MHT-CET Biology Sample Paper-8

Duration: 90 Minutes **Maximum Marks: 100**

Instructions

- This paper contains a total of **100** Multiple Choice Questions.
- Each correct answer carries **+1 mark**.
- No negative marking for incorrect questions.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.
- No marks will be deducted for questions that are left unattempted.

Q1. During the light reaction of photosynthesis, a researcher observed that ATP synthesis continued even when NADP reduction was experimentally blocked. Considering the movement of electrons and involvement of PSI and PSII, identify the pathway that can still operate under such conditions.

(A) Non-cyclic photophosphorylation only

(B) Cyclic photophosphorylation only

(C) Calvin cycle only

(D) C4 pathway only

Q2. A student studying enzyme kinetics noticed that increasing substrate concentration failed to increase the reaction rate beyond a certain limit. The enzyme concentration was kept constant throughout the experiment. Which of the following best explains this observation?

(A) Competitive inhibition of enzyme

(B) Denaturation of substrate

(C) Saturation of all active sites

(D) Conversion of apoenzyme into holoenzyme

Q3. In a flowering plant, the megaspore mother cell undergoes meiosis to form four megaspores. However, only one megaspore remains functional while the remaining degenerate. This surviving megaspore eventually forms the embryo sac. Such development is termed as:

(A) Bisporic development

(B) Monosporic development

(C) Tetrasporic development

(D) Polyembryony

Q4. A patient suffering from chronic renal failure showed accumulation of nitrogenous wastes in blood, edema, and electrolyte imbalance. The physician recommended a procedure in which blood is circulated through a semipermeable membrane to remove waste substances. This procedure is called:

(A) Ultrafiltration

(B) Hemodialysis

(C) Tubular secretion

(D) Counter-current mechanism

Q5. In Mendel's dihybrid cross involving seed shape and seed colour, the F2 generation showed a phenotypic ratio of 9:3:3:1. Which of the following principles can be directly inferred from this observation?

(A) Incomplete dominance

(B) Law of segregation only

(C) Law of independent assortment

(D) Linkage between genes

Q6. While examining a transverse section of a dorsiventral leaf, a botanist observed compactly arranged cells with chloroplasts towards the upper epidermis and loosely arranged cells with air spaces towards the lower side. Identify the tissues referred to above.

(A) Sclerenchyma and collenchyma

(B) Palisade and spongy parenchyma

(C) Epidermis and pericycle

(D) Xylem and phloem

Q7. A molecular biologist inserted a normal functional gene into the bone marrow cells of a patient suffering from adenosine deaminase deficiency. The therapeutic approach mentioned above is known as:

(A) Hybridoma technology

(B) Gene therapy

(C) Somatic hybridization

(D) RNA interference

Q8. During ecological succession in a water body, phytoplanktons were gradually replaced by rooted submerged plants, followed by floating vegetation and finally forest communities. Such succession occurring in aquatic habitats is called:

(A) Xerarch succession

(B) Hydrarch succession

(C) Secondary succession

(D) Lithosere succession

Q9. A scientist isolated a bacterium capable of converting atmospheric nitrogen into ammonia in the root nodules of leguminous plants. The enzyme complex involved in this conversion is highly sensitive to oxygen. Identify the enzyme.

(A) Nitrogenase

(B) Rubisco

(C) DNA polymerase

(D) RuBP carboxylase

Q10. During spermatogenesis, primary spermatocytes undergo meiosis-I to form secondary spermatocytes, which further divide by meiosis-II. How many sperms are ultimately produced from one primary spermatocyte?

(A) Two

(B) Three

(C) Four

(D) Eight

Q11. A researcher observed that in a particular food chain, the biomass of producers was exceptionally low compared to consumers, especially in an aquatic ecosystem. Which ecological pyramid can appear inverted in such a condition?

(A) Pyramid of energy

(B) Pyramid of biomass

(C) Pyramid of numbers only

(D) Pyramid of productivity

Q12. While studying DNA replication, a student noted that one strand is synthesized continuously whereas the other is synthesized discontinuously in short fragments. These short segments are called:

(A) Exons

(B) Introns

(C) Okazaki fragments

(D) Operons

Q13. A farmer cultivated a crop variety that matured early, showed resistance to diseases, and produced high yield under varying environmental conditions. Such improvement in crop traits is generally achieved through:

(A) Mutation only

(B) Plant breeding

(C) Vegetative propagation

(D) Tissue necrosis

Q14. In a human population, the frequency of heterozygous carriers for sickle-cell anaemia remains relatively high in regions affected by malaria. This persistence can be best explained by:

(A) Genetic drift

(B) Founder effect

(C) Heterozygote advantage

(D) Artificial selection

Q15. During transcription in eukaryotes, the primary RNA transcript undergoes processing before becoming functional mRNA. Which of the following modifications does NOT occur during RNA processing?

(A) Splicing

(B) Polyadenylation

(C) Capping

(D) Translation

Q16. A patient infected with Human Immunodeficiency Virus showed a severe decline in immunity due to destruction of helper T-lymphocytes. Which receptor-bearing cells are primarily targeted by the virus?

(A) CD8 cells

(B) CD4 cells

(C) Plasma cells

(D) Mast cells

Q17. In the experiment conducted by Griffith on *Streptococcus pneumoniae*, non-virulent bacteria became virulent when mixed with heat-killed virulent bacteria. The phenomenon demonstrated by the experiment is known as:

(A) Translation

(B) Transduction

(C) Transformation

(D) Conjugation

Q18. A botanist observed that certain flowers possessed both androecium and gynoecium, yet self-pollination was prevented due to temporal differences in maturation of stamens and stigma. This condition is called:

(A) Herkogamy

(B) Dichogamy

(C) Cleistogamy

(D) Apomixis

Q19. In a pedigree analysis of a family, the trait appeared predominantly in males and was transmitted from carrier mothers to sons. Which inheritance pattern is most likely involved?

(A) Autosomal dominant

(B) Autosomal recessive

(C) X-linked recessive

(D) Y-linked inheritance

Q20. During muscle contraction, calcium ions bind with a specific protein present on actin filaments, resulting in movement of tropomyosin and exposure of active sites. Identify the protein.

(A) Myosin

(B) Troponin

(C) Actinin

(D) Titin

Q21. A xerophytic plant growing in desert conditions showed thick cuticle, sunken stomata, and reduced leaf surface area. These features collectively help the plant primarily by:

(A) Increasing transpiration

(B) Enhancing mineral absorption

(C) Reducing water loss

(D) Promoting guttation

Q22. During glycolysis, glucose undergoes a sequence of enzymatic reactions to produce pyruvate. Net gain of ATP molecules produced directly through substrate-level phosphorylation per glucose molecule is:

(A) 1 ATP

(B) 2 ATP

(C) 4 ATP

(D) 8 ATP

Q23. In an experiment on transpiration pull, a leafy shoot immersed in water continued to absorb water even after root removal. This observation supports the concept that ascent of sap occurs mainly due to:

(A) Root pressure

(B) Capillarity

(C) Transpiration pull

(D) Imbibition

Q24. A scientist studying operon regulation observed that lactose utilization genes were expressed only in the presence of lactose and absence of glucose. This regulatory mechanism is associated with:

(A) Trp operon

(B) Lac operon

(C) Split genes

(D) Repetitive DNA

Q25. During meiosis-I, homologous chromosomes pair together and exchange genetic material at chiasmata. This exchange contributes significantly to:

(A) DNA replication

(B) Mutation repair

(C) Genetic recombination

(D) Cytokinesis

Q26. A marine ecosystem was found to contain organisms occupying multiple trophic levels due to their omnivorous feeding habits. Such interconnected feeding relationships form:

(A) Ecological pyramid

(B) Food web

(C) Ecotone

(D) Biome

Q27. A pregnant woman was advised to undergo amniocentesis only under medical necessity because indiscriminate use of the technique led to ethical concerns. The procedure primarily involves:

(A) Examination of embryo after birth

(B) Analysis of amniotic fluid cells

(C) Direct gene insertion into fetus

(D) Artificial insemination

Q28. During respiration in humans, oxygen dissociation from oxyhaemoglobin occurs more readily in tissues because of increased carbon dioxide concentration and lower pH. This phenomenon is referred to as:

(A) Haldane effect

(B) Bohr effect

(C) Root effect

(D) Donnan effect

Q29. In biotechnology laboratories, plasmids are commonly used as vectors because they possess the ability to replicate independently inside bacterial cells. Which additional property makes them suitable cloning vectors?

(A) Presence of ribosomes

(B) Antibiotic resistance markers

(C) Ability to synthesize proteins

(D) Presence of lysosomes

Q30. While studying the origin of life, a scientist proposed that life originated from pre-existing non-living organic molecules under primitive earth conditions. This hypothesis is known as:

(A) Theory of spontaneous generation

(B) Chemical evolution theory

(C) Biogenesis theory

(D) Catastrophism

Q31. In a certain angiosperm species, pollen grains remain viable for only a few minutes after release, whereas in cereals they may survive for months under proper storage conditions. Which factor primarily affects pollen viability?

(A) pH of soil

(B) Temperature and humidity

(C) Rate of transpiration

(D) Nitrogen fixation

Q32. A patient was unable to clot blood efficiently due to deficiency of a plasma protein synthesized in the liver with the help of vitamin K. Identify the protein involved.

(A) Albumin

(B) Globulin

(C) Prothrombin

(D) Fibrinogen

Q33. In a biogas plant, organic wastes are decomposed anaerobically by methanogenic bacteria. Which of the following gases constitutes the major component of biogas?

(A) Carbon dioxide

(B) Methane

(C) Hydrogen sulphide

(D) Nitrogen

Q34. A mutation in a single nucleotide pair of DNA resulted in substitution of one amino acid in the polypeptide chain. Such mutation is classified as:

(A) Frameshift mutation

(B) Point mutation

(C) Chromosomal inversion

(D) Polyploidy

Q35. During ecological studies, a population was found to maintain a relatively stable size despite fluctuations in environmental conditions. This stability was mainly due to the carrying capacity of the habitat. Carrying capacity refers to:

(A) Maximum number of predators present

(B) Total genetic variability of population

(C) Maximum sustainable population size

(D) Rate of migration in ecosystem

Q36. A scientist discovered that chloroplasts and mitochondria possess their own DNA and ribosomes and can replicate independently within cells. This observation strongly supports:

(A) Lamarckism

(B) Endosymbiotic theory

(C) Mutation theory

(D) Germplasm theory

Q37. In a human female reproductive cycle, rupture of the Graafian follicle and release of secondary oocyte occurs approximately on the:

(A) 1st day

(B) 7th day

(C) 14th day

(D) 28th day

Q38. A researcher observed that DNA fragments moved towards the anode during gel electrophoresis. The movement occurred because DNA molecules possess:

(A) Positive charge due to histones

(B) Neutral phosphate backbone

(C) Negative charge due to phosphate groups

(D) Lipid-rich structure

Q39. While studying immunity, it was observed that antibodies produced during the first exposure to an antigen appeared slowly, but subsequent exposure resulted in rapid and enhanced antibody production. This phenomenon is due to:

(A) Innate immunity

(B) Memory cells

(C) Inflammation

(D) Passive immunity

Q40. A plant breeder crossed two pure lines and observed superior traits in the F1 progeny, including increased yield and disease resistance. This phenomenon of superior hybrid performance is termed:

(A) Inbreeding depression

(B) Heterosis

(C) Polyploidy

(D) Mutation breeding

Q41. In the nephron, selective reabsorption of glucose, amino acids, and ions mainly occurs in the proximal convoluted tubule due to its specialized epithelial lining. The lining consists primarily of:

(A) Squamous epithelium

(B) Cuboidal epithelium with microvilli

(C) Stratified epithelium

(D) Ciliated epithelium

Q42. During Darwin's voyage, he observed variations among finches inhabiting different islands of the Galapagos. These variations eventually contributed to the formulation of the concept of:

(A) Mutation theory

(B) Natural selection

(C) Germplasm inheritance

(D) Catastrophism

Q43. A geneticist observed that a single gene influenced multiple phenotypic traits simultaneously in an organism. Such a phenomenon is known as:

(A) Polygenic inheritance

(B) Pleiotropy

(C) Codominance

(D) Epistasis

Q44. In the process of transcription, the RNA polymerase binds to a specific DNA sequence that signals the beginning of transcription. This sequence is called:

(A) Terminator

(B) Operator

(C) Promoter

(D) Enhancer

Q45. While comparing C3 and C4 plants, a student noted that C4 plants show negligible photorespiration due to spatial separation of initial carbon fixation and Calvin cycle. Which enzyme initially fixes carbon dioxide in C4 plants?

(A) Rubisco

(B) PEP carboxylase

(C) ATP synthase

(D) NAD reductase

Q46. A patient complained of muscular fatigue and reduced ATP production. Laboratory investigation revealed dysfunction of cristae in mitochondria. Which process would be directly affected?

(A) Glycolysis

(B) Krebs cycle only

(C) Oxidative phosphorylation

(D) Fermentation

Q47. In flowering plants, double fertilization results in formation of both zygote and endosperm. The endosperm formed in angiosperms is generally:

(A) Haploid

(B) Diploid

(C) Triploid

(D) Tetraploid

Q48. A parasitic plant lacking chlorophyll obtains nutrition from host plants through specialized sucking roots penetrating host tissues. These roots are known as:

(A) Prop roots

(B) Pneumatophores

(C) Haustoria

(D) Stilt roots

Q49. During blood circulation, arteries carry blood away from the heart under high pressure. Which structural feature enables arteries to withstand such pressure?

(A) Thin walls with valves

(B) Thick elastic muscular walls

(C) Presence of cilia

(D) Discontinuous endothelium

Q50. In recombinant DNA technology, restriction endonucleases are frequently used because they cut DNA at specific recognition sites. EcoRI recognizes the sequence:

(A) 5'-AAGCTT-3'

(B) 5'-GGATCC-3'

(C) 5'-GAATTC-3'

(D) 5'-CTGCAG-3'

Q51. The human heart possesses a specialized conducting system that initiates and regulates rhythmic contractions. Which structure acts as the natural pacemaker of the heart?

(A) AV node

(B) Bundle of His

(C) Purkinje fibres

(D) SA node

Q52. During secondary growth in dicot stems, vascular cambium produces secondary xylem towards the inner side and secondary phloem towards the outer side. Continuous deposition of secondary xylem leads to formation of:

(A) Cork cambium

(B) Annual rings

(C) Root hairs

(D) Companion cells

Q53. According to Hardy-Weinberg equilibrium, allele frequencies in a population remain constant from generation to generation provided evolutionary influences are absent. Which factor can disturb this equilibrium?

(A) Random mating

(B) Large population size

(C) Gene migration

(D) Lack of selection

Q54. The Human Genome Project aimed at identifying all genes and sequencing the entire human genome. Approximately how many base pairs are present in the human genome?

(A) 3 thousand

(B) 3 million

(C) 3 billion

(D) 30 billion

Q55. A gardener observed that spraying a particular plant hormone promoted stem elongation, breaking of seed dormancy, and bolting in rosette plants. Identify the hormone involved.

(A) Cytokinin

(B) Ethylene

(C) Gibberellin

(D) Abscisic acid

Q56. Certain desert animals avoid extreme daytime heat by remaining inactive in burrows and becoming active during night hours. This behavioral adaptation is known as:

(A) Migration

(B) Hibernation

(C) Nocturnality

(D) Aestivation

Q57. A child exhibited short stature, webbed neck, reduced ovarian development, and absence of Barr body. Cytogenetic analysis revealed monosomy of sex chromosomes. Identify the disorder.

(A) Klinefelter syndrome

(B) Turner syndrome

(C) Down syndrome

(D) Edwards syndrome

Q58. In ecological succession, lichens are often the pioneer species on bare rocks because they can survive under harsh conditions and contribute to soil formation. Such succession beginning on naked rocks is termed:

(A) Hydrosere

(B) Lithosere

(C) Halosere

(D) Psammosere

Q59. In polymerase chain reaction (PCR), repeated cycles of denaturation, annealing, and extension result in exponential amplification of DNA. Which enzyme is commonly used due to its thermostable nature?

(A) DNA ligase

(B) Taq polymerase

(C) Reverse transcriptase

(D) RNA polymerase

Q60. Carbon monoxide poisoning can be fatal because carbon monoxide binds strongly with haemoglobin and prevents oxygen transport. The affinity of haemoglobin for carbon monoxide is approximately:

(A) Equal to oxygen

(B) 20 times more than oxygen

(C) 200–250 times more than oxygen

(D) 1000 times more than oxygen

Q61. During aerobic respiration, acetyl CoA enters a cyclic pathway in the mitochondrial matrix where carbon dioxide, ATP, NADH, and $FADH_2$ are produced. This metabolic pathway is known as:

(A) Glycolysis

(B) Calvin cycle

(C) Krebs cycle

(D) Pentose phosphate pathway

Q62. A toxic pesticide entered an aquatic food chain and its concentration increased progressively at successive trophic levels, reaching the maximum concentration in top carnivores. This phenomenon is called:

(A) Eutrophication

(B) Biomagnification

(C) Bioaccumulation

(D) Ecological succession

Q63. A tall pea plant with unknown genotype was crossed with a dwarf plant to determine whether the tall plant was homozygous or heterozygous. Such a cross is referred to as:

(A) Back cross

(B) Monohybrid cross

(C) Test cross

(D) Reciprocal cross

Q64. In higher plants, chlorophyll *a* acts as the chief photosynthetic pigment while other pigments assist in light absorption and transfer of energy. These accessory pigments include:

(A) Carotenoids and chlorophyll *b*

(B) Anthocyanins only

(C) Xanthophylls only

(D) Flavonoids only

Q65. A patient suffering from excessive urination and intense thirst was diagnosed with deficiency of antidiuretic hormone. Which endocrine gland secretes this hormone?

(A) Thyroid gland

(B) Adrenal cortex

(C) Posterior pituitary

(D) Pineal gland

Q66. In human ABO blood group inheritance, individuals with genotype I^AI^B express both A and B antigens simultaneously on the surface of RBCs. This inheritance pattern demonstrates:

(A) Incomplete dominance

(B) Polygenic inheritance

(C) Codominance

(D) Multiple allelism only

Q67. An orchid growing on the branch of a mango tree derives support and better exposure to sunlight without causing harm or benefit to the tree. This ecological interaction is known as:

(A) Mutualism

(B) Commensalism

(C) Parasitism

(D) Competition

Q68. In eukaryotic chromosomes, negatively charged DNA wraps around positively charged histone proteins to form repeating structural units. These repeating units are called:

(A) Chromatids

(B) Nucleosomes

(C) Centromeres

(D) Operons

Q69. A person accidentally touched a hot object and withdrew the hand immediately even before consciously perceiving pain. This rapid automatic response is mediated through:

(A) Cerebral cortex only

(B) Reflex arc

(C) Cerebellum

(D) Hypothalamus

Q70. Blue-green algae such as *Anabaena* and *Nostoc* are commonly used in paddy fields because they improve soil fertility mainly through:

(A) Phosphate solubilization

(B) Nitrogen fixation

(C) Potassium enrichment

(D) Organic acid secretion

Q71. A cell organelle containing hydrolytic enzymes enclosed within a single membrane is involved in intracellular digestion and autophagy. Identify the organelle.

(A) Ribosome

(B) Lysosome

(C) Centrosome

(D) Dictyosome

Q72. Forelimbs of humans, whales, bats, and horses possess similar skeletal structures despite performing different functions. Such structures are considered evidence of:

(A) Convergent evolution

(B) Analogous organs

(C) Homologous organs

(D) Adaptive radiation only

Q73. Following fertilization in humans, the zygote undergoes cleavage divisions while moving through the fallopian tube. Implantation normally occurs at the:

(A) Ovary

(B) Cervix

(C) Endometrium of uterus

(D) Vagina

Q74. Transpiration in plants is often referred to as a necessary evil because although it leads to water loss, it also contributes significantly to:

(A) Photosynthetic oxygen evolution only

(B) Ascent of sap and cooling

(C) Breakdown of chlorophyll

(D) Fruit ripening

Q75. The genetic code is considered degenerate because a single amino acid can be specified by more than one codon. Which amino acid is coded by only one codon?

(A) Leucine

(B) Serine

(C) Methionine

(D) Arginine

Q76. The total amount of organic matter produced through photosynthesis per unit area per unit time in an ecosystem is known as:

(A) Net primary productivity

(B) Secondary productivity

(C) Gross primary productivity

(D) Standing crop

Q77. A digestive enzyme secreted in inactive form by the pancreas becomes activated in the small intestine and plays a major role in protein digestion. Identify the enzyme.

(A) Ptyalin

(B) Pepsin

(C) Trypsin

(D) Lipase

Q78. Exposure to ionizing radiations and certain chemicals can induce sudden heritable changes in genetic material. Such changes are collectively known as:

(A) Adaptations

(B) Variations

(C) Mutations

(D) Recombinations

Q79. A small piece of plant tissue cultured under aseptic conditions on a nutrient medium gave rise to an entire plant. This property of plant cells is referred to as:

(A) Plasticity

(B) Totipotency

(C) Permeability

(D) Differentiation

Q80. Animals adapted to arid environments often excrete nitrogenous wastes mainly in the form of uric acid because it helps in:

(A) Rapid diffusion

(B) Conservation of water

(C) Increased toxicity

(D) Enhanced ammonia formation

Q81. During the cell cycle, DNA replication occurs in a specific phase of interphase before the cell enters mitosis. Identify the phase during which DNA synthesis takes place.

(A) G_1 phase

(B) S phase

(C) G_2 phase

(D) M phase

Q82. A person was unable to clearly see nearby objects due to reduction in the power of accommodation of the eye lens associated with ageing. This visual defect is known as:

(A) Myopia

(B) Hypermetropia

(C) Presbyopia

(D) Astigmatism

Q83. Two closely related species competing for identical resources in the same habitat cannot coexist indefinitely because one eventually outcompetes the other. This concept is explained by:

(A) Gause's competitive exclusion principle

(B) Hardy-Weinberg principle

(C) Allen's rule

(D) Bergmann's rule

Q84. In monocot stems, vascular bundles are scattered throughout the ground tissue and lack cambium. Consequently, monocot stems generally do not exhibit:

(A) Primary growth

(B) Secondary growth

(C) Vascular bundles

(D) Mechanical tissues

Q85. Vaccination provides protection against infectious diseases by stimulating the body to produce antibodies and memory cells without causing severe disease symptoms. This type of immunity is known as:

(A) Passive natural immunity

(B) Active acquired immunity

(C) Innate immunity

(D) Passive artificial immunity

Q86. Industrial melanism observed in peppered moths during the industrial revolution demonstrated that environmental changes can alter survival rates of organisms possessing favorable traits. This observation supports:

(A) Lamarckism

(B) Mutation theory

(C) Natural selection

(D) Theory of inheritance of acquired characters

Q87. Certain flowering plants produce seeds without fertilization, leading to formation of genetically identical offspring. This phenomenon is known as:

(A) Polyembryony

(B) Apomixis

(C) Hybridization

(D) Double fertilization

Q88. Enzymes increase the rate of biochemical reactions primarily by lowering the activation energy required for the reaction to proceed. However, enzymes remain unchanged because they:

(A) Are consumed completely

(B) Act as catalysts

(C) Alter equilibrium permanently

(D) Increase substrate concentration

Q89. During vigorous exercise, skeletal muscles may temporarily switch to anaerobic respiration leading to accumulation of lactic acid. This accumulation causes:

(A) Increased oxygen transport

(B) Muscle fatigue

(C) Enhanced ATP storage

(D) Reduced respiration rate

Q90. Conversion of ammonia into nitrites and subsequently into nitrates by soil bacteria is an important step of the nitrogen cycle known as:

(A) Ammonification

(B) Nitrogen fixation

(C) Denitrification

(D) Nitrification

Q91. During cell division, spindle fibres attach to chromosomes at a specific region responsible for movement of chromosomes toward opposite poles. This region is called:

(A) Chromatid

(B) Centromere

(C) Telomere

(D) Nucleosome

Q92. The maximum volume of air that can be forcibly exhaled after taking the deepest possible breath is termed as:

(A) Tidal volume

(B) Inspiratory reserve volume

(C) Vital capacity

(D) Residual volume

Q93. In the Calvin cycle, carbon dioxide combines with ribulose bisphosphate to form an unstable six-carbon compound which immediately breaks down into two molecules of:

(A) Phosphoglyceric acid

(B) Oxaloacetic acid

(C) Pyruvic acid

(D) Malic acid

Q94. A genetically engineered bacterium capable of producing human insulin was developed using recombinant DNA technology. The first commercial insulin produced through this method was called:

(A) Humulin

(B) Interferon

(C) Cyclosporin

(D) Streptokinase

Q95. The hormone responsible for maintenance of pregnancy by sustaining the uterine endometrium during the initial stages is mainly:

(A) Estrogen

(B) Progesterone

(C) Oxytocin

(D) Relaxin

Q96. India is recognized as one of the mega-diversity nations of the world because it possesses a high level of species richness and endemism. Which region of India is considered a biodiversity hotspot?

