic matter content present in water.

Final Answer: Organic matter content present in water

Answer: (B)

Q74.

Solution

Concept: Cyclosporin A is an immunosuppressant drug used to prevent organ transplant rejection. It primarily acts by inhibiting T-lymphocyte activation, thereby suppressing cell-mediated immune responses responsible for graft rejection.

Solution: Graft rejection occurs mainly due to activation of the recipient's immune system, especially T-lymphocytes, which recognize the transplanted tissue as foreign and initiate cell-mediated immune responses. Cyclosporin A is a powerful immunosuppressive drug that inhibits calcineurin, a key signaling molecule required for activation of T-helper cells. As a result, it blocks interleukin production and prevents T-cell proliferation and differentiation. This suppression of T-lymphocyte function reduces cell-mediated immunity, thereby preventing graft rejection. It does not primarily affect B-lymphocytes, macrophages, or interferon production. Therefore, its main action is inhibition of T-cell mediated immune response.

Final Answer: T-lymphocyte function and cell-mediated immunity

Answer: (C)

Q75.

Solution

Concept: In industrial microbiology, specific microorganisms are used for the production of biochemical compounds such as acids, antibiotics, and enzymes. Each microbe has a specific validated product.

Solution: Microorganisms play a crucial role in industrial fermentation processes. *Aspergillus niger* is widely used for the commercial production of citric acid due to its high yield and efficiency in fermentation. *Propionibacterium sharmanii* is involved in Swiss cheese production but mainly produces propionic acid and CO_2, not directly matched as stated. *Clostridium butylicum* produces butyric acid, not lactic acid. *Saccharomyces cerevisiae* is used in alcohol fermentation and bread making, while cyclosporin A is produced by fungi like *Trichoderma polysporum*, not yeast. Therefore, the correctly matched pair is *Aspergillus niger* with citric acid production.

Final Answer: Aspergillus niger : $Citricacidproduction$

Answer: (B)

Q76.

Solution

Concept: A molecular probe is used in genetic screening to detect complementary nucleic acid sequences through hybridization. It must be single-stranded and labeled for detection.

Solution: Molecular probes are essential tools in molecular biology used for identifying specific DNA or RNA sequences in a sample. A probe is a short single-stranded DNA or RNA molecule that is complementary to the target sequence. It is labeled with radioactive isotopes or fluorescent markers to enable detection after hybridization. Double-stranded DNA cannot function as a probe because it cannot efficiently bind to target sequences. Proteins and non-specific sequences are also not used as probes. Therefore, the essential characteristic of a probe is that it is single-stranded and labeled for detection.

Final Answer: Single-stranded DNA or RNA, tagged with a radioactive or fluorescent molecule

Answer: (B)

Q77.

Solution

Concept: PCR (Polymerase Chain Reaction) is a highly sensitive molecular technique used to amplify trace amounts of DNA, making it ideal for early detection of pathogens even before symptoms appear.

Solution: Early detection of pathogens is critical for timely diagnosis and treatment of infectious diseases. Polymerase Chain Reaction (PCR) is a highly sensitive and specific technique that amplifies even minute quantities of pathogen DNA present in a sample. This allows detection of infections at very early stages, even before symptoms develop. Serum analysis or urine tests may not detect low pathogen loads, while X-ray diffraction is unrelated to pathogen detection. Western blotting is used for protein detection, not early nucleic acid detection. Therefore, PCR is the most suitable method for early pathogen detection.

Final Answer: Polymerase Chain Reaction (PCR)

Answer: (B)

Q78.

Solution

Concept: Bt toxin genes (cry genes) from *Bacillus thuringiensis* are insect-specific and target particular pest groups such as corn borers and cotton bollworms based on their protein specificity.
Solution: The cry genes of *Bacillus thuringiensis* encode insecticidal proteins that are specific to certain insect groups. *cryIAc* is effective against corn borer, while *cryIAb* also targets corn borer. *cryIIAb* is effective against cotton bollworm. These proteins bind to specific receptors in the insect gut, leading to cell lysis and death. The specificity of each cry gene ensures targeted pest control without affecting non-target organisms. Therefore, the correct matching is (i) corn borer, (ii) cotton bollworm, (iii) corn borer.
Final Answer: (i) Corn borer, (ii) Cotton bollworm, (iii) Corn borer

Answer: (B)

Q79.