(A) Thar Desert

(B) Western Ghats

(C) Indo-Gangetic Plain

(D) Deccan Plateau

Q97. According to the central dogma proposed by Francis Crick, genetic information generally flows in a sequential manner from:

(A) Protein to DNA to RNA

(B) RNA to DNA to Protein

(C) DNA to RNA to Protein

(D) DNA to Protein to RNA

Q98. The growth of a plant organ towards light stimulus is regulated mainly by unequal distribution of auxin, resulting in differential cell elongation. This directional growth response is known as:

(A) Geotropism

(B) Hydrotropism

(C) Phototropism

(D) Thigmotropism

Q99. Large-scale deforestation can significantly increase atmospheric carbon dioxide levels and contribute to global warming because forests normally act as:

(A) Carbon sources

(B) Carbon sinks

(C) Nitrogen reservoirs

(D) Ozone producers

Q100. The tendency of related organisms to evolve different adaptations while inhabiting different ecological niches is best described as:

(A) Convergent evolution

(B) Divergent evolution

(C) Parallel evolution

(D) Artificial selection

Detailed Solutions

Q1.

Solution

Concept: Photosynthesis consists of two major phases: the light reactions and the Calvin cycle. During the light reactions, ATP and NADPH are synthesized. ATP formation occurs through two mechanisms — cyclic and non-cyclic photophosphorylation. Non-cyclic photophosphorylation utilizes both Photosystem I (PSI) and Photosystem II (PSII) and generates ATP as well as NADPH. In contrast, cyclic photophosphorylation involves only PSI and produces ATP alone without forming NADPH.

Solution: Step 1: Interpret the condition given in the question. The reduction of $NADP^+$ to NADPH has been blocked, but ATP synthesis still continues. Therefore, the process responsible for ATP production must be capable of functioning independently of NADPH formation.

Step 2: Examine the role of the two photophosphorylation pathways.
In non-cyclic photophosphorylation, electrons originate from PSII, travel through an electron transport chain, and finally reach PSI, where they are transferred to $NADP^+$ to form NADPH. Since NADP reduction is blocked, the electron flow in this pathway would eventually stop, thereby affecting ATP generation as well.
In cyclic photophosphorylation, only PSI participates. The excited electrons return back to PSI through a cyclic route instead of reducing $NADP^+$. This cyclic movement of electrons establishes a proton gradient that drives ATP synthesis. As NADPH is not formed in this pathway, it can continue even when NADP reduction is inhibited.

Step 3: Relate the observation to the correct pathway. Since ATP production is still occurring despite the blockage of NADPH formation, the pathway responsible must be cyclic photophosphorylation, because it is independent of $NADP^+$ reduction.

Step 4: Eliminate the remaining options.
The Calvin cycle (Option C) consumes ATP and NADPH for carbon fixation; it does not directly synthesize ATP under these conditions.
The C4 pathway (Option D) is associated with carbon fixation in certain plants and is unrelated to ATP generation during the light reactions.

Step 5: Arrive at the conclusion.
Cyclic photophosphorylation alone can maintain ATP production even when NADP reduction does not occur.

Final Answer: Cyclic photophosphorylation only

Answer: (B)

Go Back to Question 1

Q2.

Solution

Concept: The rate of an enzyme-catalyzed reaction depends on factors such as substrate concentration, enzyme concentration, pH, and temperature. As substrate concentration increases, the reaction velocity also increases, but only up to a certain limit. Once all enzyme active sites become occupied, the enzyme reaches its maximum reaction rate (V_{max}).

Solution: Step 1: Interpret the experimental finding. The reaction rate increases initially with substrate concentration but eventually becomes constant even though more substrate is added, while the enzyme concentration remains unchanged. This suggests that the enzyme has reached its maximum working capacity.

Step 2: Understand the effect of increasing substrate concentration. At low substrate levels, many enzyme active sites remain free, allowing additional substrate molecules to bind easily. Consequently, the reaction rate rises proportionally with substrate concentration.

Step 3: Explain enzyme saturation. As substrate concentration continues to increase, more active sites become occupied until eventually every active site is engaged with a substrate molecule. At this stage, the enzyme is fully saturated. Since no free active sites remain available, adding extra substrate cannot further increase the reaction rate. The system therefore attains its maximum velocity, denoted as V_{max}.

Step 4: Analyze the alternatives provided.
Competitive inhibition (Option A): In competitive inhibition, inhibitor molecules compete with the substrate for the active site. Although this affects enzyme activity, the characteristic plateau observed here is more directly explained by enzyme saturation.
Denaturation of substrate (Option B): If the substrate were denatured, its interaction with the enzyme would decrease, leading to reduced reaction rates rather than a stable maximum rate.
Saturation of all active sites (Option C): This accurately explains the observation because the enzyme cannot process substrate molecules any faster once every active site is occupied.
Conversion of apoenzyme into holoenzyme (Option D): This process activates enzymes by cofactor binding, but it does not account for the leveling off of reaction velocity with increasing substrate concentration.

Step 5: Draw the conclusion. The constant reaction rate at high substrate concentration clearly indicates complete occupation of enzyme active sites.

Final Answer: Saturation of all active sites

Answer: (C)

Go Back to Question 2

Q3.

Solution

Concept: In angiosperms, the development of the female gametophyte (embryo sac) from the megaspore is a crucial process. This development can follow different patterns, primarily based on the number of megaspores that participate in embryo sac formation.

Solution: Step 1: Understand the initial process. A megaspore mother cell in the ovule undergoes meiosis to produce four haploid megaspores.

Step 2: Identify the fate of the megaspores. The question states that only one megaspore remains functional, and the others degenerate. This functional megaspore then develops into the embryo sac.

Step 3: Define different types of embryo sac development based on the number of functional megaspores:
Monosporic development: In this type, only one megaspore (out of the four produced by meiosis) develops into the embryo sac. The most common example is the Polygonum type.
Bisporic development: In this type, two megaspores (out of the four) participate in the development of the embryo sac.
Tetrasporic development: In this type, all four megaspores fuse or participate in the formation of the embryo sac.

Step 4: Match the described development to the correct term. Since the question explicitly states that "only one megaspore remains functional" and develops into the embryo sac, this directly corresponds to monosporic development.

Step 5: Consider other options.
Bisporic development (Option A): This involves two megaspores.
Tetrasporic development (Option C): This involves four megaspores.
Polyembryony (Option D): This refers to the development of more than one embryo from a single ovule or seed, which is a different phenomenon.

Final Answer: Monosporic development

Answer: (B)

Go Back to Question 3

Q4.

Solution

Concept: The excretory system, particularly the kidneys, plays a vital role in filtering waste products from the blood, maintaining electrolyte balance, and regulating blood volume and pressure. When kidneys fail, these functions are impaired, leading to a buildup of toxins and fluid imbalances.

Solution: Step 1: Analyze the patient's condition. The patient suffers from chronic renal failure, characterized by the accumulation of nitrogenous wastes in the blood (uremia), edema (fluid retention), and electrolyte imbalance. These are all symptoms of impaired kidney function.

Step 2: Understand the recommended procedure. The physician suggests a procedure where blood is circulated through a semipermeable membrane to remove waste substances. This is a method to artificially perform the filtration function of the kidneys.

Step 3: Define the given options:
Ultrafiltration (Option A): This is a process of filtration where a pressure gradient is used to force fluid and small solutes through a semipermeable membrane. While it's a component of kidney function and dialysis, it's not the complete procedure itself.
Hemodialysis (Option B): This is a medical procedure used to remove waste products and excess fluid from the blood when the kidneys are no longer functioning properly. It involves circulating the patient's blood through an artificial kidney (dialyzer) containing a semipermeable membrane, where waste products and excess fluid are removed. This perfectly matches the description in the question.
Tubular secretion (Option C): This is a process in the nephron where certain substances are actively transported from the blood into the renal tubules. It's a natural kidney function, not a procedure for renal failure.
Counter-current mechanism (Option D): This is a physiological mechanism in the kidney's medulla that helps in concentrating urine by creating a concentration gradient. It's a natural kidney function, not an external treatment.

Step 4: Identify the procedure that fits the description. Hemodialysis is specifically designed to replicate the filtering action of healthy kidneys by using a semipermeable membrane to remove waste products from the blood.

Final Answer: Hemodialysis

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept: Mendelian genetics explains how traits are inherited from one generation to the next. Through experiments on pea plants, Gregor Mendel proposed important laws of inheritance.

Solution: Step 1: Recall the basis of a dihybrid cross. Mendel studied the inheritance of two traits together, such as seed shape (round or wrinkled) and seed colour (yellow or green), by crossing plants differing in both characters.

Step 2: Examine the significance of the 9:3:3:1 phenotypic ratio. This characteristic ratio appears in the F_2 generation of a dihybrid cross between two heterozygous parents (for example, RrYy $\times$ RrYy). The ratio can be interpreted as follows:
9/16 represent individuals showing dominant traits for both characters (Round and Yellow).
3/16 represent individuals dominant for the first trait and recessive for the second (Round and green).
3/16 represent individuals recessive for the first trait and dominant for the second (wrinkled and Yellow).
1/16 represent individuals recessive for both traits (wrinkled and green).

Step 3: Relate the ratio to Mendelian inheritance. The appearance of all four combinations in the 9:3:3:1 proportion indicates that the alleles controlling one trait separate independently from the alleles controlling the other trait during gamete formation. This demonstrates Mendel's Law of Independent Assortment.

Step 4: Analyze the given options.
Incomplete dominance (Option A): In this type of inheritance, the heterozygous condition produces an intermediate phenotype, leading to ratios such as 1:2:1 rather than 9:3:3:1.
Law of segregation only (Option B): The Law of Segregation explains the separation of alleles of a single gene but does not fully account for the inheritance pattern of two traits together.
Law of independent assortment (Option C): This principle states that alleles of different genes assort independently during gamete formation, directly producing the 9:3:3:1 ratio in a dihybrid cross.
Linkage between genes (Option D): Linked genes are inherited together more frequently, which would alter the expected 9:3:3:1 ratio and increase parental combinations.

Step 5: Arrive at the conclusion. The observed F_2 ratio strongly supports Mendel's Law of Independent Assortment.

Final Answer: Law of independent assortment

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept: A dorsiventral leaf contains mesophyll tissue differentiated into palisade and spongy parenchyma for photosynthesis and gaseous exchange.

Solution: Step 1: Understand the description. The question mentions:
"compactly arranged cells with chloroplasts near the upper epidermis."
"loosely arranged cells with air spaces towards the lower side."

Step 2: Recall the mesophyll arrangement.
Palisade parenchyma consists of tightly packed chloroplast-rich cells below the upper epidermis.
Spongy parenchyma contains loosely arranged cells with intercellular spaces for gas exchange.

Step 3: Match the features.
Compact chloroplast-rich cells correspond to palisade parenchyma.
Loosely arranged cells with air spaces correspond to spongy parenchyma.

Step 4: Evaluate the options.
Sclerenchyma and collenchyma (Option A): Supportive tissues.
Palisade and spongy parenchyma (Option B): Correct; both match the description.
Epidermis and pericycle (Option C): Pericycle is mainly found in roots and stems.
Xylem and phloem (Option D): Vascular tissues involved in transport.

Step 5: Conclusion. The tissues described are palisade and spongy parenchyma.

Final Answer: Palisade and spongy parenchyma

Answer: (B)

Go Back to Question 6

Q7.

Solution

Concept: Gene therapy is a technique that uses genes to treat or prevent disease. In gene therapy, the faulty gene that causes disease is replaced with a healthy copy. Alternatively, a new gene is introduced into the body to help fight the disease.

Solution: Step 1: Understand the procedure described. A molecular biologist inserted a normal functional gene into the bone marrow cells of a patient with adenosine deaminase (ADA) deficiency. ADA deficiency is a genetic disorder.

Step 2: Define the purpose of the intervention. The goal is to correct the genetic defect by providing a functional copy of the ADA gene, enabling the patient's cells to produce the enzyme and treat the disease.

Step 3: Evaluate the provided options:
Hybridoma technology (Option A): This technology is used to produce monoclonal antibodies by fusing antibody-producing B-cells with myeloma cells. It is unrelated to correcting genetic defects.
Gene therapy (Option B): This is a broad term for techniques that modify a person's genes to treat or cure disease. Inserting a normal gene to correct a genetic deficiency, as described, is a prime example of gene therapy. Specifically, it is a form of somatic gene therapy, as it targets non-reproductive cells.
Somatic hybridization (Option C): This involves the fusion of somatic cells (body cells) from different individuals, typically to create hybrid cells for research or plant breeding. While it involves cell manipulation, it's not the direct correction of a genetic disorder by gene insertion in this manner.
RNA interference (Option D): This is a mechanism for gene silencing where specific RNA molecules are used to block gene expression. It is not used to introduce a functional gene.

Step 4: Identify the correct therapeutic approach. The insertion of a normal functional gene to correct a genetic deficiency is the definition of gene therapy.

Final Answer: Gene therapy

Answer: (B)

Go Back to Question 7

Q8.

Solution

Concept: Ecological succession is the process by which the structure of a biological community evolves over time. It involves the gradual replacement of one community by another. Succession can be classified based on the starting conditions (primary/secondary) and the habitat (hydrarch/xerarch).

Solution: Step 1: Analyze the described scenario. The succession starts in a water body and proceeds through stages: phytoplanktons -> rooted submerged plants -> floating vegetation -> forest communities. This indicates a progression from an aquatic environment towards a terrestrial one.

Step 2: Define the types of ecological succession based on habitat:
Hydrarch succession: This type of succession begins in a wet or aquatic habitat (like a pond, lake, or marsh) and proceeds towards a drier, more terrestrial climax community.
Xerarch succession: This type of succession begins in a dry habitat (like bare rock or sand) and proceeds towards a more moist, mesic climax community.

Step 3: Match the described scenario to the correct type of succession. Since the succession starts in a water body and progresses towards a drier habitat, it is a hydrarch succession. The sequence of communities described—from aquatic plants to eventually forest—is characteristic of how a water body can be filled in and become terrestrial over time.

Step 4: Evaluate the other options:
Xerarch succession (Option A): This occurs in dry habitats, which is the opposite of the scenario described.
Secondary succession (Option C): This occurs in areas where a community previously existed but was disturbed or removed (e.g., after a forest fire or abandonment of farmland). The described scenario is a primary progression in an aquatic environment.
Lithosere succession (Option D): This is a type of xerarch succession that begins on bare rock.

Step 5: Conclude the appropriate term for succession in aquatic habitats leading to terrestrial communities. The progression described is a classic example of hydrarch succession.

Final Answer: Hydrarch succession

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept: Nitrogen fixation is the biological conversion of atmospheric nitrogen gas (N_2) into ammonia (NH_3). This process is carried out by certain microorganisms, some of which live symbiotically in the root nodules of leguminous plants. This conversion requires a specific enzyme complex.

Solution: Step 1: Identify the core process described. The question describes a bacterium that converts atmospheric nitrogen into ammonia in the root nodules of leguminous plants. This is the process of biological nitrogen fixation.

Step 2: Understand the enzyme responsible for nitrogen fixation. Biological nitrogen fixation is catalyzed by a complex enzyme system called nitrogenase. This enzyme is highly conserved among nitrogen-fixing organisms.

Step 3: Recognize the sensitivity of the enzyme to oxygen. The question states that the enzyme complex involved is highly sensitive to oxygen. Nitrogenase is irreversibly inactivated by oxygen, which is why nitrogen-fixing bacteria often have mechanisms to protect the enzyme from atmospheric oxygen (e.g., by living in anaerobic environments like root nodules, or by producing oxygen-scavenging proteins).

Step 4: Evaluate the given enzyme options:
Nitrogenase (Option A): This enzyme complex is directly responsible for the reduction of atmospheric nitrogen to ammonia. It is known to be highly oxygen-sensitive. This fits all aspects of the question.
Rubisco (Ribulose-1,5-bisphosphate carboxylase/oxygenase) (Option B): This enzyme is involved in carbon fixation during the Calvin cycle of photosynthesis. It is not involved in nitrogen fixation.
DNA polymerase (Option C): This enzyme is responsible for synthesizing DNA and is involved in DNA replication. It has no role in nitrogen fixation.
RuBP carboxylase (Option D): This is another name for Rubisco. As explained above, it is involved in carbon fixation, not nitrogen fixation.

Step 5: Conclude which enzyme fits the description. Nitrogenase is the enzyme complex that performs biological nitrogen fixation and is notoriously sensitive to oxygen.

Final Answer: Nitrogenase

Answer: (A)

Go Back to Question 9

Q10.

Solution

Concept: Spermatogenesis is the process of male gamete (sperm) formation in animals. It involves meiosis, a type of cell division that reduces the chromosome number by half and produces four genetically distinct haploid cells.

Solution: Step 1: Understand the process of spermatogenesis. Spermatogenesis begins with diploid spermatogonia, which differentiate into primary spermatocytes.

Step 2: Analyze the meiotic divisions.
A primary spermatocyte is diploid (2n) and undergoes meiosis I. Meiosis I is a reductional division, where homologous chromosomes separate, resulting in two haploid cells. These cells are called secondary spermatocytes.
Each secondary spermatocyte is haploid (n) and undergoes meiosis II. Meiosis II is an equational division, similar to mitosis, where sister chromatids separate. Each secondary spermatocyte divides into two haploid spermatids.

Step 3: Trace the fate of one primary spermatocyte.
1 Primary spermatocyte (2n) $\xrightarrow{\text{Meiosis I}}$ 2 Secondary spermatocytes (n each)
Each of the 2 Secondary spermatocytes (n) $\xrightarrow{\text{Meiosis II}}$ 2 Spermatids (n each)

Step 4: Calculate the total number of spermatids produced from one primary spermatocyte. Since each of the two secondary spermatocytes produces two spermatids, the total number of spermatids from one primary spermatocyte is $2 \times 2 = 4$.

Step 5: Relate spermatids to sperm. Spermatids are immature male gametes that undergo spermiogenesis (a process of differentiation, not division) to mature into functional spermatozoa (sperm).
Therefore, the number of sperm ultimately produced is equal to the number of spermatids.

Step 6: Determine the final number of sperm. From one primary spermatocyte, four spermatids are produced, which mature into four sperm.

Step 7: Evaluate the options. The question asks how many sperms are *ultimately* produced from one primary spermatocyte. This includes the products of both meiotic divisions and subsequent maturation.

Final Answer: Four

Answer: (C)

Go Back to Question 10

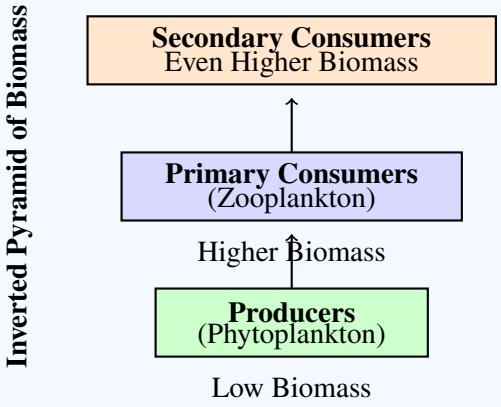
Q11.

Solution

Concept: Ecological pyramids represent the trophic structure of an ecosystem. They can depict the relationship between different trophic levels in terms of numbers of organisms, biomass, or energy.

Solution: Step 1: Understand the situation. The ecosystem has very low producer biomass compared to consumer biomass.

Step 2: Analyze the ecological pyramids.
Pyramid of energy: Always upright because energy decreases at each trophic level.
Pyramid of biomass: Can become inverted, especially in aquatic ecosystems where phytoplankton have low biomass but high turnover, while consumers may show greater biomass.



Pyramid of numbers: Can also be inverted in some ecosystems, but the question specifically concerns biomass.
Pyramid of productivity: Always upright because productivity decreases at higher trophic levels.

Step 3: Apply the concept. Low producer biomass with comparatively higher consumer biomass is typical of aquatic ecosystems showing an inverted biomass pyramid.

Step 4: Conclusion. The ecological pyramid that may appear inverted is the pyramid of biomass.

Final Answer: Pyramid of biomass

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept: DNA replication is a semi-conservative process in which DNA polymerase synthesizes new strands in the 5' to 3' direction.

Solution: Step 1: Recall the nature of DNA strands. The two DNA strands are antiparallel, so replication occurs differently on each strand.

Step 2: Understand the role of DNA polymerase. DNA polymerase can add nucleotides only in the 5' to 3' direction.

Step 3: Compare leading and lagging strand synthesis.
Leading strand: Synthesized continuously toward the replication fork.
Lagging strand: Synthesized discontinuously away from the replication fork in short DNA segments.

Step 4: Identify these short fragments. The discontinuous segments formed on the lagging strand are called Okazaki fragments.

Step 5: Evaluate the options:
Exons (Option A): Coding regions of genes.
Introns (Option B): Non-coding regions removed during RNA processing.
Okazaki fragments (Option C): Correct; short DNA fragments on the lagging strand.
Operons (Option D): Cluster of genes under one promoter.

Step 6: Conclusion. The short discontinuous DNA segments synthesized on the lagging strand are known as Okazaki fragments.

Final Answer: Okazaki fragments

Answer: (C)

Go Back to Question 12

Q13.

Solution

Concept: Plant breeding is the science and art of improving crop plants. It involves developing new varieties with desirable traits such as higher yield, disease resistance, better nutritional quality, and adaptation to various environmental conditions.

Solution: Step 1: Analyze the described crop variety's characteristics. The farmer cultivated a crop variety that exhibited early maturity, disease resistance, and high yield under varying environmental conditions. These are all desirable traits for agricultural improvement.

Step 2: Consider the methods by which such improvements are achieved.
Mutation only (Option A): Mutations are spontaneous changes in DNA. While induced mutations can be used in plant breeding, they are not the sole method for achieving a combination of traits like early maturity, disease resistance, and high yield. Moreover, mutations are random, and selecting for a specific suite of desirable traits often requires deliberate breeding programs.
Plant breeding (Option B): This encompasses a range of techniques, including hybridization (crossing different varieties or species), selection (choosing individuals with desirable traits), backcrossing, and marker-assisted selection, all aimed at developing new crop varieties with improved characteristics. Achieving multiple desirable traits like those mentioned is a hallmark of successful plant breeding programs.
Vegetative propagation (Option C): This is a method of asexual reproduction where new plants are grown from vegetative parts (stems, roots, leaves). It is used to maintain desirable existing varieties but does not inherently introduce new traits or improve them in the way described.
Tissue necrosis (Option D): Tissue necrosis is the death of plant tissue, usually due to disease or injury. This is a negative trait and not a method of improvement.

Step 3: Determine the most comprehensive and appropriate method for achieving multiple desirable traits. Plant breeding is the systematic process that integrates various techniques to achieve significant improvements in crop traits like early maturity, disease resistance, and yield adaptability.

Step 4: Conclude the method of improvement. The development of a crop variety with such combined desirable traits is a direct outcome of plant breeding efforts.

Final Answer: Plant breeding

Answer: (B)

Go Back to Question 13

Q14.

Solution

Concept: Sickle cell anaemia is caused by a mutation in the haemoglobin gene. In malaria-prone regions, heterozygous individuals (HbAS) show increased resistance to malaria.

Solution: Step 1: Understand the situation. The high frequency of HbAS individuals in malaria-endemic regions suggests that this genotype provides a survival advantage.

Step 2: Analyze the role of heterozygotes. Individuals with HbAS are more resistant to malaria than normal homozygotes (HbAA), while also avoiding the severe symptoms seen in HbSS individuals.

Step 3: Evaluate the options:
Genetic drift (Option A): Random change in allele frequency, not related to selective advantage.
Founder effect (Option B): Due to establishment of a population by a small group, not applicable here.
Heterozygote advantage (Option C): Correct; heterozygotes have higher survival in malaria-prone areas.
Artificial selection (Option D): Involves human selection, not natural selection.

Step 4: Conclusion. The persistence of the sickle cell allele in malarial regions is due to heterozygote advantage.

Final Answer: Heterozygote advantage

Answer: (C)

Go Back to Question 14

Q15.

Solution

Concept: In eukaryotic cells, the initial RNA transcript produced during transcription (pre-mRNA or primary transcript) is not yet functional. It undergoes several processing steps in the nucleus before being exported to the cytoplasm as mature messenger RNA (mRNA). These processing steps ensure the mRNA is stable, can be efficiently translated, and contains only the coding sequences.

Solution: Step 1: Understand the process of RNA processing in eukaryotes. After transcription, the primary RNA transcript undergoes modifications to become mature mRNA. These modifications are crucial for gene expression.

Step 2: Identify the key RNA processing events:
Splicing: Eukaryotic genes contain introns (non-coding sequences) interspersed with exons (coding sequences). Splicing removes the introns from the primary transcript and joins the exons together.
Capping: A modified guanine nucleotide (7-methylguanosine cap) is added to the 5' end of the pre-mRNA. This cap protects the mRNA from degradation and is important for ribosome binding during translation.
Polyadenylation: A tail of adenine nucleotides (poly-A tail) is added to the 3' end of the pre-mRNA. This tail also protects the mRNA from degradation and plays a role in translation initiation and termination.

Step 3: Evaluate the given options to identify which process is *not* part of RNA processing:
Splicing (Option A): This is a major step in RNA processing, where introns are removed.
Polyadenylation (Option B): This is another crucial modification at the 3' end of the mRNA.
Capping (Option C): This is the addition of the 5' cap, a critical processing step.
Translation (Option D): Translation is the process of synthesizing a protein from the mature mRNA sequence. It occurs in the cytoplasm *after* RNA processing is complete and the mRNA has been exported from the nucleus. Therefore, translation is not a part of RNA processing.

Step 4: Conclude which option is not a part of RNA processing. Translation is a separate cellular process that follows RNA processing.

Final Answer: Translation

Answer: (D)

Go Back to Question 15

Q16.

Solution

Concept: Human Immunodeficiency Virus (HIV) is a retrovirus that primarily infects cells of the immune system, leading to Acquired Immunodeficiency Syndrome (AIDS). The virus targets specific cells that have particular surface receptors that the virus can bind to.

Solution: Step 1: Understand the target of HIV infection. The question states that HIV infects cells leading to a decline in immunity by destroying helper T-lymphocytes. We need to identify the specific type of T-lymphocyte primarily targeted by HIV.

Step 2: Recall the role of T-lymphocytes in immunity. Helper T-lymphocytes (also known as T_H cells or $CD4^+$ T cells) are crucial components of the adaptive immune system. They help to activate other immune cells, including B cells and cytotoxic T cells.

Step 3: Identify the specific receptor on the targeted cells. HIV primarily infects cells that express the CD4 receptor on their surface. These cells are predominantly helper T-lymphocytes. The virus uses its gp120 surface protein to bind to the CD4 receptor.

Step 4: Evaluate the given cell types:
CD8 cells (Option A): $CD8^+$ T cells are cytotoxic T-lymphocytes, which kill infected cells. While they are part of the immune response, they are not the primary target of HIV.
CD4 cells (Option B): $CD4^+$ T cells (helper T-lymphocytes) are the main target of HIV. Their destruction by the virus leads to immunodeficiency. This perfectly matches the description.
Plasma cells (Option C): Plasma cells are differentiated B cells that produce antibodies. They are not the primary target of HIV infection.
Mast cells (Option D): Mast cells are involved in allergic responses and inflammation and are not the primary target of HIV.

Step 5: Conclude which cells are primarily targeted by HIV. HIV primarily targets $CD4^+$ T cells (helper T-lymphocytes) due to their expression of the CD4 receptor.

Final Answer: CD4 cells

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept: Frederick Griffith's experiment in 1928 with Streptococcus pneumoniae (pneumococcus bacteria) provided early evidence for the existence of a genetic material. He observed that non-virulent bacteria could acquire the virulent trait from dead virulent bacteria.

Solution: Step 1: Understand Griffith's experiment. Griffith worked with two strains of Streptococcus pneumoniae: the virulent S strain (smooth colonies) and the non-virulent R strain (rough colonies). He performed several experiments:
Injecting living S strain into mice caused pneumonia and death.
Injecting living R strain into mice did not cause disease.
Injecting heat-killed S strain into mice did not cause disease.
Injecting a mixture of living R strain and heat-killed S strain into mice caused pneumonia and death.

Step 2: Analyze the key observation. When living R strain bacteria were mixed with heat-killed virulent S strain bacteria, the R strain bacteria were somehow converted into virulent S strain bacteria. The mice that received this mixture died, and live virulent S strain bacteria were recovered from them.

Step 3: Identify the phenomenon demonstrated. Griffith concluded that some "transforming principle" from the dead S strain bacteria had transferred the genetic information for virulence to the living R strain bacteria, transforming them into virulent S strain. This process of genetic alteration by the uptake of external DNA is known as transformation.

Step 4: Evaluate the given options:
Translation (Option A): Translation is the process of synthesizing proteins from mRNA. It is not a mechanism of genetic transfer between bacteria.
Transduction (Option B): Transduction is the transfer of bacterial DNA from one bacterium to another via a bacteriophage (a virus that infects bacteria). This was not involved in Griffith's experiment.
Transformation (Option C): Transformation is the uptake of naked DNA from the environment by a bacterial cell, leading to a heritable change in the cell's genotype. This perfectly describes the phenomenon observed by Griffith.
Conjugation (Option D): Conjugation is the direct transfer of genetic material from one bacterial cell to another through cell-to-cell contact, often involving a pilus. This mechanism was not demonstrated in Griffith's experiment.

Step 5: Conclude the phenomenon demonstrated by Griffith's experiment. The experiment demonstrated the process of transformation.

Final Answer: Transformation

Answer: (C)

Go Back to Question 17

Q18.

Solution

Concept: Pollination is the transfer of pollen from an anther to a stigma. Self-pollination (transfer of pollen to the stigma of the same flower or another flower on the same plant) can be prevented by various mechanisms. Dichogamy is one such mechanism that deals with the temporal separation of maturation of anthers and stigma within a flower.

Solution: Step 1: Understand the context. The question describes flowers that have both male (androecium) and female (gynoecium) reproductive parts but are prevented from self-pollination due to differences in maturation timing.

Step 2: Define the given terms related to pollination mechanisms:
Herkogamy (Option A): This refers to spatial separation of anthers and stigma within a flower, making self-pollination physically difficult.
Dichogamy (Option B): This is the temporal separation of the maturation of the androecium and gynoecium within the same flower. There are two types:
Protandry: Anthers mature and release pollen before the stigma becomes receptive.
Protogyny: Stigma becomes receptive before the anthers release pollen.
This fits the description in the question.
Cleistogamy (Option C): This is when flowers remain permanently closed, ensuring self-pollination. It is the opposite of what is described.
Apomixis (Option D): This is asexual reproduction that mimics sexual reproduction, where seeds are produced without fertilization. It's not directly related to the timing of anther and stigma maturation preventing self-pollination.

Step 3: Match the described condition with the correct term. The scenario where "temporal differences in maturation of stamens and stigma" prevents self-pollination describes dichogamy.

Step 4: Conclude the correct term. The condition described is dichogamy.

Final Answer: Dichogamy

Answer: (B)

Go Back to Question 18

Q19.

Solution

Concept: Sex-linked inheritance refers to the inheritance of genes located on the sex chromosomes (X and Y). In humans, X-linked inheritance patterns are common, with traits predominantly affecting males because they have only one X chromosome.

Solution: Step 1: Analyze the pedigree pattern described. The trait appears predominantly in males and is transmitted from carrier mothers to sons.

Step 2: Evaluate the possible inheritance patterns:
Autosomal dominant (Option A): In autosomal dominant inheritance, affected individuals typically have at least one affected parent, and both males and females are affected roughly equally. A trait would not appear predominantly in males, nor would it be transmitted specifically from carrier mothers to sons in this manner.
Autosomal recessive (Option B): In autosomal recessive inheritance, affected individuals often have unaffected parents (who are carriers). Both males and females are affected roughly equally. While a carrier mother can pass the recessive allele to her son, leading to him being affected, it doesn't inherently explain the predominant appearance in males unless there are other factors.
X-linked recessive (Option C): This pattern fits the description perfectly.
Predominantly in males: Males have only one X chromosome. If they inherit an affected X chromosome (carrying the recessive allele), they will express the trait because there is no corresponding allele on the Y chromosome to mask it. Females have two X chromosomes; therefore, they would need to inherit the recessive allele on both X chromosomes to be affected. Thus, X-linked recessive traits are much more common in males.
Transmission from carrier mothers to sons: A carrier mother has one normal X chromosome and one X chromosome with the recessive allele. She passes one of her X chromosomes to her son. If she passes the X chromosome carrying the recessive allele, the son will be affected.
Y-linked inheritance (Option D): Y-linked traits are passed directly from father to all his sons. They do not appear in females, and they are not transmitted from mothers. This does not fit the described pattern.

Step 3: Conclude the most likely inheritance pattern. The combination of predominantly affected males and transmission from carrier mothers to sons is characteristic of X-linked recessive inheritance.

Final Answer: X-linked recessive

Answer: (C)

Go Back to Question 19

Q20.

Solution

Concept: Muscle contraction is regulated by actin, myosin, tropomyosin, and troponin. Calcium ions help expose the myosin-binding sites on actin.

Solution: Step 1: Understand the role of calcium ions. During contraction, Ca^{2+} binds to a protein on the thin filament, causing tropomyosin to shift and expose active sites on actin.

Step 2: Recall the regulatory proteins.
Tropomyosin blocks myosin-binding sites on actin in a resting muscle.
Troponin is attached to tropomyosin, and its troponin C subunit binds calcium ions.

Step 3: Explain the mechanism. Calcium ions released from the sarcoplasmic reticulum bind to troponin, causing a conformational change that moves tropomyosin away from the active sites on actin. This allows myosin heads to attach and initiate contraction.

Step 4: Evaluate the options:
Myosin (Option A): Motor protein responsible for force generation.
Troponin (Option B): Correct; binds calcium ions and regulates contraction.
Actinin (Option C): Structural protein of Z-discs.
Titin (Option D): Elastic protein providing support to muscle fibres.

Step 5: Conclusion. Troponin is the protein that binds calcium ions during muscle contraction.

Final Answer: Troponin

Answer: (B)

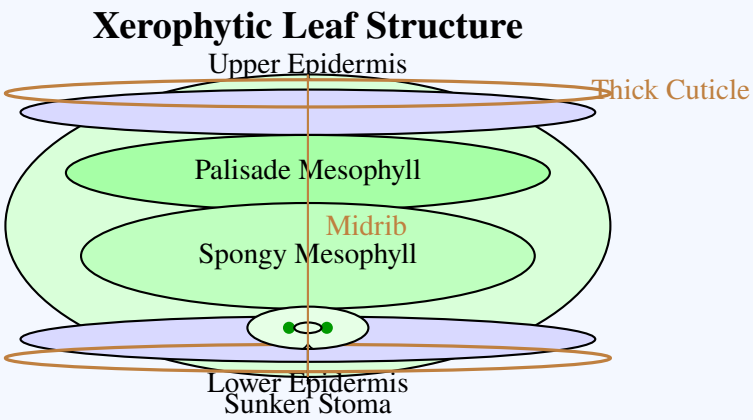
Go Back to Question 20

Q21.

Solution

Concept: Xerophytes are plants adapted to arid or desert environments where water is scarce. They exhibit various morphological and physiological adaptations to minimize water loss and maximize water uptake and storage.

Solution: Step 1: Analyze the xerophytic adaptations described. The plant shows:
Thick cuticle: Reduces water loss from the plant surface.
Sunken stomata: Trap moist air around stomata and reduce transpiration.
Reduced leaf surface area: Minimizes the area available for water loss.



Step 2: Understand the major challenge in xerophytes. Desert plants face severe water scarcity and must prevent dehydration.

Step 3: Relate the adaptations to their function. Thick cuticle, sunken stomata, and reduced leaf area all help in lowering transpiration and conserving water.

Step 4: Evaluate the options:
Increasing transpiration (Option A): Incorrect; these adaptations reduce transpiration.
Enhancing mineral absorption (Option B): Related mainly to roots, not leaf adaptations.
Reducing water loss (Option C): Correct; all features help conserve water.
Promoting guttation (Option D): Incorrect; guttation is unrelated to these xerophytic features.

Step 5: Conclusion. These adaptations mainly help the plant reduce water loss in dry conditions.

Final Answer: Reducing water loss

Answer: (C)

Go Back to Question 21

Q22.

Solution

Concept: Glycolysis is the initial stage of cellular respiration, occurring in the cytoplasm. It breaks down one molecule of glucose (a 6-carbon sugar) into two molecules of pyruvate (a 3-carbon molecule). This process involves a series of enzymatic reactions that produce a net gain of ATP and NADH.

Solution: Step 1: Understand the process of glycolysis. Glycolysis can be divided into two main phases:
Energy investment phase: In this phase, 2 ATP molecules are consumed to activate the glucose molecule and prepare it for cleavage.
Energy payoff phase: In this phase, the split glucose molecule is further processed, leading to the production of ATP and NADH.

Step 2: Calculate the ATP produced through substrate-level phosphorylation.
For each molecule of glucose, two molecules of pyruvate are formed.
In the energy payoff phase, there are two steps where ATP is generated via substrate-level phosphorylation:
Conversion of 1,3-bisphosphoglycerate to 3-phosphoglycerate: 1 ATP produced per pyruvate molecule. Since there are two pyruvate molecules, this yields $2 \times 1 = 2$ ATP.
Conversion of phosphoenolpyruvate to pyruvate: 1 ATP produced per pyruvate molecule. Since there are two pyruvate molecules, this yields $2 \times 1 = 2$ ATP.
Thus, a total of $2 + 2 = 4$ ATP molecules are produced in the energy payoff phase.

Step 3: Calculate the net gain of ATP. The gross production of ATP is 4 molecules. However, 2 ATP molecules were consumed in the energy investment phase.
Net gain of ATP = Gross ATP produced - ATP consumed
Net gain of ATP = $4 - 2 = 2$ ATP molecules per glucose molecule.

Step 4: Evaluate the options. The question asks for the net gain of ATP molecules produced directly through substrate-level phosphorylation per glucose molecule.

Final Answer: 2 ATP

Answer: (B)

Go Back to Question 22

Q23.

Solution

Concept: Ascent of sap is the upward movement of water and minerals through xylem, mainly driven by transpiration pull.

Solution: Step 1: Analyze the observation. A leafy shoot continued to absorb water even after its roots were removed.

Step 2: Compare the mechanisms.
Root pressure (Option A): Requires roots and cannot explain continued absorption after root removal.
Capillarity (Option B): Helps water movement in xylem but is insufficient alone in tall plants.
Transpiration pull (Option C): Correct; evaporation of water from leaves creates a pulling force that draws water upward through xylem.
Imbibition (Option D): Involves absorption of water by solids and is not responsible for long-distance water transport.

Step 3: Conclusion. Since water absorption continued without roots, the ascent of sap is mainly due to transpiration pull.

Final Answer: Transpiration pull

Answer: (C)

Go Back to Question 23

Q24.

Solution

Concept: Operons are clusters of genes in bacteria that are transcribed together under the control of a single promoter. They are regulated by repressor proteins and activators, allowing bacteria to efficiently express genes only when needed. The lac operon is a classic example of an inducible operon involved in lactose metabolism.

Solution: Step 1: Understand the characteristics of the lac operon. The lac operon in *E. coli* is responsible for the breakdown of lactose. Its expression is regulated in response to the presence or absence of lactose and glucose.
In the presence of glucose: The lac operon is generally repressed, even if lactose is present. Glucose is the preferred energy source, so the cell doesn't need to break down lactose.
In the absence of glucose and presence of lactose: The lac operon is induced. Lactose is metabolized, and the genes for lactose breakdown are expressed.

Step 2: Analyze the observation in the question. The scientist observed that lactose utilization genes were expressed only in the presence of lactose and absence of glucose. This is the hallmark of the lac operon's regulatory mechanism.

Step 3: Evaluate the given operon types and genetic elements:
Trp operon (Option A): The Trp operon is a repressible operon involved in tryptophan synthesis. It is switched OFF when tryptophan levels are high and switched ON when tryptophan levels are low. This is different from the described mechanism.
Lac operon (Option B): This operon is inducible. It is normally OFF but is switched ON in the presence of lactose (inducer) and, importantly, when glucose (preferred energy source) is absent. This exactly matches the observed regulatory mechanism.
Split genes (Option C): Split genes are found in eukaryotes, where a gene consists of exons and introns. This is a structural feature of genes, not a regulatory mechanism for operons.
Repetitive DNA (Option D): Repetitive DNA sequences are non-coding regions found in genomes. They are not directly involved in the operon regulation described.

Step 4: Conclude the operon associated with the observed regulation. The described regulatory mechanism, where genes are expressed only in the presence of lactose and absence of glucose, is characteristic of the lac operon.

Final Answer: Lac operon

Answer: (B)

Go Back to Question 24

Q25.

Solution

Concept: Meiosis is a type of cell division that reduces the number of chromosomes by half, producing gametes. Crossing over, which occurs during prophase I of meiosis, is the exchange of genetic material between homologous chromosomes. This exchange is a significant source of genetic variation.

Solution: Step 1: Understand the process of crossing over. During prophase I of meiosis, homologous chromosomes pair up (synapsis) and form bivalents. At points called chiasmata, segments of non-sister chromatids from homologous chromosomes are exchanged.

Step 2: Analyze the outcome of crossing over. When segments of homologous chromosomes are exchanged, new combinations of alleles are formed on those chromosomes. For example, if one chromosome has alleles A and B, and its homolog has alleles a and b, after crossing over between these genes, one chromosome might carry A and b, and the other a and B.

Step 3: Relate this outcome to genetic variation. The creation of new combinations of alleles on chromosomes is the definition of genetic recombination. This process shuffles genes between homologous chromosomes, leading to offspring with combinations of traits different from those of their parents.

Step 4: Evaluate the given options:
DNA replication (Option A): DNA replication occurs before meiosis begins, during the S phase of interphase. Crossing over happens during meiosis itself and does not involve replication.
Mutation repair (Option B): While some DNA repair mechanisms exist, crossing over is not primarily a DNA repair process. Its main function is generating new genetic combinations.
Genetic recombination (Option C): This is the process by which genetic material is exchanged between different chromosomes or different regions of the same chromosome, resulting in new combinations of genes. Crossing over is a major mechanism of genetic recombination during meiosis.
Cytokinesis (Option D): Cytokinesis is the division of the cytoplasm, which usually follows nuclear division (karyokinesis) in meiosis. Crossing over occurs during nuclear division and is distinct from cytoplasmic division.

Step 5: Conclude the contribution of crossing over. The exchange of genetic material at chiasmata during crossing over is a fundamental mechanism for generating genetic recombination.

Final Answer: Genetic recombination

Answer: (C)

Go Back to Question 25

Q26.

Solution

Concept: Ecosystems are characterized by complex interactions between living organisms and their environment. Feeding relationships are a key aspect of these interactions, describing how energy flows through the ecosystem.

Solution: Step 1: Analyze the description of the ecosystem. The marine ecosystem contains organisms that occupy multiple trophic levels due to their omnivorous feeding habits. This implies that organisms consume from different trophic levels, creating interconnected feeding relationships.

Step 2: Define the given ecological terms:
Ecological pyramid (Option A): This is a graphical representation of the relationship between successive trophic levels in an ecosystem, showing biomass, numbers, or energy. It represents a simplified linear flow, not interconnectedness.
Food web (Option B): A food web is a complex network of interconnected food chains, showing the feeding relationships between different organisms in an ecosystem. It illustrates how energy flows through multiple pathways, often with omnivorous organisms connecting different trophic levels. This perfectly matches the description.
Ecotone (Option C): An ecotone is a transitional area between two different ecosystems, such as a forest and a grassland. It has characteristics of both adjacent ecosystems.
Biome (Option D): A biome is a large geographical area characterized by specific climate conditions and dominant plant and animal communities (e.g., desert biome, tropical rainforest biome). It is a broader classification than the feeding relationships within a single ecosystem.

Step 3: Match the description to the correct term. The interconnected feeding relationships arising from omnivorous habits that lead organisms to occupy multiple trophic levels form a food web.

Step 4: Conclude the correct term. The interconnected feeding relationships described constitute a food web.

Final Answer: Food web

Answer: (B)

Go Back to Question 26

Q27.

Solution

Concept: Amniocentesis is a prenatal diagnostic technique used to detect certain genetic abnormalities and chromosomal disorders in a fetus. It involves obtaining a sample of amniotic fluid surrounding the fetus.

Solution: Step 1: Understand the nature and purpose of amniocentesis. The question mentions that it's a procedure for pregnant women, used under medical necessity, and has ethical concerns due to indiscriminate use. This suggests it's a diagnostic tool for fetal health.