Solution

Concept: In proinsulin processing, the C-peptide connects A and B chains but is removed during maturation to form active insulin. It plays a role only in folding and assembly, not in final hormone activity.
Solution: Human insulin is initially synthesized as proinsulin, which consists of A chain, B chain, and a connecting C-peptide. The C-peptide helps in proper folding and alignment of A and B chains during synthesis. However, it is not part of the functional insulin molecule. During maturation in the Golgi apparatus, the C-peptide is enzymatically removed, resulting in active insulin composed only of A and B chains linked by disulfide bonds. Therefore, the C-peptide is removed during processing of proinsulin into mature insulin.
Final Answer: Removed during processing of proinsulin into mature insulin

Answer: (B)

Q80.

Solution

Concept: The Ti plasmid of *Agrobacterium tumefaciens* naturally transfers T-DNA into plant cells, causing tumor formation (crown gall disease) and inducing opine synthesis for bacterial nutrition.
Solution: *Agrobacterium tumefaciens* is a plant pathogenic bacterium that transfers a segment of its Ti plasmid called T-DNA into the host plant genome. This integration causes normal plant cells to become tumor cells, leading to crown gall disease. These transformed cells produce opines, which serve as a carbon and nitrogen source for the bacteria. This natural genetic engineering system is widely exploited in biotechnology for plant transformation. It does not fix nitrogen or protect plants; instead, it induces tumor formation. Therefore, the correct function is transformation of plant cells into tumor cells producing opines.
Final Answer: Transform normal plant cells into tumor cells that produce opines

Answer: (B)

Q81.

Solution

Concept: RNA interference (RNAi) is a gene-silencing mechanism triggered by double-stranded RNA, which leads to degradation of complementary mRNA and suppression of gene expression.
Solution: RNA interference is a biological process in which gene expression is regulated by RNA molecules. It is initiated when double-stranded RNA (dsRNA) enters the cell. This dsRNA is processed into small interfering RNAs (siRNAs), which guide protein complexes to complementary mRNA molecules. The target mRNA is then degraded, preventing protein synthesis. Single-stranded DNA, tRNA, or ribosomal subunits do not initiate RNAi. Therefore, dsRNA is the trigger for RNA interference and gene silencing.
Final Answer: Double-stranded RNA (dsRNA)

Answer: (B)

Q82.

Solution

Concept: Biolistics or gene gun is a physical method of gene transfer used in plant biotechnology. It involves delivery of DNA into cells using high-velocity microprojectiles coated with genetic material, bypassing the need for biological vectors.
Solution: Biolistics, also known as the gene gun method, is a direct gene transfer technique used in genetic engineering, especially in plants. In this method, microscopic particles of gold or tungsten are coated with recombinant DNA and accelerated at high speed into target cells using a gene gun. These particles penetrate the cell wall and membrane, delivering DNA into the nucleus where it can integrate into the host genome. This method is particularly useful for plants that are resistant to Agrobacterium-mediated transformation. It is not involved in DNA separation, enzymatic cutting, or diagnostic measurement. Hence, its role is direct physical delivery of DNA into host cells.
Final Answer: Introduction of DNA into host cells using gold or tungsten micro-particles

Answer: (B)

Q83.

Solution

Concept: A pyramid of numbers represents the number of organisms at each trophic level. It may be upright, inverted, or spindle-shaped depending on ecosystem structure.
Solution: In ecosystems where a single large producer such as a tree supports many herbivores like birds, and each bird further supports parasites, the number of organisms increases at higher trophic levels. This leads to a pyramid that is narrow at the base, broad in the middle, and again narrow at the top. Such a structure is called a spindle-shaped or inverted type of pyramid of numbers. It differs from upright pyramids seen in grassland ecosystems. Therefore, the correct shape is spindle-shaped.
Final Answer: Spindle-shaped

Answer: (C)

Q84.

Solution

Concept: The "Evil Quartet" refers to four major causes of biodiversity loss: habitat loss, over-exploitation, alien species invasion, and co-extinction, among which habitat loss is the most significant driver.

Solution: The major factors contributing to extinction under the Evil Quartet are habitat loss and fragmentation, over-exploitation, alien species invasion, and co-extinctions. Among these, habitat loss and fragmentation are considered the most important causes because they directly reduce living space, food availability, and breeding grounds for most species. This leads to population decline and increased vulnerability to other threats. While other factors also contribute significantly, habitat destruction remains the primary driver of biodiversity loss globally. Therefore, habitat loss and fragmentation is the most important cause.

Final Answer: Habitat loss and fragmentation

Answer: (C)

Q85.