Step 2: Describe the procedure of amniocentesis. Amniocentesis involves inserting a thin needle through the mother's abdomen and uterine wall into the amniotic sac to withdraw a small amount of amniotic fluid. This fluid contains fetal cells shed from the skin, digestive tract, and urinary tract.

Step 3: Explain what is done with the amniotic fluid. The fetal cells obtained from the amniotic fluid are then cultured and analyzed for chromosomal abnormalities (like Down syndrome, caused by trisomy 21), genetic disorders (like cystic fibrosis or sickle cell anaemia), and other fetal conditions.

Step 4: Evaluate the given options based on the procedure:
Examination of embryo after birth (Option A): Amniocentesis is a prenatal diagnostic procedure performed *before* birth.
Analysis of amniotic fluid cells (Option B): This accurately describes the core of the amniocentesis procedure. The fluid is collected, and cells within it are analyzed.
Direct gene insertion into fetus (Option C): This refers to gene therapy, a different medical intervention that might be used to treat genetic disorders, but it's not what amniocentesis is for.
Artificial insemination (Option D): This is a method of assisted reproduction where sperm is directly introduced into a woman's uterus. It is unrelated to amniocentesis.

Step 5: Conclude the primary action of amniocentesis. The procedure's main component is the analysis of cells obtained from the amniotic fluid.

Final Answer: Analysis of amniotic fluid cells

Answer: (B)

Go Back to Question 27

Q28.

Solution

Concept: The Bohr effect explains how increased CO_2 concentration and lower pH reduce the affinity of haemoglobin for oxygen, promoting oxygen release in tissues.

Solution: Step 1: Understand oxygen transport. Haemoglobin carries oxygen from lungs to tissues, and its oxygen affinity changes with physiological conditions.

Step 2: Analyze tissue conditions. Actively respiring tissues produce more CO_2, which forms carbonic acid and lowers blood pH.

Step 3: Recall the effect on haemoglobin. Higher CO_2 and lower pH decrease haemoglobin's affinity for oxygen, causing easier oxygen release to tissues.

Step 4: Compare the options.
Haldane effect (Option A): Related to CO_2 transport, not oxygen release due to pH changes.
Bohr effect (Option B): Correct; explains increased oxygen dissociation at high CO_2 and low pH.
Root effect (Option C): Seen mainly in fish haemoglobin.
Donnan effect (Option D): Related to ion distribution across membranes.

Step 5: Conclusion. The described phenomenon is the Bohr effect.

Final Answer: Bohr effect

Answer: (B)

Go Back to Question 28

Q29.

Solution

Concept: Plasmids are commonly used as cloning vectors because they replicate independently and can carry foreign DNA into bacterial cells.

Solution: Step 1: Recall the role of cloning vectors. A cloning vector must replicate inside the host cell and help identify transformed cells.

Step 2: Identify important plasmid features. Plasmids contain an origin of replication, selectable markers, and restriction sites for insertion of foreign DNA.

Step 3: Compare the options.
Presence of ribosomes (Option A): Ribosomes belong to cells, not plasmids.
Antibiotic resistance markers (Option B): Correct; they help identify bacteria carrying recombinant plasmids.
Ability to synthesize proteins (Option C): Protein synthesis is performed by the host cell.
Presence of lysosomes (Option D): Lysosomes are absent in bacteria and unrelated to plasmids.

Step 4: Conclusion. Antibiotic resistance markers make plasmids effective cloning vectors by enabling selection of transformed cells.

Final Answer: Antibiotic resistance markers

Answer: (B)

Go Back to Question 29

Q30.

Solution

Concept: The origin of life is a fundamental question in biology. Various hypotheses have been proposed to explain how life arose from non-living matter on early Earth.

Solution: Step 1: Understand the core question about the origin of life. The question asks for the name of the hypothesis proposing that life originated from pre-existing non-living organic molecules under primitive Earth conditions.

Step 2: Analyze the options:
Theory of spontaneous generation (Option A): This theory, disproven by Pasteur, suggested that life could arise spontaneously from non-living matter (e.g., maggots from decaying meat). While it involves non-living matter, it was a general idea about *ongoing* abiogenesis, not specifically the origin of life from complex organic molecules under primitive Earth conditions.
Chemical evolution theory (Option B): Also known as the Oparin-Haldane hypothesis, this theory proposes that life arose through a gradual process of chemical evolution. It suggests that under the conditions of early Earth (reducing atmosphere, energy sources like lightning and UV radiation), simple inorganic molecules could have reacted to form complex organic molecules (like amino acids and nucleotides), which then assembled into more complex structures, eventually leading to self-replicating systems and the first primitive life forms. This aligns perfectly with the description.
Biogenesis theory (Option C): This theory states that all life arises from pre-existing life ("Omne vivum ex vivo"). This is in direct contrast to the origin of life from non-living matter.
Catastrophism (Option D): This geological theory, proposed by Cuvier, suggests that Earth's geological features were shaped by sudden, violent, and short-lived events (like floods or volcanic eruptions). While such events might have influenced early Earth conditions, it is not a theory about the origin of life itself.

Step 3: Identify the theory that matches the description. The chemical evolution theory (or abiogenesis via chemical evolution) is the hypothesis that life originated from non-living organic molecules formed under primitive Earth conditions.

Final Answer: Chemical evolution theory

Answer: (B)

Go Back to Question 30

Q31.

Solution

Concept: Pollen viability refers to the ability of pollen grains to germinate and fertilize an ovule. This ability is influenced by several environmental and genetic factors, with temperature and humidity being particularly crucial for maintaining viability.

Solution: Step 1: Understand pollen viability. Pollen viability is the length of time pollen remains capable of germination. It varies significantly among plant species. Some pollen loses viability within minutes of shedding, while others can remain viable for months or even years under controlled conditions.

Step 2: Analyze the given examples. The question contrasts a species with very short pollen viability (minutes) with cereals, which have long viability (months) under proper storage. This implies that environmental conditions play a major role.

Step 3: Consider the factors affecting pollen viability.
Temperature: High temperatures generally decrease pollen viability, while low temperatures can preserve it.
Humidity: Very low humidity can cause pollen to dry out and lose viability quickly. High humidity can promote germination prematurely or lead to fungal growth.
Genetics: The species' genetic makeup determines its inherent potential for pollen longevity.
Storage conditions: Proper storage conditions aim to optimize these factors.

Step 4: Evaluate the options:
pH of soil (Option A): Soil pH is primarily related to nutrient availability for roots and plant growth, not directly to pollen viability after shedding.
Temperature and humidity (Option B): These are the most critical environmental factors that influence the rate of metabolic activity and desiccation in pollen grains, thus directly affecting their viability. Proper storage conditions aim to optimize these factors.
Rate of transpiration (Option C): Transpiration is the loss of water vapor from plants, mainly through leaves. While related to water balance, it doesn't directly affect the viability of shed pollen grains.
Nitrogen fixation (Option D): Nitrogen fixation is the conversion of atmospheric nitrogen into ammonia, essential for plant nutrition. It has no direct impact on pollen viability after release.

Step 5: Conclude the primary factor affecting pollen viability. Temperature and humidity are the most significant environmental factors that determine how long pollen remains viable.

Final Answer: Temperature and humidity

Answer: (B)

Go Back to Question 31

Q32.

Solution

Concept: Blood clotting is a protective mechanism that prevents excessive blood loss through a series of reactions involving clotting factors, many of which are synthesized in the liver with the help of vitamin K.

Solution: Step 1: Understand the condition. The patient has defective blood clotting due to deficiency of a plasma protein produced in the liver and dependent on vitamin K.

Step 2: Recall the role of vitamin K. Vitamin K is required for the synthesis of important clotting factors such as prothrombin (Factor II).

Step 3: Compare the options.
Albumin (Option A): Maintains osmotic balance; not involved in clotting.
Globulin (Option B): Mainly involved in immunity and transport functions.
Prothrombin (Option C): Correct; a vitamin K-dependent clotting factor converted into thrombin during coagulation.
Fibrinogen (Option D): Forms fibrin threads but is not the primary vitamin K-dependent factor referred to here.

Step 4: Final conclusion. Deficiency of prothrombin leads to impaired blood clotting.

Final Answer: Prothrombin

Answer: (C)

Go Back to Question 32

Q33.

Solution

Concept: Biogas is a renewable energy source produced from the anaerobic decomposition of organic matter, such as animal manure, plant waste, and sewage, by methanogenic bacteria. The primary component of biogas is methane.

Solution: Step 1: Understand the process of biogas production. Biogas is generated through anaerobic digestion, a microbial process where organic matter is broken down in the absence of oxygen. Methanogenic bacteria play a key role in the final stages of this decomposition.

Step 2: Identify the gases produced during anaerobic digestion. The decomposition process involves several steps carried out by different groups of microorganisms. Initially, complex organic matter is broken down into simpler organic acids, alcohols, and carbon dioxide. In the final stage, methanogenic archaea convert these products into methane (CH_4) and carbon dioxide (CO_2).

Step 3: Determine the major component of biogas. While biogas contains several gases, methane is the primary combustible component and the one that gives biogas its energy value. Biogas typically consists of 50-75% methane, 25-45% carbon dioxide, and smaller amounts of other gases like hydrogen sulphide (H_2S), nitrogen (N_2), and hydrogen (H_2).

Step 4: Evaluate the given options:
Carbon dioxide (Option A): Carbon dioxide is a significant component of biogas, but it is usually the second most abundant gas, not the major one.
Methane (Option B): Methane is the primary combustible gas and is present in the highest proportion in biogas, making it the major component.
Hydrogen sulphide (Option C): Hydrogen sulphide is often present in small amounts and is responsible for the characteristic smell of biogas. It is usually removed because it is corrosive and toxic.
Nitrogen (Option D): Nitrogen can be present in small amounts, especially if air leaks into the digester, but it is not a major component derived from the anaerobic digestion of organic matter.

Step 5: Conclude the major component of biogas. Methane is the most abundant and energetically significant gas in biogas.

Final Answer: Methane

Answer: (B)

Go Back to Question 33

Q34.

Solution

Concept: Mutations are changes in the DNA sequence. They can range from small alterations in a single nucleotide to large-scale changes in chromosomes. Mutations that affect a single nucleotide pair are called point mutations.

Solution: Step 1: Understand the definition of mutation. A mutation is a permanent alteration in the DNA sequence that makes up a gene.

Step 2: Analyze the described mutation. The question states that a mutation in a single nucleotide pair resulted in the substitution of one amino acid in the polypeptide chain.

Step 3: Evaluate the types of mutations:
Frameshift mutation (Option A): Frameshift mutations occur due to insertions or deletions of nucleotides that are not multiples of three. These mutations shift the reading frame of the genetic code, altering all amino acids downstream of the mutation site. This is different from a single amino acid substitution.
Point mutation (Option B): A point mutation is a change in a single nucleotide base in the DNA sequence. This can involve substitution (one base is replaced by another), insertion (an extra base is added), or deletion (a base is removed). A substitution point mutation can lead to the substitution of a single amino acid in the resulting protein (a missense mutation). This matches the description perfectly.
Chromosomal inversion (Option C): Chromosomal inversion is a mutation where a segment of a chromosome is reversed end to end. This involves large segments of DNA and multiple genes, not a single nucleotide pair.
Polyploidy (Option D): Polyploidy is the condition of having more than two complete sets of chromosomes. This is a change in chromosome number, not a change in a single nucleotide pair.

Step 4: Conclude the classification of the described mutation. A mutation that results in the substitution of a single amino acid due to a change in a single nucleotide pair is classified as a point mutation.

Final Answer: Point mutation

Answer: (B)

Go Back to Question 34

Q35.

Solution

Concept: In ecology, carrying capacity (K) refers to the maximum population size of a biological species that can be sustained by the environment, given the available resources (food, habitat, water, etc.) and the services of that ecosystem.

Solution: Step 1: Understand the scenario. A population maintains a relatively stable size despite fluctuations in environmental conditions, and this stability is attributed to the "carrying capacity of the habitat."

Step 2: Define carrying capacity. Carrying capacity (K) is the maximum population size that an environment can sustain indefinitely, given the food, habitat, water, and other necessities available in that environment. When a population reaches its carrying capacity, its growth rate slows down and eventually stabilizes, often fluctuating around K.

Step 3: Evaluate the given options:
Maximum number of predators present (Option A): The number of predators influences the population size of their prey, but it is not the definition of carrying capacity itself. Carrying capacity is determined by the *overall* resource availability and environmental limitations.
Total genetic variability of population (Option B): Genetic variability is important for a population's ability to adapt, but it does not define the maximum sustainable population size.
Maximum sustainable population size (Option C): This is the precise definition of carrying capacity. It represents the largest population that the environment can support over the long term without degrading the resources it depends on.
Rate of migration in ecosystem (Option D): Migration (immigration and emigration) affects population size, but carrying capacity is a property of the environment's ability to support a population, regardless of migration rates.

Step 4: Conclude the correct definition of carrying capacity. Carrying capacity refers to the maximum number of individuals of a species that an environment can support sustainably.

Final Answer: Maximum sustainable population size

Answer: (C)

Go Back to Question 35

Q36.

Solution

Concept: The endosymbiotic theory, proposed by Lynn Margulis, explains the origin of eukaryotic organelles like mitochondria and chloroplasts. It suggests that these organelles were once free-living prokaryotic organisms that were engulfed by ancestral eukaryotic cells and established a symbiotic relationship.

Solution: Step 1: Analyze the key observations about chloroplasts and mitochondria. The scientist discovered that these organelles possess:
Their own DNA.
Their own ribosomes.
The ability to replicate independently within the cell.

Step 2: Understand the implications of these observations. The presence of independent DNA and ribosomes suggests that these organelles have their own genetic material and protein synthesis machinery, similar to free-living organisms. Their ability to replicate independently further supports this idea.

Step 3: Evaluate the proposed theories:
Lamarckism (Option A): Lamarckism proposed that acquired characteristics are heritable. This theory is largely discredited and does not explain the origin of organelles.
Endosymbiotic theory (Option B): This theory states that mitochondria and chloroplasts originated from prokaryotes that were engulfed by ancestral eukaryotic cells. These engulfed prokaryotes then lived symbiotically within the host cell, eventually evolving into the organelles we see today. The observations of independent DNA, ribosomes, and replication are strong evidence for this theory, as they resemble features of free-living bacteria.
Mutation theory (Option C): Mutation theory, associated with Hugo de Vries, explains the origin of new species through sudden, large changes in genetic material (mutations). It does not explain the origin of organelles like mitochondria and chloroplasts from other organisms.
Germplasm theory (Option D): Proposed by August Weismann, this theory distinguished between germ cells (which carry hereditary information) and somatic cells, stating that changes in somatic cells are not inherited. It does not address the origin of organelles.

Step 4: Conclude which theory is strongly supported by the observations. The independent DNA, ribosomes, and replication capability of mitochondria and chloroplasts are direct evidence supporting the endosymbiotic theory.

Final Answer: Endosymbiotic theory

Answer: (B)

Go Back to Question 36

Q37.

Solution

Concept: The human female reproductive cycle, or menstrual cycle, is a series of natural changes in hormone production and the structures of the uterus and ovaries of the female reproductive system that make pregnancy possible. Ovulation, the release of a mature egg from the ovary, is a key event in this cycle.

Solution: Step 1: Understand the human female reproductive cycle. The cycle is typically around 28 days long and involves distinct phases: menstruation, the follicular phase (where follicles develop), ovulation, and the luteal phase (where the corpus luteum functions).

Step 2: Identify the event of ovulation. Ovulation is the release of a secondary oocyte from a mature ovarian follicle (Graafian follicle). This event is triggered by a surge in luteinizing hormone (LH).

Step 3: Determine the timing of ovulation within a typical cycle.
The menstrual cycle begins on the first day of menstruation (Day 1).
The follicular phase involves the development of follicles under the influence of follicle-stimulating hormone (FSH).
The LH surge, which triggers ovulation, typically occurs around the middle of the cycle. In a standard 28-day cycle, this surge happens approximately 24-36 hours before ovulation.
Therefore, ovulation itself occurs around the 14th day of a 28-day cycle.

Step 4: Evaluate the given options:
1st day: This is the start of menstruation.
7th day: This is during the follicular phase, before ovulation.
14th day: This is the typical day for ovulation in a 28-day cycle.
28th day: This is typically the start of the next menstrual period if fertilization does not occur.

Step 5: Conclude the approximate day of ovulation. Ovulation occurs around the 14th day of a typical 28-day menstrual cycle.

Final Answer: 14th day

Answer: (C)

Go Back to Question 37

Q38.

Solution

Concept: Gel electrophoresis is a technique used to separate macromolecules, such as DNA, RNA, and proteins, based on their size and electrical charge. DNA fragments are separated by applying an electric field across a gel matrix.

Solution: Step 1: Understand the principle of gel electrophoresis for DNA. DNA molecules are polymers of nucleotides. Each nucleotide consists of a deoxyribose sugar, a phosphate group, and a nitrogenous base. The phosphate groups are negatively charged at physiological pH.

Step 2: Analyze the charge of DNA molecules. Due to the presence of negatively charged phosphate groups in their backbone, DNA molecules carry an overall negative charge. The charge-to-mass ratio of DNA fragments is relatively constant.

Step 3: Explain the movement of DNA during electrophoresis. In gel electrophoresis, an electric field is applied across the gel. The negatively charged DNA molecules will migrate towards the positive electrode (anode). The gel matrix acts as a sieve, slowing down larger fragments more than smaller fragments, thus separating them by size.

Step 4: Evaluate the options in relation to the charge of DNA fragments:
Positive charge due to histones (Option A): DNA in eukaryotes is associated with positively charged histone proteins, forming nucleosomes. However, in typical DNA gel electrophoresis (especially of purified DNA fragments), histones are usually removed or not present in significant amounts that would alter the overall charge. Furthermore, the primary charge of DNA itself comes from its phosphate backbone.
Neutral phosphate backbone (Option B): This is incorrect. The phosphate backbone is negatively charged.
Negative charge due to phosphate groups (Option C): This is correct. The repetitive phosphate groups in the DNA backbone give DNA molecules a strong negative charge. This negative charge is responsible for their migration towards the positive anode in an electric field.
Lipid-rich structure (Option D): DNA is not lipid-rich; it is a nucleic acid composed of nucleotides. Lipids are fats and oils and have different properties.

Step 5: Conclude the reason for DNA fragment movement. The negative charge of the phosphate groups in the DNA backbone causes DNA fragments to migrate towards the anode during gel electrophoresis.

Final Answer: Negative charge due to phosphate groups

Answer: (C)

Go Back to Question 38

Q39.

Solution

Concept: The immune system has a remarkable ability to "remember" past encounters with pathogens. This memory allows for a faster, stronger, and more effective response upon subsequent exposure to the same antigen. This is known as the secondary immune response.

Solution: Step 1: Understand the difference between primary and secondary immune responses.
Primary immune response: Occurs upon the first exposure to an antigen. It is characterized by a lag phase, a slow rise in antibody levels, and a relatively low peak antibody concentration, followed by a decline. This response is mediated by naive B cells and T cells.
Secondary immune response: Occurs upon subsequent exposures to the same antigen. It is much faster, stronger, and longer-lasting than the primary response. It is characterized by a shorter lag phase, a more rapid and significant increase in antibody levels (especially IgG), and a higher peak antibody concentration.

Step 2: Identify the cellular basis of the secondary immune response. The rapid and enhanced response during the secondary exposure is due to the presence of memory cells. These are long-lived lymphocytes (both B cells and T cells) that were generated during the primary response. Upon re-exposure to the antigen, these memory cells are quickly activated and proliferate, leading to a much more robust immune reaction.

Step 3: Evaluate the given options:
Innate immunity (Option A): Innate immunity is the body's first line of defense, providing a non-specific, immediate response. It does not involve immunological memory.
Memory cells (Option B): These are the specialized lymphocytes that are primed to recognize specific antigens after a primary exposure and mount a rapid and amplified secondary response. This is the direct cause of the observed phenomenon.
Inflammation (Option C): Inflammation is a local response to injury or infection, characterized by redness, swelling, heat, and pain. While it is part of the immune response, it is not the primary mechanism responsible for the enhanced antibody production in a secondary response.
Passive immunity (Option D): Passive immunity is acquired by receiving antibodies from an external source (e.g., maternal antibodies or antibody injections). It provides immediate but temporary protection and does not involve the development of immunological memory.

Step 4: Conclude the reason for the enhanced secondary immune response. The rapid and amplified antibody production upon subsequent exposure to an antigen is a hallmark of immunological memory, mediated by memory cells.

Final Answer: Memory cells

Answer: (B)

Go Back to Question 39

Q40.

Solution

Concept: Heterosis, also known as hybrid vigor, is a phenomenon in plant and animal breeding where the offspring of a cross between two different inbred lines (or parent strains) exhibit enhanced or superior traits compared to either parent.

Solution: Step 1: Analyze the scenario described. A plant breeder crossed two pure lines and observed superior traits in the F1 progeny, specifically increased yield and disease resistance. This indicates that the hybrid offspring are better than the parental lines.

Step 2: Define the phenomenon of superior hybrid performance. When the F1 generation resulting from a cross between two distinct parent strains shows improved traits (such as increased vigor, growth rate, yield, fertility, or disease resistance) compared to both parents, this phenomenon is called heterosis or hybrid vigor.

Step 3: Evaluate the given options:
Inbreeding depression (Option A): Inbreeding depression is the opposite of heterosis. It is the reduced biological fitness of a population resulting from increased homozygosity due to inbreeding, which often leads to the expression of deleterious recessive alleles.
Heterosis (Option B): This term directly describes the superior performance of hybrid offspring over their parents, including increased yield and disease resistance, as observed in the F1 generation.
Polyploidy (Option C): Polyploidy is the condition of having more than two complete sets of chromosomes. While it can sometimes lead to larger size and increased vigor in plants, it is a change in chromosome number and not the direct term for hybrid superiority resulting from crossing distinct lines.
Mutation breeding (Option D): Mutation breeding involves inducing mutations to create genetic variation and then selecting for desirable traits. While it aims to improve crop varieties, the specific phenomenon of superior hybrid performance from crossing pure lines is not called mutation breeding.

Step 4: Conclude the term for superior hybrid performance. The observed phenomenon of superior traits in the F1 progeny from crossing two pure lines is termed heterosis.

Final Answer: Heterosis

Answer: (B)

Go Back to Question 40

Q41.

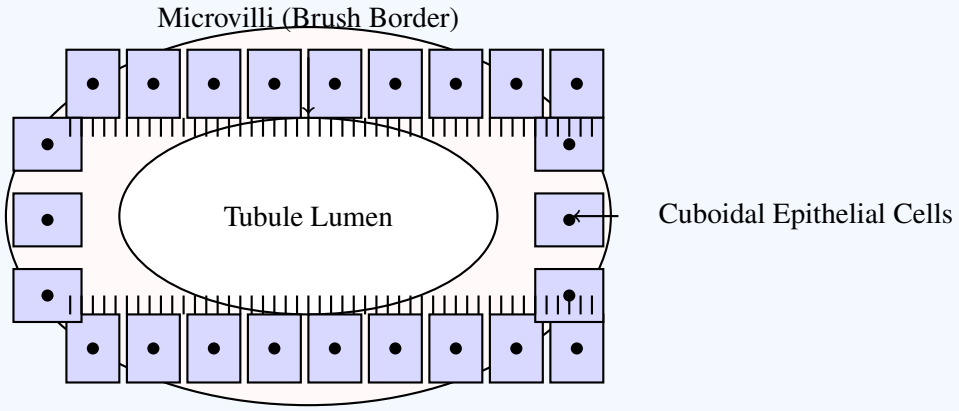
Solution

Concept: The nephron is the functional unit of the kidney, responsible for filtering blood and producing urine. Selective reabsorption of essential substances from the glomerular filtrate back into the blood occurs along different segments of the nephron. The proximal convoluted tubule (PCT) is a major site for this reabsorption.

Solution: Step 1: Identify the location and function. Selective reabsorption of glucose, amino acids, and ions mainly occurs in the proximal convoluted tubule (PCT), requiring efficient absorption.

Step 2: Recall the epithelial lining. The PCT is lined by simple cuboidal epithelium with a brush border (microvilli) that increases surface area for reabsorption.

Simple Cuboidal Epithelium with Microvilli



Step 3: Recall the role of microvilli. They increase surface area for efficient reabsorption, and PCT cells also contain many mitochondria to support active transport.

Step 4: Compare the options.
Squamous epithelium (Option A): Thin layer for diffusion, not reabsorption.
Cuboidal epithelium with microvilli (Option B): Correct; specialized for absorption with increased surface area.
Stratified epithelium (Option C): Protective, not involved in renal reabsorption.
Ciliated epithelium (Option D): Used for movement of material, not present in PCT.

Step 5: Final conclusion. The PCT is lined by cuboidal epithelium with microvilli.

Final Answer: Cuboidal epithelium with microvilli

Answer: (B)

Go Back to Question 41

Q42.

Solution

Concept: Charles Darwin's voyage on HMS Beagle, particularly his observations of the Galapagos Islands, provided crucial evidence for his theory of evolution by natural selection. His studies of finches on these islands were pivotal.

Solution: Step 1: Understand the context of Darwin's observations. Darwin observed variations among finches on different Galapagos islands. He noted that the beak shapes and sizes of these finches were adapted to the specific food sources available on their respective islands. For example, finches on islands with hard seeds had thicker, stronger beaks, while those on islands with insects had thinner, pointed beaks.

Step 2: Connect these observations to evolutionary concepts. Darwin inferred that these variations were not random but were shaped by the environment. Finches with beak shapes better suited to their food sources were more likely to survive, reproduce, and pass on their advantageous traits to their offspring. Over generations, this differential survival and reproduction led to the diversification of finches into different species, each adapted to its specific island environment.

Step 3: Identify the evolutionary mechanism that explains this process.
Mutation theory (Option A): This theory, later proposed by de Vries, emphasizes large, sudden changes (mutations) as the source of variation. While mutations are the ultimate source of variation, Darwin's focus was on the selection of existing variations.
Natural selection (Option B): This is the core of Darwin's theory. It is the process whereby organisms better adapted to their environment tend to survive and produce more offspring. The variations observed in finches, which were advantageous for survival and reproduction in their specific island niches, are a classic example of natural selection at work.
Germplasm inheritance (Option C): Weismann's germplasm theory distinguished between heritable germ cells and non-heritable somatic cells. It relates to the mechanism of inheritance but not the driving force behind the observed adaptations.
Catastrophism (Option D): This geological theory explains landforms through sudden, catastrophic events, not the gradual adaptation of species.

Step 4: Conclude the concept formulated by Darwin based on these observations. Darwin's observations of finch beak variations and their adaptations to different food sources led him to formulate the concept of natural selection as the primary mechanism of evolution.

Final Answer: Natural selection

Answer: (B)

Go Back to Question 42

Q43.

Solution

Concept: The relationship between genes and phenotypic traits is not always one-to-one. Some genes can influence multiple traits, while multiple genes can contribute to a single trait.

Solution: Step 1: Understand the scenario. A geneticist observed that a single gene influenced multiple phenotypic traits simultaneously.

Step 2: Define the genetic terms provided:
Polygenic inheritance (Option A): This occurs when multiple genes contribute to a single phenotypic trait (e.g., height, skin color). This is the opposite of the described phenomenon.
Pleiotropy (Option B): This is the phenomenon where a single gene locus affects multiple, often seemingly unrelated, phenotypic traits. This directly matches the description in the question.
Codominance (Option C): Codominance is a type of inheritance where both alleles of a gene pair are fully expressed in the heterozygote, resulting in a phenotype that shows both traits simultaneously (e.g., AB blood type). This describes the expression of two alleles of a single gene, not one gene affecting multiple traits.
Epistasis (Option D): Epistasis occurs when the expression of one gene masks or modifies the expression of another gene. This involves interactions between different genes, not one gene affecting multiple traits.

Step 3: Match the definition to the observed phenomenon. The observation that a single gene influences multiple phenotypic traits is the definition of pleiotropy.

Final Answer: Pleiotropy

Answer: (B)

Go Back to Question 43

Q44.

Solution

Concept: Transcription is the process of synthesizing RNA from a DNA template. This process is initiated when the enzyme RNA polymerase binds to a specific DNA sequence called a promoter.

Solution: Step 1: Understand the process of transcription. Transcription begins with the binding of RNA polymerase to the DNA template. This binding is not random; it occurs at specific sites that signal the start of a gene.

Step 2: Identify the DNA sequence that initiates transcription. The sequence of DNA to which RNA polymerase binds to initiate transcription is called a promoter. Promoters are typically located upstream of the gene they regulate.

Step 3: Evaluate the given options:
Terminator (Option A): The terminator is a DNA sequence that signals the end of transcription, causing RNA polymerase to detach from the DNA template.
Operator (Option B): The operator is a DNA sequence, often found in prokaryotic operons, that serves as a binding site for a repressor protein. Binding of the repressor to the operator can block transcription. It is involved in regulation but is not the primary site for RNA polymerase binding to initiate transcription.
Promoter (Option C): This is the DNA sequence that serves as the binding site for RNA polymerase, initiating the process of transcription. This perfectly matches the description.
Enhancer (Option D): Enhancers are regulatory DNA sequences that can increase the rate of transcription. They often bind transcription factors and can be located far from the gene they regulate. While involved in regulating transcription, they are not the primary initiation site for RNA polymerase binding.

Step 4: Conclude the name of the sequence where RNA polymerase binds to start transcription. This sequence is called the promoter.

Final Answer: Promoter

Answer: (C)

Go Back to Question 44

Q45.

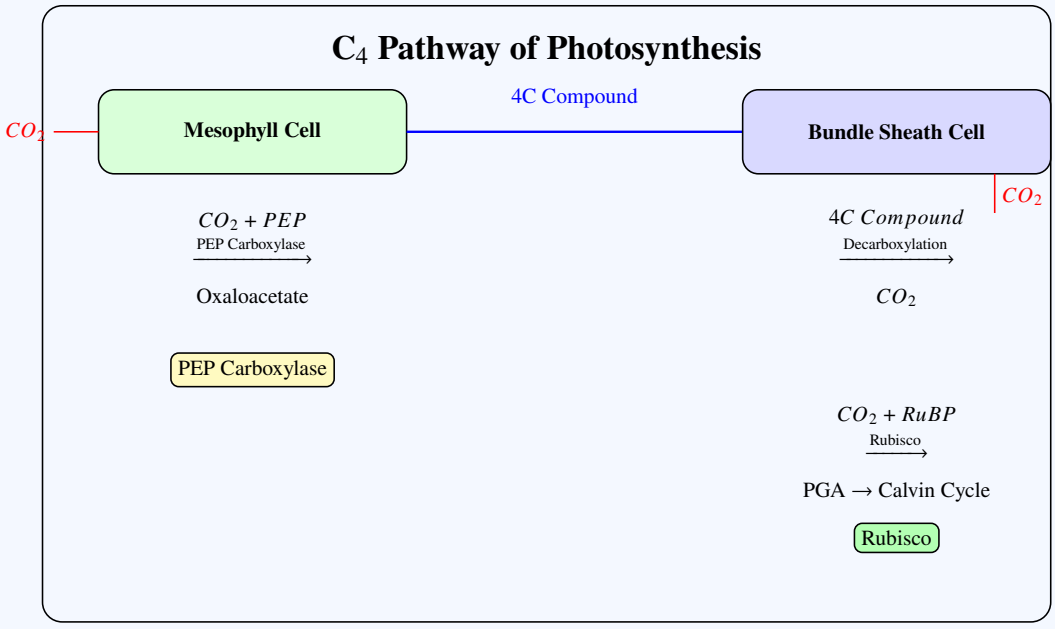
Solution

Concept: C4 plants have a specialized photosynthetic pathway that minimizes photorespiration, particularly in hot and dry environments. This pathway involves spatial separation of initial carbon fixation and the Calvin cycle, utilizing different enzymes in different cell types.

Solution: Step 1: Understand C_4 photosynthesis. C_4 plants reduce photorespiration by separating the initial fixation of CO_2 and the Calvin cycle into different cells.

Step 2: Recall the process of carbon fixation in C_4 plants.

In mesophyll cells, CO_2 is first fixed by the enzyme PEP carboxylase, which has a high affinity for CO_2 and does not bind oxygen. This forms a 4-carbon compound that is transported to the bundle sheath cells. In bundle sheath cells, the compound releases CO_2, which is then used by Rubisco in the Calvin cycle.



Step 3: Evaluate the given enzymes:

(a) Rubisco (Option A): Functions in the Calvin cycle but does not perform the initial CO_2 fixation in C_4 plants.

(b) PEP carboxylase (Option B): Correct option. It carries out the first fixation of CO_2 in mesophyll cells to form a 4-carbon compound.

(c) ATP synthase (Option C): Involved in ATP formation, not carbon fixation.

(d) NAD reductase (Option D): Participates in electron transfer reactions, not CO_2 fixation.

Step 4: Conclude the answer. The enzyme responsible for the initial fixation of CO_2 in C_4 plants is PEP carboxylase.

Final Answer: PEP carboxylase

Answer: (B)

Go Back to Question 45

Q46.

Solution

Concept: Cellular respiration is the process by which cells generate ATP. Oxidative phosphorylation, occurring in the mitochondria, is the primary ATP-producing stage, involving the electron transport chain and chemiosmosis. The inner mitochondrial membrane, folded into cristae, is the site of oxidative phosphorylation.

Solution: Step 1: Understand the structure and function of mitochondria. Mitochondria are often called the "powerhouses" of the cell. They are responsible for generating most of the cell's ATP through cellular respiration. The inner mitochondrial membrane is folded into cristae, which significantly increase the surface area for the enzymes and protein complexes involved in oxidative phosphorylation.

Step 2: Analyze the patient's condition. The patient experiences muscular fatigue and reduced ATP production, and laboratory investigations reveal dysfunction of the cristae in mitochondria.

Step 3: Relate cristae dysfunction to cellular respiration stages.
Glycolysis (Option A): Glycolysis occurs in the cytoplasm and breaks down glucose into pyruvate. It is not directly dependent on mitochondrial cristae.
Krebs cycle (Option B): The Krebs cycle (citric acid cycle) occurs in the mitochondrial matrix. While it produces NADH and $FADH_2$ that are used in oxidative phosphorylation, the cycle itself does not directly depend on the cristae structure.
Oxidative phosphorylation (Option C): This process involves the electron transport chain (ETC) and ATP synthesis via chemiosmosis. The ETC complexes and ATP synthase are embedded within the inner mitochondrial membrane, which forms the cristae. Dysfunction of the cristae directly impairs the function of these components, severely affecting ATP production.
Fermentation (Option D): Fermentation is an anaerobic process that occurs in the cytoplasm when oxygen is absent. It follows glycolysis and regenerates NAD^+ but produces far less ATP than aerobic respiration. It is not dependent on mitochondria.

Step 4: Conclude the process directly affected by cristae dysfunction. Dysfunction of the cristae, the folds of the inner mitochondrial membrane, would directly and severely impact oxidative phosphorylation, the main ATP-generating process in aerobic respiration.

Final Answer: Oxidative phosphorylation

Answer: (C)

Go Back to Question 46

Q47.

Solution

Concept: Double fertilization is a unique event in angiosperms. It involves the fusion of one male gamete with the egg cell to form the zygote and the fusion of the second male gamete with the central cell (containing two polar nuclei) to form the primary endosperm nucleus.

Solution: Step 1: Understand double fertilization in angiosperms. Double fertilization involves two fusion events:
1. Male gamete (n) + Egg cell (n) $\rightarrow$ Zygote (2n)
2. Male gamete (n) + Two polar nuclei (n + n) $\rightarrow$ Primary endosperm nucleus (typically 3n)

Step 2: Determine the ploidy of the endosperm. The primary endosperm nucleus is formed by the fusion of three haploid (n) nuclei: one male gamete and two polar nuclei from the central cell. Therefore, the primary endosperm nucleus is typically triploid (3n). This triploid nucleus then divides mitotically to form the endosperm tissue.

Step 3: Evaluate the options for the ploidy of the endosperm.
Haploid (Option A): Haploid means having a single set of chromosomes (n).
Diploid (Option B): Diploid means having two sets of chromosomes (2n). The zygote is diploid.
Triploid (Option C): Triploid means having three sets of chromosomes (3n). This is the typical ploidy of the endosperm in most angiosperms due to double fertilization.
Tetraploid (Option D): Tetraploid means having four sets of chromosomes (4n). While some exceptions might exist, triploid is the most common and generally formed ploidy.

Step 4: Conclude the ploidy of the endosperm formed in angiosperms. The endosperm in angiosperms is generally triploid (3n).

Final Answer: Triploid

Answer: (C)

Go Back to Question 47

Q48.

Solution

Concept: Parasitic plants are plants that derive some or all of their nutritional requirements from another living plant (the host). They possess specialized structures to tap into the host's vascular system.

Solution: Step 1: Understand the characteristics of a parasitic plant. The question describes a parasitic plant that lacks chlorophyll (meaning it cannot photosynthesize and is completely or partially dependent on a host) and obtains nutrition from host plants using specialized sucking roots that penetrate host tissues.

Step 2: Define the specialized root structures of parasitic plants. Parasitic plants develop specialized organs called haustoria (singular: haustorium) which are root-like structures that emerge from the stem or root of the parasite and penetrate the tissues of the host plant. Haustoria tap into the host's xylem and/or phloem to absorb water, minerals, and/or organic nutrients.

Step 3: Evaluate the given options:
Prop roots (Option A): Prop roots are adventitious roots that grow downwards from the stem, providing additional support to the plant, especially in plants like maize. They are not involved in parasitism.
Pneumatophores (Option B): Pneumatophores are specialized root-like structures that grow upwards from the soil surface in mangrove plants. They facilitate aeration of the submerged roots. They are not involved in parasitism.
Haustoria (Option C): These are the specialized sucking roots of parasitic plants that penetrate the host tissues to absorb nutrients. This perfectly matches the description.
Stilt roots (Option D): Stilt roots are adventitious roots that grow from the lower part of the stem, providing support, similar to prop roots, found in plants like mangroves and pandanus. They are not involved in parasitism.

Step 4: Conclude the name of the specialized sucking roots. The specialized sucking roots of parasitic plants are called haustoria.

Final Answer: Haustoria

Answer: (C)

Go Back to Question 48

Q49.

Solution

Concept: Arteries are blood vessels that carry oxygenated blood (except for the pulmonary artery) away from the heart to the rest of the body. They operate under high pressure due to the pumping action of the heart. Their structure is adapted to withstand and manage this high pressure.

Solution: Step 1: Understand the function of arteries. Arteries transport blood under high pressure from the heart. This high pressure is due to the forceful ejection of blood from the ventricles during each heartbeat.

Step 2: Recall the structure of an artery wall. The wall of an artery is composed of three layers:
Tunica intima: The innermost layer, consisting of endothelium.
Tunica media: The middle layer, which is the thickest. It contains smooth muscle and elastic fibers. The smooth muscle allows arteries to constrict or dilate, regulating blood flow. The elastic fibers allow the artery to stretch and recoil with each pulse of blood.
Tunica externa (adventitia): The outermost layer, composed of connective tissue.

Step 3: Analyze how the structure withstands high pressure. The thick, elastic, and muscular tunica media is crucial for arteries to withstand the high pressure. The elasticity allows them to expand when blood is pumped into them and recoil when the pressure drops, helping to maintain blood flow. The muscular component allows for regulation of blood pressure and flow.

Step 4: Evaluate the given options:
Thin walls with valves (Option A): Thin walls would not withstand high pressure. Valves are found in veins and the heart, not in arteries (except for the semilunar valves at the origin of the aorta and pulmonary artery from the ventricles, but these are heart valves, not within the arterial wall itself for systemic pressure management).
Thick elastic muscular walls (Option B): This description accurately reflects the tunica media, which is responsible for the strength, elasticity, and pressure-handling capacity of arteries.
Presence of cilia (Option C): Cilia are hair-like structures involved in movement of substances along surfaces, found in tissues like the respiratory tract or fallopian tubes. They are not found in arteries.
Discontinuous endothelium (Option D): The endothelium lining arteries is continuous to form a smooth inner surface for blood flow. A discontinuous endothelium would be inefficient and could lead to leakage.

Step 5: Conclude the structural feature enabling arteries to withstand high pressure. The thick, elastic, and muscular walls of arteries, primarily the tunica media, are essential for handling high blood pressure.

Final Answer: Thick elastic muscular walls

Answer: (B)

Go Back to Question 49

Q50.

Solution

Concept: Restriction endonucleases, or restriction enzymes, are enzymes that cut DNA at specific recognition nucleotide sequences known as restriction sites. They are fundamental tools in molecular biology and recombinant DNA technology.

Solution: Step 1: Understand the function of restriction endonucleases. These enzymes act like molecular scissors, recognizing specific short DNA sequences and cleaving the DNA molecule at or near these sites. This allows for the cutting of DNA into manageable fragments for analysis or manipulation.

Step 2: Recall the recognition sequence of EcoRI. EcoRI is a widely used restriction enzyme derived from *Escherichia coli*. It recognizes a palindromic DNA sequence. Palindromic sequences read the same forwards and backward on opposite strands.

Step 3: Determine the recognition sequence of EcoRI. EcoRI recognizes the sequence:
5'-GAATTC-3'
3'-CTTAAG-5'
EcoRI typically cuts between the G and A on both strands, producing "sticky ends" (short, single-stranded overhangs).

Step 4: Evaluate the given options:
5'-AAGCTT-3' (Option A): This is the recognition sequence for HindIII.
5'-GGATCC-3' (Option B): This is the recognition sequence for BamHI.
5'-GAATTC-3' (Option C): This is the recognition sequence for EcoRI.
5'-CTGCAG-3' (Option D): This is the recognition sequence for PstI.

Step 5: Conclude the recognition sequence for EcoRI. The sequence recognized by EcoRI is 5'-GAATTC-3'.

Final Answer: 5'-GAATTC-3'

Answer: (C)

Go Back to Question 50

Q51.

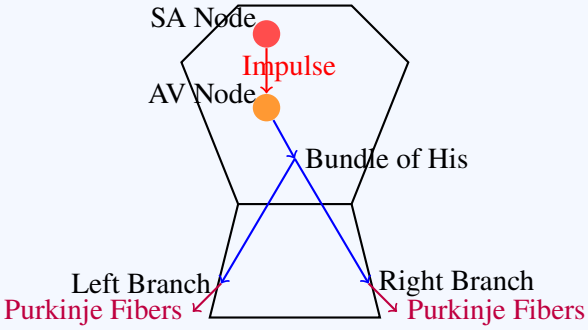
Solution

Concept: The human heart has an intrinsic conducting system that generates and transmits electrical impulses, leading to coordinated contractions of the atria and ventricles. This system ensures efficient pumping of blood.

Solution: Step 1: Recall the cardiac conduction system. It coordinates heartbeat by generating and conducting electrical impulses so that atria contract before ventricles.

Step 2: Identify its main parts.
SA node: Natural pacemaker located in the right atrium.
AV node: Delays impulse and passes it to ventricles.
Bundle of His: Conducts impulse from AV node into septum.
Bundle branches: Carry impulse down the septum.
Purkinje fibres: Distribute impulse through ventricular walls to trigger contraction.

Cardiac Conduction System



Step 3: Identify the natural pacemaker of the heart. The SA node has the highest rate of spontaneous depolarization (60–100 bpm), so it initiates and controls the heartbeat. The AV node (40–60 bpm) and Purkinje fibres (20–40 bpm) act as slower backup pacemakers.

Step 4: Compare the options.
AV node (Option A): Secondary pacemaker, not primary.
Bundle of His (Option B): Conducts impulses, does not generate them.
Purkinje fibres (Option C): Ventricular conduction system; can act as last-resort pacemaker.
SA node (Option D): Primary pacemaker due to highest firing rate and rhythm control.

Final Answer: SA node

Answer: (D)

Go Back to Question 51

Q52.

Solution

Concept: Secondary growth is the increase in girth or diameter of stems and roots in dicotyledonous plants and gymnosperms. It is brought about by the activity of the vascular cambium and cork cambium.

Solution: Step 1: Understand secondary growth in dicot stems. Secondary growth involves the formation of secondary xylem and secondary phloem by the vascular cambium.
The vascular cambium is a lateral meristem that lies between the primary xylem and primary phloem. It produces new vascular tissue: secondary xylem towards the inside and secondary phloem towards the outside.

Step 2: Analyze the fate of secondary xylem. Continuous deposition of secondary xylem forms the bulk of the wood. In temperate regions, the rate of wood formation varies with seasons.
During spring, when water is abundant and temperatures are favorable, the vascular cambium produces larger, thin-walled xylem vessels, forming spring wood (or early wood).
During summer or autumn, when conditions are less favorable, the vascular cambium produces smaller, thick-walled xylem vessels, forming summer wood (or late wood).

Step 3: Relate seasonal wood formation to annual rings. The distinct layers of spring wood and summer wood formed in a year, when viewed in a cross-section of the stem, appear as concentric rings. Each pair of spring wood and summer wood constitutes one annual ring, which indicates one year of growth.

Step 4: Evaluate the options:
Cork cambium (Option A): Cork cambium is another lateral meristem responsible for producing cork and secondary cortex (periderm). It is distinct from the consequence of secondary xylem deposition.
Annual rings (Option B): The continuous deposition of secondary xylem, with variations due to seasonal changes, leads to the formation of annual rings, which are characteristic of secondary growth in woody stems. This matches the description.
Root hairs (Option C): Root hairs are outgrowths of epidermal cells in the root, involved in water and mineral absorption. They are not related to secondary growth in stems.
Companion cells (Option D): Companion cells are associated with sieve elements in the phloem and are involved in phloem loading and unloading. They are part of the vascular tissue but do not form annual rings.

Final Answer: Annual rings

Answer: (B)

Go Back to Question 52

Q53.

Solution

Concept: The Hardy-Weinberg principle describes the genetic makeup of a population that is not evolving. It states that allele and genotype frequencies in a population will remain constant from generation to generation in the absence of other evolutionary influences.

Solution: Step 1: Understand the Hardy-Weinberg equilibrium conditions. The principle states that allele and genotype frequencies remain constant under the following five conditions:
1. No mutation
2. Random mating
3. No gene flow (migration)
4. No genetic drift (large population size)
5. No natural selection

Step 2: Identify factors that disturb the equilibrium. Any deviation from these five conditions will lead to a change in allele frequencies, meaning evolution is occurring.