Solution

Concept: The species–area relationship describes how species richness increases with increasing area. It is a fundamental ecological pattern observed across taxa.

Empirical Relationship:

- Species richness increases with area
- Relationship is non-linear and follows a power law

Mathematical Form:

$$S = CA^Z$$

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Where:

- S = species richness
- A = area
- C = constant (intercept)
- Z = slope (species–area exponent)

Taking logarithm on both sides:

$$\log S = \log(CA^Z)$$

Using log rules:

$$\log S = \log C + \log A^Z$$

$$\log S = \log C + Z \log A$$

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Area (A) ———— Species (S)

Power law

$$S = CA^Z$$

Key Insight:

- On a log scale, the relationship becomes linear
- Slope = Z, intercept = $\log C$

Final Answer: $\boxed{\log S = \log C + Z \log A}$

Answer: (A)

Q86.

Solution

Concept: The Sixth Extinction refers to the current biodiversity crisis caused primarily by human activities, occurring at a much faster rate than previous natural mass extinctions.

Solution: The Sixth Extinction is an ongoing mass extinction event primarily driven by human activities such as habitat destruction, pollution, climate change, and over-exploitation. Unlike previous mass extinctions caused by natural catastrophes like asteroid impacts or volcanic eruptions, this extinction is anthropogenic in nature. Scientific estimates suggest that current extinction rates are 100 to 1,000 times higher than the natural background rate. This rapid loss of biodiversity distinguishes it from earlier events. Therefore, the key difference is the extremely accelerated rate of extinction due to human influence.

Final Answer: The rate of extinction is estimated to be 100 to 1,000 times faster

Answer: (B)

Q87.

Solution

Concept: Decomposition involves fragmentation, leaching, catabolism, humification, and mineralisation. Each step has a specific biological or physical role in nutrient cycling.

Solution: Decomposition is a multi-step process in ecosystems. Fragmentation is the physical breakdown of detritus by detritivores like earthworms, not fungal enzymes. Catabolism refers to enzymatic breakdown of organic matter by microbes, not physical breakdown. Leaching is the process where water-soluble inorganic nutrients are washed down into deeper soil layers. Humification leads to formation of dark amorphous humus, not rapid mineral release. Therefore, the correct definition is leaching, where soluble nutrients move into soil profile.

Final Answer: Leaching: water-soluble inorganic nutrients go down into soil profile

Answer: (C)

Q88.

Solution

Concept: Primary productivity refers to the rate at which producers convert solar energy into organic matter through photosynthesis in an ecosystem.

Solution: Primary productivity is defined as the rate at which energy is converted into organic matter by autotrophs, mainly green plants and algae, through photosynthesis. These organisms are known as producers and form the base of the food chain. Decomposers break down dead matter, and consumers depend on producers for energy. Therefore, primary productivity is exclusively associated with producers and reflects the biomass accumulation in an ecosystem over time.

Final Answer: Producers

Answer: (A)

Q89.

Solution

Concept: In ecosystems, energy flow occurs through different food chains. In aquatic systems, grazing food chains dominate due to phytoplankton-based productivity, whereas in terrestrial ecosystems, most energy flows through detritus-based pathways involving decomposers.

Solution: In aquatic ecosystems, producers like phytoplankton are directly consumed by herbivores, forming a dominant grazing food chain (GFC). However, in terrestrial ecosystems, a large amount of organic matter is produced as leaf litter, dead plants, and animal remains. This detritus is broken down by decomposers such as bacteria and fungi, forming the detritus food chain (DFC). This pathway contributes a major fraction of energy flow in terrestrial habitats. Parasitic and predatory food chains are secondary pathways and do not dominate energy transfer. Hence, the correct answer is detritus food chain.

Final Answer: Detritus food chain

Answer: (B)

Q90.

Solution

Concept: Ex-situ conservation involves protecting endangered species outside their natural habitats in controlled environments such as zoos, botanical gardens, and seed banks.

Solution: Biodiversity conservation strategies are broadly classified into in-situ and ex-situ methods. In-situ conservation protects species in their natural ecosystems, such as biosphere reserves and sacred groves. In contrast, ex-situ conservation involves preservation of endangered species outside their natural habitats under controlled conditions. Examples include zoological parks, botanical gardens, cryopreservation, and seed banks. This method is especially useful for critically endangered species that cannot survive in the wild. Therefore, the correct feature of ex-situ conservation is conservation in controlled environments like zoos or seed banks.

Final Answer: Endangered species are conserved in zoos and seed banks

Answer: (C)

Answer Key

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