Step 3: Evaluate the options to find a factor that disturbs the equilibrium:
Random mating (Option A): Random mating is one of the conditions *required* for Hardy-Weinberg equilibrium. Non-random mating (like assortative mating) can disturb equilibrium, but random mating itself does not.
Large population size (Option B): A large population size is required to minimize the effects of genetic drift, which is a random fluctuation of allele frequencies. Therefore, a large population size maintains equilibrium, it doesn't disturb it.
Gene migration (Option C): Gene migration (or gene flow) is the movement of alleles into or out of a population. This introduces new alleles or changes the frequencies of existing alleles, thus disturbing the Hardy-Weinberg equilibrium.
Lack of selection (Option D): Lack of selection means that all genotypes have equal survival and reproductive rates. This is a condition *required* for Hardy-Weinberg equilibrium. The presence of natural selection would disturb it.

Step 4: Conclude the factor that disturbs the Hardy-Weinberg equilibrium. Gene migration (gene flow) is a factor that directly alters allele frequencies and thus disturbs the equilibrium.

Final Answer: Gene migration

Answer: (C)

Go Back to Question 53

Q54.

Solution

Concept: The Human Genome Project (HGP) was an international scientific research project with the goal of determining the sequence of nucleotide base pairs that make up human DNA, and identifying and mapping all of the genes of the human genome from both a physical and a functional standpoint.

Solution: Step 1: Understand the objective of the Human Genome Project. The HGP aimed to sequence the entire human genome, which is the complete set of genetic information in an organism.

Step 2: Recall the scale of the human genome. The human genome is vast and contains billions of base pairs.

Step 3: Approximate the number of base pairs in the human genome. The human genome consists of approximately 3 billion (3×10^9) base pairs. This includes both coding regions (genes) and non-coding regions.

Step 4: Evaluate the options:
3 thousand (Option A): This is far too small for a genome.
3 million (Option B): This is also significantly smaller than the actual size of the human genome.
3 billion (Option C): This number (3×10^9) is the widely accepted approximation for the number of base pairs in the human genome.
30 billion (Option D): This is larger than the actual size of the human genome.

Step 5: Conclude the approximate number of base pairs in the human genome. The human genome contains approximately 3 billion base pairs.

Final Answer: 3 billion

Answer: (C)

Go Back to Question 54

Q55.

Solution

Concept: Plant hormones, or phytohormones, are chemical signals produced by plants that regulate growth and development. Different hormones have distinct functions.

Solution: Step 1: Analyze the observed effects of the plant hormone. The gardener observed the following effects:
Promoted stem elongation.
Breaking of seed dormancy.
Bolting in rosette plants (rapid stem elongation and flowering).

Step 2: Recall the functions of major plant hormones:
Cytokinin (Option A): Primarily promotes cell division and differentiation, delays senescence (aging of leaves). It does not significantly promote stem elongation or breaking of seed dormancy.
Ethylene (Option B): Primarily promotes fruit ripening, abscission (leaf and fruit drop), and senescence. It can inhibit stem elongation in some cases.
Gibberellin (Option C): Gibberellins (GAs) are a group of hormones that promote stem elongation, induce seed germination by breaking dormancy, and cause bolting in rosette plants. These effects precisely match the observations.
Abscisic acid (ABA) (Option D): Abscisic acid is generally an inhibitory hormone. It promotes dormancy (in seeds and buds) and closes stomata in response to stress. It is antagonistic to gibberellins regarding seed dormancy and germination.

Step 3: Match the observed effects with the hormone functions. The promotion of stem elongation, breaking of seed dormancy, and bolting are all characteristic functions of gibberellins.

Step 4: Conclude the identity of the hormone. The hormone responsible for these effects is gibberellin.

Final Answer: Gibberellin

Answer: (C)

Go Back to Question 55

Q56.

Solution

Concept: Animals living in extreme environments often exhibit behavioral or physiological adaptations to cope with harsh conditions, such as extreme temperatures.

Solution: Step 1: Analyze the described behavior. Desert animals avoid extreme daytime heat by remaining inactive in burrows and becoming active during cooler night hours.

Step 2: Define the given terms related to animal adaptations:
Migration (Option A): Migration is the seasonal movement of animals from one region to another in search of food, better climate, or breeding grounds. This is a movement, not a daily inactivity pattern.
Hibernation (Option B): Hibernation is a state of prolonged inactivity and lowered metabolic rate during winter months, typically to conserve energy and survive cold temperatures. This is a seasonal response to cold.
Nocturnality (Option C): Nocturnality refers to animals that are primarily active during the night and rest during the day. This behavior is an adaptation to avoid daytime heat and predators active during the day. It perfectly matches the description of desert animals being inactive during the day and active at night to avoid heat.
Aestivation (Option D): Aestivation is a state of prolonged inactivity and lowered metabolic rate during hot or dry periods, typically to survive summer heat and drought. While it is a response to heat, it refers to a prolonged state of dormancy, not necessarily nightly activity patterns.

Step 3: Match the observed behavior with the correct term. The behavior of being inactive during the hot daytime and active at night is known as nocturnality.

Final Answer: Nocturnality

Answer: (C)

Go Back to Question 56

Q57.

Solution

Concept: Chromosomal disorders result from abnormalities in chromosome number or structure, often leading to characteristic clinical features.

Solution: Step 1: Note the key findings in the patient.
Short stature
Webbed neck
Underdeveloped ovaries
Absence of Barr body
Monosomy of sex chromosomes

Step 2: Interpret the cytogenetic evidence.
Absence of Barr body indicates only one X chromosome is present (XO condition).
Monosomy of sex chromosomes confirms loss of one sex chromosome.
The clinical features strongly suggest a sex chromosome disorder.

Step 3: Compare with the options.
Klinefelter syndrome (Option A): XXY males with a Barr body and tall stature; does not match.
Turner syndrome (Option B): XO females with short stature, webbed neck, streak ovaries, and absence of Barr body; matches all features.
Down syndrome (Option C): Trisomy 21, an autosomal disorder unrelated to sex chromosomes.
Edwards syndrome (Option D): Trisomy 18, also an autosomal disorder unrelated to the given findings.

Step 4: Conclusion. The findings are diagnostic of Turner syndrome (XO).

Final Answer: Turner syndrome

Answer: (B)

Go Back to Question 57

Q58.

Solution

Concept: Ecological succession is the process of change in the species structure of an ecological community over time. Primary succession begins in environments devoid of life, such as bare rock, where soil needs to be formed.

Solution: Step 1: Understand the concept of ecological succession and pioneer species. Ecological succession describes the process by which a community develops over time. Pioneer species are the first to colonize a barren environment.

Step 2: Analyze the scenario described. The succession begins on bare rocks, where lichens are the pioneer species. Lichens are capable of surviving harsh conditions and play a role in breaking down rocks to initiate soil formation.

Step 3: Define the different types of sere (successions) based on the habitat:
Hydrosere (Option A): Succession starting in an aquatic environment (e.g., pond).
Lithosere (Option B): Succession starting on bare rock (litho- refers to rock). This perfectly matches the scenario.
Halosere (Option C): Succession starting in saline habitats (e.g., salt marshes).
Psammosere (Option D): Succession starting on sand (psammo- refers to sand).

Step 4: Match the pioneer species and habitat to the correct sere. Succession that begins on naked rocks, with lichens as pioneers, is specifically termed a lithosere.

Final Answer: Lithosere

Answer: (B)

Go Back to Question 58

Q59.

Solution

Concept: Polymerase Chain Reaction (PCR) is a powerful laboratory technique used to amplify a specific segment of DNA. It involves repeated cycles of DNA denaturation, primer annealing, and DNA synthesis (extension).

Solution: Step 1: Understand the process of Polymerase Chain Reaction (PCR). PCR involves three main steps that are repeated in cycles:
1. Denaturation: Heating the DNA sample to high temperatures (typically 94-98°C) to separate the double-stranded DNA into two single strands.
2. Annealing: Cooling the reaction to allow short DNA sequences called primers to bind (anneal) to complementary sequences on the single-stranded DNA templates.
3. Extension: Raising the temperature (typically 70-72°C) to allow a thermostable DNA polymerase to synthesize new DNA strands, starting from the primers, complementary to the template strands.

Step 2: Identify the enzyme responsible for DNA synthesis in PCR. The extension step requires a DNA polymerase enzyme.

Step 3: Consider the temperature requirements. The high temperatures used during denaturation would denature and inactivate most standard DNA polymerases. Therefore, a special thermostable DNA polymerase is required to withstand these temperatures across multiple cycles.

Step 4: Evaluate the given enzymes:
DNA ligase (Option A): DNA ligase is an enzyme that joins DNA fragments together. It is not involved in synthesizing new DNA strands.
Taq polymerase (Option B): Taq polymerase is a thermostable DNA polymerase isolated from the thermophilic bacterium Thermus aquaticus. It can withstand the high temperatures required for denaturation in PCR, making it the enzyme of choice for this technique.
Reverse transcriptase (Option C): This enzyme synthesizes DNA from an RNA template (used in RT-PCR). It is not typically used in standard PCR for DNA amplification from a DNA template.
RNA polymerase (Option D): RNA polymerase is involved in transcription (synthesizing RNA from a DNA template). It is not involved in DNA synthesis during PCR.

Step 5: Conclude the enzyme commonly used in PCR due to its thermostable nature. Taq polymerase is the standard enzyme used in PCR because of its ability to function at high temperatures.

Final Answer: Taq polymerase

Answer: (B)

Go Back to Question 59

Q60.

Solution

Concept: Haemoglobin is the primary respiratory pigment in vertebrates, responsible for transporting oxygen from the lungs to the tissues. Its affinity for oxygen can be affected by various factors, including the presence of other gases like carbon monoxide (CO).

Solution: Step 1: Understand the problem of carbon monoxide poisoning. Carbon monoxide (CO) is a toxic gas that interferes with oxygen transport by haemoglobin.

Step 2: Recall how CO affects haemoglobin. CO binds to the same site on haemoglobin as oxygen (the heme group). However, CO binds much more strongly to haemoglobin than oxygen does. This strong binding prevents oxygen from binding to haemoglobin and also shifts the oxygen dissociation curve to the left, making it harder for the remaining bound oxygen to be released to the tissues.

Step 3: Quantify the affinity difference. Scientific studies have measured the relative affinity of haemoglobin for CO compared to oxygen.

Step 4: Evaluate the options regarding haemoglobin's affinity for CO vs. O_2:
Equal to oxygen (Option A): If the affinity were equal, CO would simply compete with oxygen, but the poisoning effect would not be as severe.
20 times more than oxygen (Option B): While CO has a higher affinity, this magnitude is too low to explain the severe toxicity.
200–250 times more than oxygen (Option C): This range accurately reflects the significantly higher affinity of haemoglobin for carbon monoxide compared to oxygen. This strong binding effectively "ties up" haemoglobin, reducing its oxygen-carrying capacity and leading to hypoxia.
1000 times more than oxygen (Option D): While the affinity is very high, this value is generally considered an overestimation. The commonly cited range is around 200-250 times.

Step 5: Conclude the approximate affinity of haemoglobin for carbon monoxide relative to oxygen. Haemoglobin binds carbon monoxide approximately 200–250 times more strongly than oxygen.

Final Answer: 200–250 times more than oxygen

Answer: (C)

Go Back to Question 60

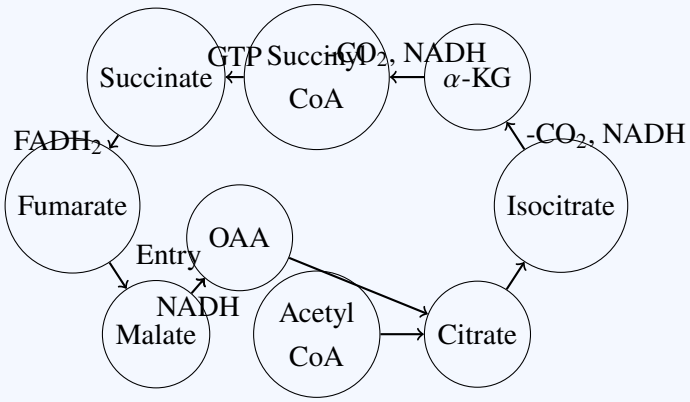
Q61.

Solution

Concept: Aerobic respiration consists of glycolysis, the Krebs cycle, and oxidative phosphorylation. The Krebs cycle (citric acid cycle or TCA cycle) is a key metabolic pathway that operates in the mitochondrial matrix.

Solution: Step 1: Krebs cycle oxidizes acetyl CoA, which is formed from pyruvate, through a series of enzymatic reactions. This results in the release of CO_2 and the production of ATP (or GTP), NADH, and $FADH_2$ as energy carriers.

Step 2: Identify its cellular location. The Krebs cycle occurs in the mitochondrial matrix, which is the inner compartment of mitochondria where most aerobic respiration reactions take place.



TCA Cycle (Krebs Cycle)

Step 3: Compare the pathways.
Glycolysis (Option A): A cytoplasmic, linear pathway that converts glucose into pyruvate.
Calvin cycle (Option B): A chloroplast pathway that fixes CO_2 using ATP and NADPH; unrelated to respiration.
Krebs cycle (Option C): Correct. A cyclic pathway in the mitochondrial matrix that oxidizes acetyl CoA, producing CO_2, ATP (or GTP), NADH, and $FADH_2$.
Pentose phosphate pathway (Option D): A cytoplasmic pathway producing NADPH and pentoses, not involved in acetyl CoA oxidation.

Step 4: Final conclusion. The Krebs cycle (citric acid cycle) is the cyclic mitochondrial pathway that oxidizes acetyl CoA and produces CO_2, ATP, NADH, and $FADH_2$.

Final Answer: Krebs cycle

Answer: (C)

Go Back to Question 61

Q62.

Solution

Concept: Biomagnification (also known as bioamplification or ecological magnification) is the increasing concentration of a substance, such as a toxic chemical, in organisms at successively higher levels in a food chain.

Solution: Step 1: Understand the scenario. A toxic pesticide enters an aquatic food chain, and its concentration increases at each successive trophic level, reaching its maximum in top carnivores.

Step 2: Define the related ecological terms:
Eutrophication (Option A): This is the process by which a body of water becomes overly enriched with nutrients (like nitrogen and phosphorus), leading to excessive growth of algae and depletion of oxygen. It is related to nutrient pollution, not pesticide accumulation.
Biomagnification (Option B): This is the progressive increase in the concentration of a substance (like a persistent toxin) in the tissues of organisms at successively higher levels in a food chain. This perfectly describes the situation in the question.
Bioaccumulation (Option C): Bioaccumulation is the accumulation of a substance, such as a pesticide, in an organism over time. While biomagnification involves bioaccumulation at each trophic level, bioaccumulation itself refers to the build-up within a single organism, not the increase across trophic levels.
Ecological succession (Option D): This is the process of change in the species structure of an ecological community over time. It is unrelated to the accumulation of toxins in a food chain.

Step 3: Match the phenomenon to the correct term. The increase in pesticide concentration from lower trophic levels to higher trophic levels in a food chain is specifically called biomagnification.

Final Answer: Biomagnification

Answer: (B)

Go Back to Question 62

Q63.

Solution

Concept: A test cross is a genetic cross used to determine the genotype of an individual showing a dominant phenotype. It involves crossing that individual with a homozygous recessive individual.

Solution: Step 1: Understand the context of the cross. A tall pea plant (dominant phenotype) with an unknown genotype is crossed with a dwarf plant (recessive phenotype) to determine if the tall plant is homozygous dominant (TT) or heterozygous (Tt).

Step 2: Define the types of crosses:
Back cross (Option A): A backcross is a cross between an F1 hybrid and one of its parent genotypes. If the parent is homozygous recessive, it becomes a test cross. If the parent is not homozygous recessive, it's just a backcross.
Monohybrid cross (Option B): A monohybrid cross involves the inheritance of a single trait. While this scenario involves a single trait (height), the specific purpose of determining the unknown genotype defines the type of cross.
Test cross (Option C): A test cross is a cross between an individual with an unknown dominant genotype and a homozygous recessive individual. If the offspring show a 1:1 phenotypic ratio (dominant:recessive), the unknown parent was heterozygous. If all offspring show the dominant phenotype, the unknown parent was homozygous dominant. This precisely matches the scenario described. Reciprocal cross (Option D): A reciprocal cross involves reversing the sex of the parents in a cross (e.g., crossing a tall male with a dwarf female, and then a tall female with a dwarf male). This is done to check for sex-linked inheritance.

Step 3: Match the described cross to its definition. Crossing an individual with a dominant phenotype but unknown genotype with a homozygous recessive individual to determine the genotype is the definition of a test cross.

Final Answer: Test cross

Answer: (C)

Go Back to Question 63

Q64.

Solution

Concept: Photosynthesis in higher plants involves various pigments located in the thylakoid membranes of chloroplasts. Chlorophyll a is the primary pigment, directly involved in converting light energy into chemical energy. Accessory pigments absorb light energy at different wavelengths and transfer it to chlorophyll a.

Solution: Step 1: Understand the role of photosynthetic pigments. Photosynthetic pigments are molecules that absorb specific wavelengths of light. Chlorophyll a is the primary pigment because it can directly convert light energy into chemical energy. Accessory pigments broaden the spectrum of light that can be absorbed for photosynthesis.

Step 2: Identify the major classes of photosynthetic pigments in higher plants.
Chlorophylls: Chlorophyll a (primary) and chlorophyll b (accessory).
Carotenoids: This group includes carotenes and xanthophylls. They are accessory pigments.

Step 3: Evaluate the options based on the definition of accessory pigments.
Carotenoids and chlorophyll *b* (Option A): Chlorophyll b is an accessory chlorophyll pigment, and carotenoids (which include carotenes and xanthophylls) are accessory pigments. This option lists valid accessory pigments.
Anthocyanins only (Option B): Anthocyanins are water-soluble pigments that often appear red, purple, or blue. They are found in the vacuole and are generally not directly involved in photosynthesis, although they can protect chlorophyll from photodamage.
Xanthophylls only (Option C): Xanthophylls are a type of carotenoid and are accessory pigments. However, this option excludes chlorophyll b, which is also an accessory pigment.
Flavonoids only (Option D): Flavonoids are a diverse group of plant pigments, many of which are water-soluble and contribute to flower color or UV protection, but they are not the primary photosynthetic accessory pigments.

Step 4: Select the option that correctly lists accessory pigments that assist chlorophyll a. Chlorophyll b and carotenoids (which encompass xanthophylls and carotenes) are the main accessory pigments in higher plants that broaden the absorption spectrum for photosynthesis.

Final Answer: Carotenoids and chlorophyll *b*

Answer: (A)

Go Back to Question 64

Q65.

Solution

Concept: Hormones are chemical messengers produced by endocrine glands that regulate various physiological processes. Antidiuretic hormone (ADH), also known as vasopressin, plays a crucial role in water balance.

Solution: Step 1: Understand the symptoms of the patient. The patient suffers from excessive urination (polyuria) and intense thirst (polydipsia). This condition is indicative of a problem with water regulation.

Step 2: Identify the hormone involved. The question explicitly mentions a deficiency of antidiuretic hormone (ADH). ADH's primary function is to reduce water loss by increasing the reabsorption of water in the kidneys. A deficiency in ADH leads to excessive water excretion and increased thirst.

Step 3: Determine the source of ADH. ADH is synthesized in the hypothalamus, but it is stored and released from the posterior pituitary gland. The posterior pituitary gland is essentially a storage and release site for hormones produced by the hypothalamus.

Step 4: Evaluate the endocrine glands listed:
Thyroid gland (Option A): The thyroid gland produces thyroid hormones (T3 and T4), which regulate metabolism. It does not produce ADH.
Adrenal cortex (Option B): The adrenal cortex produces corticosteroids (like aldosterone and cortisol). Aldosterone influences sodium and potassium balance, indirectly affecting water balance, but it is not ADH.
Posterior pituitary (Option C): This gland stores and releases ADH (and oxytocin), which are synthesized in the hypothalamus. Therefore, dysfunction or deficiency related to ADH release is directly linked to the posterior pituitary.
Pineal gland (Option D): The pineal gland produces melatonin, which regulates sleep-wake cycles. It does not produce ADH.

Step 5: Conclude the endocrine gland that secretes (releases) ADH. ADH is released from the posterior pituitary gland.

Final Answer: Posterior pituitary

Answer: (C)

Go Back to Question 65

Q66.

Solution

Concept: In genetics, different patterns of inheritance describe how alleles are expressed in heterozygotes. These include complete dominance, incomplete dominance, codominance, and multiple allelism.

Solution: Step 1: Understand the ABO blood group system. The human ABO blood group system is determined by a gene with three common alleles: I^A, I^B, and i.
I^A allele codes for the A antigen.
I^B allele codes for the B antigen.
i allele codes for no antigen (Type O).

Step 2: Analyze the inheritance pattern in the given scenario. The scenario describes individuals with the genotype I^AI^B who express *both* A and B antigens simultaneously on their red blood cells (RBCs).

Step 3: Define the types of dominance:
Incomplete dominance (Option A): In incomplete dominance, the heterozygote phenotype is an intermediate blend of the two parental phenotypes (e.g., pink flowers from red and white parents). This is not observed in the ABO system where both antigens are expressed fully.
Polygenic inheritance (Option B): This is when a trait is controlled by multiple genes. The ABO blood group is controlled by a single gene with multiple alleles.
Codominance (Option C): In codominance, both alleles in a heterozygous genotype are fully and simultaneously expressed in the phenotype. In the ABO system, both the A allele and the B allele are expressed in the I^AI^B heterozygote, resulting in the AB blood type where both A and B antigens are present. This perfectly fits the description.
Multiple allelism only (Option D): Multiple allelism refers to the existence of more than two alleles for a gene in a population (e.g., I^A, I^B, and i for the ABO gene). While the ABO system does exhibit multiple allelism, the expression of both A and B antigens in the heterozygote specifically demonstrates codominance.

Step 4: Conclude the inheritance pattern. The expression of both A and B antigens in individuals with the genotype I^AI^B is an example of codominance.

Final Answer: Codominance

Answer: (C)

Go Back to Question 66

Q67.

Solution

Concept: Ecological interactions describe the relationships between different species living in the same ecosystem. These interactions can be beneficial, harmful, or neutral to the species involved.

Solution: Step 1: Analyze the described ecological interaction. An orchid (epiphyte) grows on the branch of a mango tree. The orchid gains support and better access to sunlight (benefits for the orchid). However, the mango tree is neither harmed nor benefited by the orchid's presence.

Step 2: Define the types of ecological interactions:
Mutualism (Option A): A relationship where both species benefit (e.g., bees pollinating flowers).
Commensalism (Option B): A relationship where one species benefits, and the other is neither harmed nor benefited. This fits the description of the orchid and mango tree interaction. The orchid benefits from support and light, while the mango tree is unaffected.
Parasitism (Option C): A relationship where one species (parasite) benefits at the expense of the other species (host), which is harmed (e.g., a tapeworm in the human intestine). The orchid in this case is not harming the mango tree.
Competition (Option D): Competition occurs when two or more organisms require the same limited resource, and the presence of one affects the ability of the other to survive or reproduce. This is not the case here.

Step 3: Match the interaction to the correct term. The relationship where one organism benefits and the other is unaffected is called commensalism.

Final Answer: Commensalism

Answer: (B)

Go Back to Question 67

Q68.

Solution

Concept: DNA in eukaryotic cells is highly organized to fit within the nucleus. This packaging involves wrapping the negatively charged DNA around positively charged histone proteins to form nucleosomes, which are the fundamental units of chromatin.

Solution: Step 1: Understand DNA packaging in eukaryotes. DNA is a long, double-stranded molecule with a negatively charged sugar-phosphate backbone. To fit into the nucleus, it needs to be condensed.

Step 2: Recall the proteins involved in DNA packaging. Eukaryotic DNA is packaged with basic proteins called histones. These histones are positively charged due to the abundance of lysine and arginine residues.

Step 3: Describe the structure formed by DNA and histones. A core of eight histone proteins (two each of H2A, H2B, H3, and H4) forms a histone octamer. Approximately 147 base pairs of DNA wrap around this histone octamer, forming a structure called a nucleosome. The nucleosome bead and the linker DNA between beads are the repeating units of chromatin.

Step 4: Evaluate the given options:
Chromatids (Option A): Chromatids are one of two identical halves of a replicated chromosome, joined at the centromere. They are formed after DNA replication.
Nucleosomes (Option B): These are the fundamental repeating structural units of chromatin in eukaryotes, consisting of DNA wrapped around a histone octamer. This precisely matches the description.
Centromeres (Option C): Centromeres are specialized regions of chromosomes that serve as the attachment point for spindle fibers during cell division.
Operons (Option D): Operons are functional units of DNA in prokaryotes that consist of a promoter, operator, and structural genes. They are unrelated to DNA packaging in eukaryotes.

Step 5: Conclude the name of the repeating structural units. The repeating units of DNA wrapped around histone proteins are called nucleosomes.

Final Answer: Nucleosomes

Answer: (B)

Go Back to Question 68

Q69.

Solution

Concept: A reflex action is a rapid, involuntary, and automatic response to a stimulus. It is mediated by a neural pathway called a reflex arc, which allows for quick responses without conscious processing by the brain.

Solution: Step 1: Analyze the described scenario. A person touches a hot object and withdraws their hand immediately, even before consciously perceiving pain. This indicates a rapid, automatic response.

Step 2: Understand the neural pathways involved in responses.
Cerebral cortex (Option A): The cerebral cortex is responsible for conscious thought, perception, and higher-level processing. While it eventually perceives pain, the immediate withdrawal suggests a pathway that bypasses full cortical processing initially.
Reflex arc (Option B): A reflex arc is the neural pathway that mediates a reflex action. It typically involves a sensory receptor, a sensory neuron, an interneuron (in many cases, but not all, e.g., monosynaptic reflexes), a motor neuron, and an effector (muscle or gland). This pathway allows for a very rapid response because it bypasses the brain's higher processing centers for the initial action. This fits the description perfectly.
Cerebellum (Option C): The cerebellum is primarily involved in coordinating voluntary movements, posture, balance, and motor learning. It is not the primary mediator of a simple, rapid withdrawal reflex.
Hypothalamus (Option D): The hypothalamus is involved in regulating basic bodily functions like temperature, hunger, thirst, and hormonal release. It is not the primary pathway for rapid motor reflexes like hand withdrawal.

Step 3: Connect the rapid response to the neural pathway. The immediate withdrawal of the hand, even before conscious perception of pain, is characteristic of a reflex action mediated by a reflex arc. The sensory signal travels to the spinal cord, a motor command is issued from the spinal cord to the muscles of the arm to withdraw the hand, and only then is the signal processed by the brain for conscious perception.

Step 4: Conclude the mechanism mediating the response. The rapid, automatic response is mediated through a reflex arc.

Final Answer: Reflex arc

Answer: (B)

Go Back to Question 69

Q70.

Solution

Concept: Biofertilizers are natural fertilizers containing living microorganisms that, when applied to seeds, plant surfaces, or soil, colonize the rhizosphere or the interior of the plant and promote growth by increasing the supply or availability of primary nutrients to the host plant.

Solution: Step 1: Understand the role of biofertilizers. Biofertilizers enhance soil fertility by providing essential nutrients to plants through biological processes.

Step 2: Identify the specific organisms mentioned. The question refers to blue-green algae (cyanobacteria) such as Anabaena and Nostoc, commonly used in paddy fields.

Step 3: Recall the functions of these cyanobacteria in paddy fields. Cyanobacteria like Anabaena and Nostoc are well-known for their ability to fix atmospheric nitrogen. They contain the enzyme nitrogenase, which converts atmospheric nitrogen gas (N_2) into ammonia (NH_3), a form that plants can utilize. In paddy fields, they contribute significantly to soil nitrogen content.

Step 4: Evaluate the given options for their contribution to soil fertility:
Phosphate solubilization (Option A): Some microorganisms can solubilize insoluble phosphates, making them available to plants. While this is a biofertilizer function, it is not the primary function of Anabaena and Nostoc in paddy fields.
Nitrogen fixation (Option B): As explained above, Anabaena and Nostoc are highly effective nitrogen fixers. This process directly enriches the soil with usable nitrogen for plant growth, which is a major benefit to paddy crops.
Potassium enrichment (Option C): Potassium enrichment is typically achieved through the use of potassium-rich mineral fertilizers or specific microorganisms that can mobilize soil potassium, but it is not the primary role of these cyanobacteria.
Organic acid secretion (Option D): Some microbes secrete organic acids that can help mobilize nutrients, but nitrogen fixation is the dominant contribution of these cyanobacteria to paddy field fertility.

Step 5: Conclude the main mechanism by which Anabaena and Nostoc improve soil fertility in paddy fields. Their primary contribution is through nitrogen fixation, thus enriching the soil with available nitrogen.

Final Answer: Nitrogen fixation

Answer: (B)

Go Back to Question 70

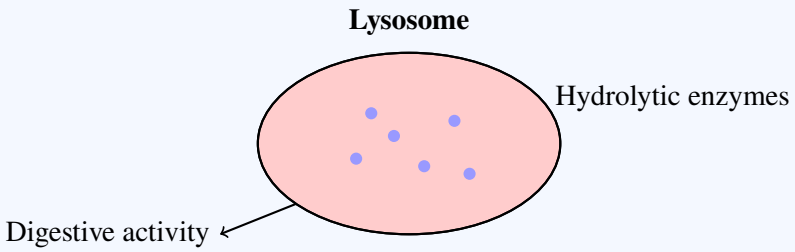
Q71.

Solution

Concept: Eukaryotic cells contain various membrane-bound organelles, each with specific functions. Lysosomes are key organelles involved in intracellular digestion and waste removal.

Solution: Step 1: Analyze the description of the organelle. The organelle is described as:
Containing hydrolytic enzymes.
Enclosed within a single membrane.
Involved in intracellular digestion.
Involved in autophagy (breakdown of the cell's own components).

Step 2: Recall the functions of various cell organelles:
Ribosome (Option A): Ribosomes are responsible for protein synthesis. They are not membrane-bound and do not contain hydrolytic enzymes.
Lysosome (Option B): Lysosomes are membrane-bound organelles containing a variety of hydrolytic enzymes (acid hydrolases) that function at acidic pH. They are involved in breaking down waste materials, cellular debris, and ingested particles (intracellular digestion) and also in autophagy. This perfectly matches the description.



Centrosome (Option C): Centrosomes are involved in cell division (spindle formation). They are not membrane-bound and do not contain hydrolytic enzymes for digestion.
Dictyosome (Option D): Dictyosomes are stacks of flattened membrane-bound sacs (cisternae) that are part of the Golgi apparatus. The Golgi apparatus modifies, sorts, and packages proteins and lipids, but lysosomes are the primary sites of intracellular digestion. While the Golgi produces lysosomes, it is not the lysosome itself.

Step 3: Conclude the identity of the organelle. Based on its contents (hydrolytic enzymes), membrane structure (single membrane), and functions (intracellular digestion, autophagy), the organelle is a lysosome.

Final Answer: Lysosome

Answer: (B)

Go Back to Question 71

Q72.

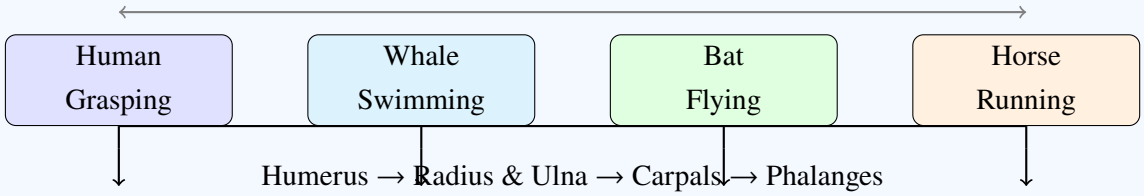
Solution

Concept: Evidence for evolution comes from various fields, including comparative anatomy. Homologous organs provide strong support for the idea of common ancestry and divergent evolution.

Solution: Step 1: Examine the forelimb structures. Humans, whales, bats, and horses show a similar skeletal pattern in their forelimbs (one upper bone, two forearm bones, wrist and digit bones), but these limbs perform different functions such as grasping, swimming, flying, and running.

Step 2: Recall relevant evolutionary terms.
Convergent evolution (Option A): Similar functions evolve independently in unrelated organisms, often resulting in different structural origins.
Analogous organs (Option B): Organs with similar function but different structural and evolutionary origins.
Homologous organs (Option C): Organs with similar structural plan and common ancestry, but different functions due to adaptation. The given forelimbs match this definition.

Homologous Forelimbs (Common Ancestry)



Adaptive radiation only (Option D): Adaptive radiation refers to the evolution of multiple species from a common ancestor, each adapted to different ecological niches. Although homologous organs may arise through adaptive radiation, this term describes a process rather than the organs themselves.

Step 3: Relate the observation to evolutionary evidence. The similar skeletal pattern in the forelimbs of different mammals, despite their varied functions, indicates a shared ancestral origin. This is the key feature of homologous organs.

Step 4: Draw the conclusion. Such structural similarity with different functions supports the idea of common ancestry and divergent evolution, and is best explained by homologous organs.

Final Answer: Homologous organs

Answer: (C)

Go Back to Question 72

Q73.

Solution

Concept: Human reproduction involves fertilization, followed by the development of the zygote into an embryo. Implantation, the attachment of the early embryo to the uterine wall, is a critical step for pregnancy.

Solution: Step 1: Understand the process following fertilization. Fertilization typically occurs in the fallopian tube. The resulting zygote undergoes rapid mitotic divisions called cleavage.

Step 2: Trace the journey of the early embryo. As the zygote divides, it forms a ball of cells called a morula, which then develops into a blastocyst. The blastocyst travels from the fallopian tube down into the uterus.

Step 3: Identify the site of implantation. Implantation is the process by which the blastocyst embeds itself into the lining of the uterus. This lining is called the endometrium. A properly developed endometrium is essential for successful implantation and subsequent pregnancy.

Step 4: Evaluate the options:
Ovary (Option A): The ovary produces the egg cell and hormones but is not the site of implantation.
Cervix (Option B): The cervix is the lower, narrow part of the uterus that opens into the vagina. It is not the site of implantation.
Endometrium of uterus (Option C): The endometrium is the inner lining of the uterus, which is prepared to receive and nourish the blastocyst. Implantation normally occurs here. This matches the description.
Vagina (Option D): The vagina is the birth canal and receives sperm during sexual intercourse. It is not involved in implantation.

Step 5: Conclude where implantation normally occurs. Implantation of the blastocyst typically occurs in the endometrium of the uterus.

Final Answer: Endometrium of uterus

Answer: (C)

Go Back to Question 73

Q74.

Solution

Concept: Transpiration is the process of water movement through a plant and its evaporation from aerial parts, such as leaves, stems, and flowers. While it leads to water loss, it also serves crucial physiological roles.

Solution: Step 1: Understand the dual nature of transpiration. The question refers to transpiration as a "necessary evil" because it involves water loss but also provides significant benefits to the plant.

Step 2: Analyze the benefits of transpiration.
Ascent of sap: Transpiration creates a continuous pull (tension) in the xylem vessels due to the evaporation of water from leaves. This transpiration pull is the main driving force that draws water and dissolved minerals from the roots up to the leaves.
Cooling of the plant: The evaporation of water during transpiration has a cooling effect on the plant surface, preventing overheating, especially in hot conditions.

Step 3: Evaluate the given options in light of these benefits:
Photosynthetic oxygen evolution only (Option A): Oxygen evolution is a product of photosynthesis, not directly driven by transpiration.
Ascent of sap and cooling (Option B): Transpiration is essential for the upward movement of water and minerals (ascent of sap) and provides a cooling effect. This option accurately describes the significant benefits.
Breakdown of chlorophyll (Option C): Chlorophyll breakdown is related to senescence and is not directly caused or aided by transpiration.
Fruit ripening (Option D): Fruit ripening is primarily regulated by hormones like ethylene. Transpiration is not directly involved.

Step 4: Conclude the benefits of transpiration that make it "necessary." The crucial roles of transpiration in facilitating the ascent of sap and cooling the plant make it a necessary process, despite the water loss.

Final Answer: Ascent of sap and cooling

Answer: (B)

Go Back to Question 74

Q75.

Solution

Concept: The genetic code is a set of rules by which information encoded in genetic material (DNA or RNA sequences) is translated into proteins (amino acid sequences) by living cells. It is nearly universal, with some exceptions.

Solution: Step 1: Understand the concept of degeneracy in the genetic code. The genetic code is degenerate, meaning that most amino acids are specified by more than one codon (a triplet of nucleotides on mRNA that codes for an amino acid). For example, leucine is coded by six different codons.

Step 2: Identify amino acids coded by only one codon. While degeneracy is a common feature, there are a few exceptions. Some amino acids are specified by only a single codon. These are typically the start codon and a few others.

Step 3: Recall the codons for specific amino acids. The genetic code table shows the codons for each amino acid.
Methionine (Met) is coded by the start codon AUG.
Tryptophan (Trp) is also coded by a single codon, UGG.

Step 4: Evaluate the given options:
Leucine (Option A): Leucine is coded by six different codons (UUA, UUG, CUU, CUC, CUA, CUG).
Serine (Option B): Serine is coded by six codons (UCU, UCC, UCA, UCG, AGU, AGC).
Methionine (Option C): Methionine is coded by a single codon, AUG. This codon also serves as the start codon for translation.
Arginine (Option D): Arginine is coded by six codons (CGU, CGC, CGA, CGG, AGA, AGG).

Step 5: Conclude the amino acid specified by only one codon. Methionine is specified by only one codon (AUG).

Final Answer: Methionine

Answer: (C)

Go Back to Question 75

Q76.

Solution

Concept: Productivity in an ecosystem refers to the rate at which organic matter is produced. Primary productivity is the rate at which producers (plants, algae, cyanobacteria) synthesize organic compounds from inorganic sources.

Solution: Step 1: Understand the definitions of different types of productivity.
Primary productivity: The rate of production of organic matter by producers (autotrophs).
Secondary productivity: The rate of production of organic matter by consumers (heterotrophs).

Step 2: Differentiate between Gross Primary Productivity (GPP) and Net Primary Productivity (NPP).
Gross Primary Productivity (GPP): This is the total rate at which producers capture and store energy from sunlight through photosynthesis. It represents the total organic matter produced.
Respiration: Producers also respire, using some of the organic matter they produce for their own metabolic needs. Net Primary Productivity (NPP): NPP is the GPP minus the energy lost through respiration by the producers. It represents the energy available to consumers. NPP = GPP - Respiration.

Step 3: Analyze the question's definition. The question asks for "the total amount of organic matter produced through photosynthesis per unit area per unit time." This refers to the total production before any is used for the producers' own metabolism.

Step 4: Evaluate the options:
Net primary productivity (Option A): This is the organic matter remaining after producers use some for respiration. It is not the total organic matter produced.
Secondary productivity (Option B): This refers to the production of organic matter by consumers, not producers.
Gross primary productivity (Option C): This is the total rate of photosynthesis or the total amount of organic matter produced by producers. This matches the definition provided in the question.
Standing crop (Option D): This refers to the biomass of producers present at a particular point in time, not the rate of production.

Step 5: Conclude the correct term for the total organic matter produced. The total amount of organic matter produced through photosynthesis is Gross Primary Productivity.

Final Answer: Gross primary productivity

Answer: (C)

Go Back to Question 76

Q77.

Solution

Concept: Digestion in humans involves the breakdown of food into smaller molecules that can be absorbed. This process is facilitated by various enzymes secreted in different parts of the digestive system.

Solution: Step 1: Analyze the description of the enzyme. The enzyme is:
Secreted by the pancreas.
Secreted in an inactive form.
Activated in the small intestine.
Plays a major role in protein digestion.

Step 2: Recall the major digestive enzymes and their origins/activation:
Ptyalin (Option A): Also known as salivary amylase, it is secreted in saliva and begins carbohydrate digestion in the mouth. It is not secreted by the pancreas and does not primarily digest proteins.
Pepsin (Option B): Pepsin is a protein-digesting enzyme secreted by the stomach in an inactive form (pepsinogen) and activated by the acidic environment of the stomach. It is not from the pancreas.
Trypsin (Option C): Trypsin is a key enzyme in protein digestion. It is secreted by the pancreas in an inactive form called trypsinogen. Trypsinogen is activated to trypsin in the small intestine (by the enzyme enterokinase). Trypsin then activates other pancreatic proteases and also digests proteins. This perfectly matches the description.
Lipase (Option D): Pancreatic lipase is secreted by the pancreas and is active in the small intestine, where it digests fats (lipids). While secreted by the pancreas, its primary substrate is fat, not protein.

Step 3: Match the description to the correct enzyme. The enzyme secreted by the pancreas in an inactive form, activated in the small intestine, and crucial for protein digestion is trypsin.

Final Answer: Trypsin

Answer: (C)

Go Back to Question 77

Q78.

Solution

Concept: Mutations are changes in the genetic material. They can be induced by various agents, including radiation and chemicals, and are a source of genetic variation.

Solution: Step 1: Understand the scenario. Exposure to ionizing radiations and certain chemicals can cause sudden, heritable changes in the genetic material.

Step 2: Define the terms related to genetic changes:
Adaptations (Option A): Adaptations are traits that increase an organism's survival and reproduction in its environment. They are the result of evolution, which can be driven by mutations, but adaptations themselves are not the changes in genetic material.
Variations (Option B): Variations are differences among individuals within a population. Mutations are the ultimate source of new variations, but variation itself is a broader term for the differences observed.
Mutations (Option C): Mutations are permanent alterations in the DNA sequence. They are the direct cause of sudden heritable changes in the genetic material. Ionizing radiation and chemicals are known mutagens (agents that cause mutations). This fits the description perfectly.
Recombinations (Option D): Recombination (like crossing over during meiosis) shuffles existing genetic material to create new combinations of alleles but does not change the DNA sequence itself.

Step 3: Conclude the term for sudden heritable changes in genetic material. The process of sudden, heritable changes in genetic material is called mutation.

Final Answer: Mutations

Answer: (C)

Go Back to Question 78

Q79.

Solution

Concept: Plant tissue culture is a technique used to grow plant cells, tissues, or organs in a sterile nutrient medium under controlled laboratory conditions. It is a powerful tool for plant propagation, genetic modification, and research.

Solution: Step 1: Understand the process described in plant tissue culture. A small piece of plant tissue (an explant) is cultured on a nutrient medium. Under appropriate conditions, this small piece of tissue can develop into an entire, complete plant.

Step 2: Define the property that allows a single cell or small group of cells to develop into a whole organism.
Plasticity (Option A): Plasticity refers to the ability of an organism to change its phenotype in response to environmental changes. While plant cells exhibit plasticity, it's not the specific term for developing a whole plant from a tissue.
Totipotency (Option B): Totipotency is the ability of a single cell or a group of cells to differentiate and develop into a whole organism. This property is the basis of plant tissue culture, where a small piece of tissue can regenerate into a complete plant. This matches the description perfectly.
Permeability (Option C): Permeability refers to the ability of a membrane to allow substances to pass through it. This is a property of cell membranes, not the ability to form a whole organism.
Differentiation (Option D): Differentiation is the process by which a less specialized cell becomes a more specialized cell type. While differentiation is a part of regeneration, totipotency is the underlying potential that allows for the entire process of developing into a whole plant.

Step 3: Conclude the property of plant cells that enables regeneration into an entire plant. The ability of a single plant cell or a small tissue to regenerate into a whole plant is called totipotency.

Final Answer: Totipotency

Answer: (B)

Go Back to Question 79

Q80.

Solution

Concept: Animals adapted to arid environments often have specialized excretory systems to conserve water. The form in which nitrogenous waste is excreted is a key adaptation for water conservation.

Solution: Step 1: Understand the challenge for animals in arid environments. Animals living in deserts face extreme scarcity of water. Conserving water is crucial for their survival.

Step 2: Consider the nitrogenous wastes produced by animals. The primary nitrogenous waste product in animals is ammonia, which is highly toxic and requires a large amount of water for excretion. To conserve water, many animals convert ammonia into less toxic forms.

Step 3: Recall the forms of nitrogenous waste excretion:
Ammonia: Excreted by many aquatic animals. It is highly toxic and requires a lot of water for dilution and excretion.
Urea: Excreted by mammals, adult amphibians, and some marine fishes. It is less toxic than ammonia and requires less water for excretion.
Uric acid: Excreted by birds, reptiles, insects, and desert animals. It is the least toxic form of nitrogenous waste and is excreted as a semi-solid paste or slurry with very little water loss.

Step 4: Analyze the adaptation for arid environments. Animals adapted to arid environments need to minimize water loss. Excreting nitrogenous waste as uric acid is a significant adaptation because it requires minimal water for excretion.

Step 5: Evaluate the options:
Rapid diffusion (Option A): While some excretion occurs via diffusion, the primary benefit of uric acid is not rapid diffusion but water conservation.
Conservation of water (Option B): Excreting nitrogenous waste as uric acid significantly reduces water loss, which is vital for survival in arid environments. This is the primary advantage.
Increased toxicity (Option C): Uric acid is less toxic than ammonia, not more toxic. Increased toxicity would be counterproductive for water conservation and survival.
Enhanced ammonia formation (Option D): Animals in arid environments aim to *reduce* the formation and excretion of highly water-soluble ammonia, not enhance it. They convert ammonia into less soluble forms like uric acid.

Step 6: Conclude the primary benefit of excreting uric acid in arid environments. The main advantage of excreting nitrogenous wastes as uric acid in arid environments is the significant conservation of water.

Final Answer: Conservation of water

Answer: (B)

Go Back to Question 80

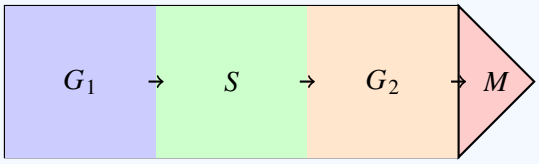
Q81.

Solution

Concept: The cell cycle is a series of events that take place in a cell leading to its division and duplication. It is divided into interphase (where the cell grows and replicates its DNA) and the mitotic phase (M phase, where the cell divides).

Solution: Step 1: Understand the phases of the cell cycle. The cell cycle consists of interphase and the M phase. Interphase is further divided into G_1, S, and G_2 phases.
G_1 phase (Gap 1): The cell grows and synthesizes proteins and organelles.
S phase (Synthesis phase): This is the phase where DNA replication occurs, and each chromosome is duplicated.
G_2 phase (Gap 2): The cell continues to grow and synthesizes proteins necessary for mitosis. M phase (Mitotic phase): This includes mitosis (nuclear division) and cytokinesis (cytoplasmic division).

Cell Cycle Overview



Growth DNA Replication Prep for Mitosis Division

Step 2: Identify the phase of DNA synthesis. The question specifically asks for the phase during which DNA synthesis (replication) takes place. This is the characteristic event of the S phase.

Step 3: Evaluate the options:
G_1 phase (Option A): This phase precedes DNA replication and is focused on cell growth.
S phase (Option B): This phase is defined by DNA replication.
G_2 phase (Option C): This phase follows DNA replication and prepares the cell for mitosis.
M phase (Option D): This is the phase of actual cell division, not DNA replication.

Step 4: Conclude the phase of DNA synthesis. DNA synthesis occurs during the S phase of interphase.

Final Answer: S phase

Answer: (B)

Go Back to Question 81

Q82.

Solution

Concept: The human eye's ability to focus on objects at different distances is called accommodation. This process is achieved by changing the shape of the lens. Age-related changes can affect this ability, leading to visual defects.

Solution: Step 1: Understand the mechanism of accommodation. The eye lens changes its focal length by altering its shape. Ciliary muscles contract to make the lens thicker and more convex for focusing on near objects, and relax to make the lens thinner and less convex for focusing on distant objects.

Step 2: Analyze the described visual defect. The patient has difficulty clearly seeing nearby objects due to a reduction in the power of accommodation associated with ageing.

Step 3: Define the visual defects:
Myopia (nearsightedness) (Option A): In myopia, the eye focuses images in front of the retina, leading to difficulty seeing distant objects clearly. This is usually due to the eyeball being too long or the lens being too powerful.
Hypermetropia (farsightedness) (Option B): In hypermetropia, the eye focuses images behind the retina, leading to difficulty seeing nearby objects clearly. This can be due to the eyeball being too short or the lens being too weak. However, it is often present from birth and not primarily age-related in its common form.
Presbyopia (Option C): This is an age-related condition characterized by a gradual loss of the eye's ability to focus on nearby objects. It occurs because the lens becomes less flexible and the ciliary muscles weaken, reducing the power of accommodation. This perfectly matches the description.
Astigmatism (Option D): Astigmatism is caused by an irregularly shaped cornea or lens, which causes blurred or distorted vision at all distances. It is not specifically related to age-related loss of accommodation.

Step 4: Conclude the visual defect. The inability to focus on nearby objects due to age-related reduction in the power of accommodation is known as presbyopia.
Final Answer: Presbyopia

Answer: (C)

Go Back to Question 82

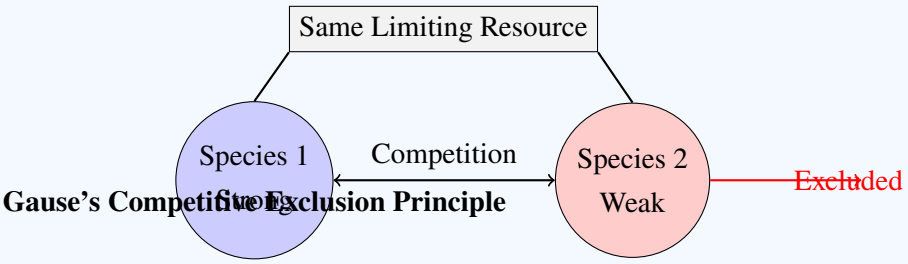
Q83.

Solution

Concept: Ecological principles explain how species interact within an ecosystem. Competition is a significant interaction, and its outcome can lead to exclusion or resource partitioning.

Solution: Step 1: Analyze the scenario. Two closely related species are competing for identical resources in the same habitat. The observation is that they cannot coexist indefinitely, and one species eventually outcompetes the other.

Step 2: Define the relevant ecological principles:
Gause's competitive exclusion principle (Option A): Also known as competitive exclusion, this principle states that two species competing for the exact same limited resources cannot coexist indefinitely in the same place. One species will eventually outcompete and eliminate the other. This precisely describes the situation.



Hardy-Weinberg principle (Option B): This principle deals with the stability of allele and genotype frequencies in a population in the absence of evolutionary influences. It is unrelated to interspecific competition.
Allen's rule (Option C): Allen's rule states that endotherms from colder climates usually have shorter appendages (limbs, ears, etc.) than equivalent animals from warmer climates. This is about thermoregulation and body shape, not competition.
Bergmann's rule (Option D): Bergmann's rule states that within a broadly distributed taxonomic clade, populations and species of larger size are found in colder environments, and species of smaller size are found in warmer regions. This relates to body size and climate, not direct competition outcomes.

Step 3: Match the principle to the observed outcome. The inability of two species to coexist indefinitely when competing for identical resources, leading to the exclusion of one, is explained by Gause's competitive exclusion principle.

Final Answer: Gause's competitive exclusion principle

Answer: (A)

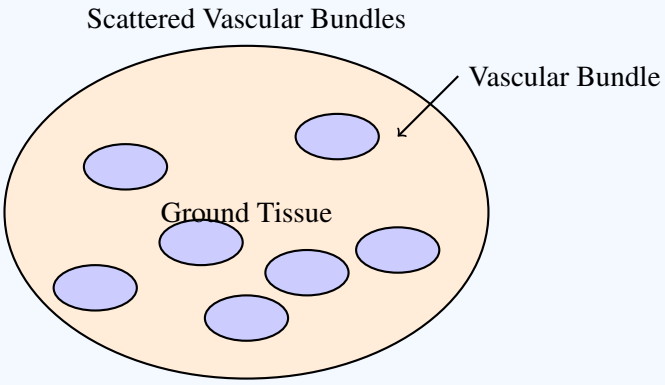
Go Back to Question 83

Q84.

Solution

Concept: Plant anatomy differs between monocots and dicots. Monocot stems have scattered vascular bundles, while dicot stems have vascular bundles arranged in a ring. This difference affects their capacity for secondary growth.

Solution: Step 1: Understand the anatomical features of monocot stems. The question states that monocot stems have:
Vascular bundles scattered throughout the ground tissue.
Lack of cambium.



Monocot Stem (No Cambium Present)

Step 2: Secondary growth increases the girth of stems and roots and is controlled mainly by vascular cambium, which forms secondary xylem and phloem.

Step 3: Monocot stems usually lack vascular cambium, so they cannot produce secondary tissues or increase in girth.

Step 4: Evaluate the options.
Primary growth (Option A): Present in monocots and responsible for increase in length.
Secondary growth (Option B): Generally absent because cambium is lacking.
Vascular bundles (Option C): Present and scattered in monocot stems.
Mechanical tissues (Option D): Present for support.

Step 5: Conclude the answer. Monocot stems generally do not show secondary growth due to the absence of vascular cambium.

Final Answer: Secondary growth

Answer: (B)

Go Back to Question 84

Q85.

Solution

Concept: The immune system provides protection against pathogens. Immunity can be acquired in different ways, including through exposure to pathogens or vaccines.

Solution: Step 1: Understand the scenario. Vaccination involves introducing a weakened or inactive form of a pathogen (or parts of it) to stimulate an immune response, producing antibodies and memory cells, without causing severe disease.

Step 2: Define the types of immunity:
Passive natural immunity (Option A): Acquired by transfer of antibodies from mother to fetus/infant via the placenta or breast milk. It is passive because the body does not produce its own antibodies.
Active acquired immunity (Option B): This type of immunity is developed after an individual's own immune system is stimulated to produce antibodies and memory cells in response to exposure to an antigen. Vaccination is a deliberate artificial stimulation of the immune system to achieve this. This matches the description.
Innate immunity (Option C): This is the non-specific, inherited immunity that an individual is born with (e.g., skin, mucous membranes, inflammatory response). It does not involve specific memory cells or antibody production against specific pathogens.
Passive artificial immunity (Option D): Acquired by the administration of pre-formed antibodies (e.g., antivenom, gamma globulin injections). The body does not produce its own antibodies.

Step 3: Match the vaccination process to the correct type of immunity. Vaccination deliberately exposes the body to antigens to elicit a primary immune response, leading to the production of antibodies and memory cells. This constitutes active acquired immunity. It's "acquired" because it's not innate, and it's "active" because the body's immune system actively produces the response. It's "artificial" because it's induced by a vaccine, not natural infection. However, "Active acquired immunity" is the overarching category.

Step 4: Conclude the type of immunity provided by vaccination. Vaccination provides active acquired immunity.

Final Answer: Active acquired immunity

Answer: (B)

Go Back to Question 85

Q86.

Solution

Concept: The peppered moth example is a classic case study in evolutionary biology, demonstrating how environmental changes can drive evolutionary adaptation through natural selection.

Solution: Step 1: Understand the observation of industrial melanism. Before the industrial revolution, peppered moths were predominantly light-colored, camouflaging well against lichen-covered trees. During the industrial revolution, pollution killed the lichens and darkened the trees with soot. The dark (melanic) form of the moth became more common because it was better camouflaged against the dark background, while the light form was easily predated by birds. After pollution controls were implemented, the light form reappeared.

Step 2: Connect this observation to evolutionary theories. This phenomenon directly illustrates how differential survival rates, based on traits (moth coloration) that match the environment, lead to changes in population characteristics over time.

Step 3: Evaluate the evolutionary theories:
Lamarckism (Option A): Lamarck proposed that acquired characteristics are inherited. This theory is not supported by the peppered moth example; the moths did not change their color based on their needs, but rather the environment selected for pre-existing variations.
Mutation theory (Option B): Mutation theory (de Vries) focuses on sudden, large genetic changes as the source of variation. While mutations provide the raw material for variation, the peppered moth case highlights the *selection* acting on these variations.
Natural selection (Option C): Natural selection is the process by which organisms with traits better suited to their environment tend to survive and reproduce more offspring. In the peppered moth example, the environment (soot-darkened trees) exerted selective pressure, favoring the dark moths. This perfectly supports natural selection.
Theory of inheritance of acquired characters (Option D): This is essentially Lamarckism, which is not supported by this observation.

Step 4: Conclude which theory is supported by industrial melanism. The peppered moth example is a classic demonstration of natural selection acting in response to environmental changes.

Final Answer: Natural selection

Answer: (C)

Go Back to Question 86

Q87.

Solution

Concept: Plant reproduction can occur sexually (involving fertilization) or asexually. Asexual reproduction in plants can lead to the formation of genetically identical offspring.

Solution: Step 1: Analyze the described mode of reproduction. The plant produces seeds without fertilization, resulting in genetically identical offspring. This means sexual reproduction (which involves the fusion of gametes from two parents or self-fertilization) is bypassed.

Step 2: Define the terms related to plant reproduction:
Polyembryony (Option A): This is the occurrence of more than one embryo in a single seed, often arising from multiple zygotes or adventitious embryos. While it leads to multiple offspring, it typically arises from sexual reproduction.
Apomixis (Option B): Apomixis is a form of asexual reproduction in plants that mimics sexual reproduction. It involves the production of seeds without fertilization. The embryo develops from maternal tissue (like the egg cell or integuments) without the fusion of gametes, resulting in offspring that are genetically identical to the parent plant. This perfectly matches the description.
Hybridization (Option C): Hybridization is the cross-breeding of two genetically different individuals, typically to produce offspring with desirable traits (hybrids). It involves sexual reproduction.
Double fertilization (Option D): This is a key process in sexual reproduction in angiosperms, involving the fusion of two male gametes with the egg cell and polar nuclei, leading to the formation of a zygote and the endosperm. It is a sexual process and results in genetic recombination.

Step 3: Match the phenomenon to the correct term. The production of seeds without fertilization, leading to genetically identical offspring, is the definition of apomixis.

Final Answer: Apomixis

Answer: (B)

Go Back to Question 87

Q88.

Solution

Concept: Enzymes are biological catalysts that speed up biochemical reactions. They achieve this by lowering the activation energy of the reaction. A key characteristic of enzymes is that they are not consumed in the reaction.

Solution: Step 1: Understand the role of enzymes. Enzymes are proteins (or sometimes RNA molecules) that act as biological catalysts, increasing the rate of specific biochemical reactions without being consumed in the process.

Step 2: Recall how enzymes lower activation energy. Enzymes bind to specific substrate molecules at their active sites, forming an enzyme-substrate complex. This binding facilitates the reaction by stabilizing the transition state and reducing the energy barrier (activation energy) that must be overcome for the reaction to occur.

Step 3: Analyze what happens to enzymes after the reaction. After the reaction is complete and the products are released, the enzyme returns to its original state and is free to bind to another substrate molecule. Enzymes are not used up in the reaction; they are regenerated.

Step 4: Evaluate the given options:
Are consumed completely (Option A): This is incorrect. Enzymes are catalysts and are not consumed.
Act as catalysts (Option B): Catalysts speed up reactions without being consumed. This is the fundamental role of enzymes and explains why they remain unchanged.
Alter equilibrium permanently (Option C): Enzymes affect the rate of reaction but do not alter the equilibrium position of a reversible reaction. They speed up both the forward and reverse reactions equally.
Increase substrate concentration (Option D): Enzymes do not increase the concentration of the substrate; they bind to the existing substrate to facilitate the reaction.

Step 5: Conclude why enzymes remain unchanged. Enzymes act as catalysts, meaning they speed up reactions without being permanently altered or consumed.

Final Answer: Act as catalysts

Answer: (B)

Go Back to Question 88

Q89.

Solution

Concept: During strenuous physical activity, skeletal muscles may experience oxygen deprivation and resort to anaerobic respiration to produce ATP. This process leads to the accumulation of lactic acid, which has physiological consequences.

Solution: Step 1: Understand the conditions for anaerobic respiration in muscles. When the demand for ATP exceeds the supply through aerobic respiration (e.g., during vigorous exercise), skeletal muscles can switch to anaerobic respiration. This involves glycolysis followed by the conversion of pyruvate to lactic acid.

Step 2: Identify the product of anaerobic respiration in muscles. The end product of anaerobic respiration in human skeletal muscles is lactic acid.

Step 3: Consider the consequences of lactic acid accumulation.
Increased oxygen transport (Option A): Lactic acid accumulation is a result of oxygen deficit, not an increase in oxygen transport.
Muscle fatigue (Option B): The buildup of lactic acid contributes to the sensation of muscle fatigue and the burning sensation experienced during intense exercise. It lowers intracellular pH, affecting enzyme activity and muscle function.
Enhanced ATP storage (Option C): Anaerobic respiration produces far less ATP than aerobic respiration (2 ATP per glucose molecule vs. 30-32 ATP). It does not enhance ATP storage; it is a temporary measure to meet ATP demand.
Reduced respiration rate (Option D): While overall energy metabolism is affected, the immediate consequence of lactic acid buildup is muscle fatigue, not a reduced respiration rate of the organism.

Step 4: Conclude the primary consequence of lactic acid accumulation. The accumulation of lactic acid in skeletal muscles during vigorous exercise is a major contributor to muscle fatigue.

Final Answer: Muscle fatigue

Answer: (B)

Go Back to Question 89

Q90.

Solution

Concept: The nitrogen cycle describes the transformations of nitrogen and nitrogen-containing compounds in nature. Several microbial processes are involved, including nitrogen fixation, ammonification, nitrification, and denitrification.

Solution: Step 1: Understand the stages of the nitrogen cycle described. The question focuses on the conversion of ammonia into nitrites and then into nitrates by soil bacteria.

Step 2: Define the terms related to nitrogen transformations:
Ammonification (Option A): This is the process where decomposers (bacteria and fungi) convert organic nitrogen (from dead organisms and waste products) into ammonia (NH_3) or ammonium ions (NH_4^+). Nitrogen fixation (Option B): This is the conversion of atmospheric nitrogen gas (N_2) into ammonia (NH_3) or other nitrogenous compounds that can be used by plants.
Denitrification (Option C): This is the process where nitrates are reduced back into atmospheric nitrogen gas (N_2) by certain bacteria, returning nitrogen to the atmosphere.
Nitrification (Option D): This is a two-step process carried out by nitrifying bacteria:
1. Ammonia (NH_3) or ammonium ions (NH_4^+) are converted into nitrites (NO_2^-) by ammonia-oxidizing bacteria (e.g., Nitrosomonas).
2. Nitrites (NO_2^-) are then converted into nitrates (NO_3^-) by nitrite-oxidizing bacteria (e.g., Nitrobacter).
This two-step process, converting ammonia to nitrites and then to nitrates, is collectively known as nitrification.

Step 3: Match the description to the correct process. The conversion of ammonia to nitrites and then to nitrates by soil bacteria is precisely the process of nitrification.

Final Answer: Nitrification

Answer: (D)

Go Back to Question 90

Q91.

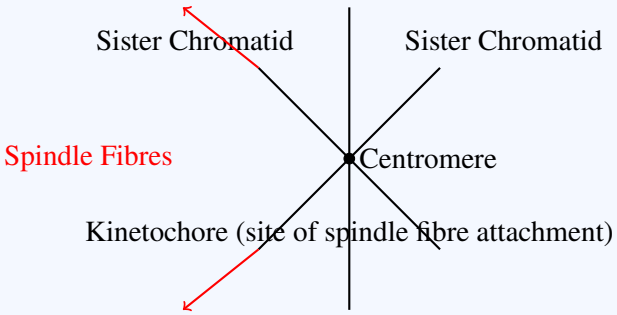
Solution

Concept: Chromosomes are structures within cells that carry genetic information. During cell division, they are segregated to daughter cells. Specific regions of chromosomes play crucial roles in this process.

Solution: Step 1: Recall chromosome movement during cell division. In mitosis and meiosis, spindle fibres help separate chromosomes by pulling them towards opposite poles of the cell.

Step 2: Identify the site of spindle fibre attachment. Spindle fibres attach to a specific region on the chromosome that ensures proper chromosome segregation.

Step 3: Analyze the given terms.
Chromatid (Option A): A chromatid is one half of a duplicated chromosome. Spindle fibres do not attach directly to the chromatid arms.
Centromere (Option B): The centromere is the constricted region joining sister chromatids. It forms the kinetochore, where spindle fibres attach during cell division.



Telomere (Option C): Telomeres are protective structures present at the ends of chromosomes and are not involved in spindle fibre attachment.
Nucleosome (Option D): Nucleosomes are units of DNA packaging formed by DNA wrapped around histone proteins. They do not function as attachment sites for spindle fibres.

Step 4: Conclude the correct region. The centromere is the region where spindle fibres attach through the kinetochore, allowing chromosomes to move towards opposite poles during cell division.

Final Answer: Centromere

Answer: (B)

Go Back to Question 91

Q92.

Solution

Concept: Pulmonary volumes and capacities are measures used in spirometry to assess lung function. They quantify the amount of air inhaled or exhaled under different breathing conditions.

Solution: Step 1: Understand the measurement of respiratory volumes. Spirometry measures different volumes of air moved in and out of the lungs.

Step 2: Define the given respiratory volumes and capacities:
Tidal volume (Option A): The volume of air inhaled or exhaled during a normal, quiet breath.
Inspiratory reserve volume (Option B): The additional volume of air that can be inhaled forcibly after a normal inhalation.
Vital capacity (Option C): This is the maximum volume of air that can be forcibly exhaled from the lungs after taking the deepest possible inhalation. It represents the total exchangeable air.
Vital Capacity = Tidal Volume + Inspiratory Reserve Volume + Expiratory Reserve Volume.
This definition perfectly matches the question's description. Residual volume (Option D): The volume of air remaining in the lungs after maximal exhalation. This air cannot be forcibly expelled.

Step 3: Match the definition to the correct term. The maximum volume of air that can be forcibly exhaled after the deepest possible breath is the definition of vital capacity.

Final Answer: Vital capacity

Answer: (C)

Go Back to Question 92

Q93.

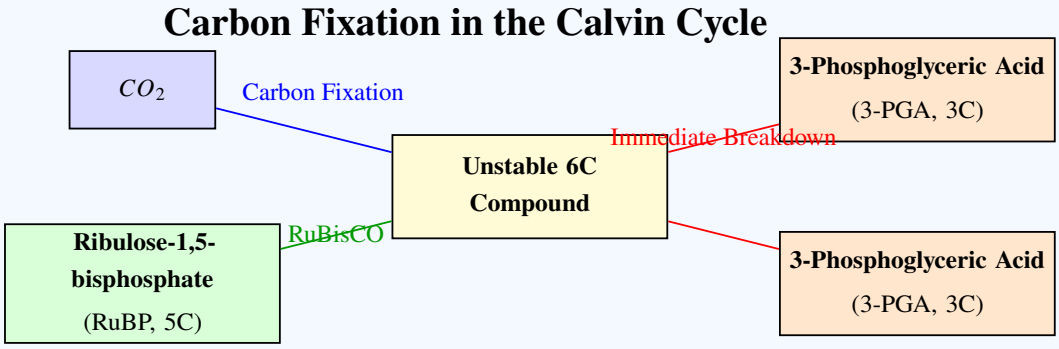
Solution

Concept: The Calvin cycle, also known as the light-independent reactions of photosynthesis, is responsible for fixing carbon dioxide and producing sugars. It involves several enzymatic steps.

Solution: Step 1: Recall the Calvin cycle. The Calvin cycle occurs in the chloroplast stroma and uses ATP and NADPH from the light reactions to convert CO_2 into sugars.

Step 2: Identify the first step of carbon fixation. The enzyme RuBisCO catalyzes the reaction between CO_2 and ribulose-1,5-bisphosphate (RuBP), a five-carbon compound.

Step 3: Determine the product formed. This reaction produces an unstable six-carbon intermediate, which immediately splits into two three-carbon molecules.



Step 4: Recall the 3-carbon product formed. The unstable 6-carbon compound immediately splits into two molecules of 3-phosphoglyceric acid (3-PGA).

Step 5: Evaluate the options:
Phosphoglyceric acid (Option A): Correct option. It is the 3-carbon compound formed during the Calvin cycle.
Oxaloacetic acid (Option B): A 4-carbon compound involved in C_4 photosynthesis and the Krebs cycle.
Pyruvic acid (Option C): A 3-carbon compound produced during glycolysis.
Malic acid (Option D): A 4-carbon compound associated with C_4 plants and the Krebs cycle.

Step 6: Conclude the answer. The unstable six-carbon compound breaks down into two molecules of phosphoglyceric acid (3-PGA).

Final Answer: Phosphoglyceric acid

Answer: (A)

Go Back to Question 93

Q94.

Solution

Concept: Recombinant DNA technology has revolutionized medicine, allowing for the production of therapeutic proteins like insulin. The Human Genome Project and subsequent advancements have enabled the development of genetically engineered drugs.

Solution: Step 1: Understand the development of human insulin through biotechnology. Prior to recombinant DNA technology, insulin for diabetic patients was extracted from animal pancreases, which could cause allergic reactions. Genetically engineered human insulin offered a safer and more efficient alternative.

Step 2: Identify the first commercially produced human insulin using recombinant DNA technology. In the early 1980s, Genentech developed a method to produce human insulin in bacteria (E. coli) using recombinant DNA technology.

Step 3: Recall the brand name or designation of this first product. The genetically engineered human insulin produced by Genentech and marketed by Eli Lilly and Company was initially called Humulin.

Step 4: Evaluate the other options:
Humulin (Option A): This is the correct name for the first genetically engineered human insulin.
Interferon (Option B): Interferons are proteins produced by the body in response to viral infections. Genetically engineered interferons are also used therapeutically, but Humulin was the first commercially available insulin.
Cyclosporin (Option C): Cyclosporin is an immunosuppressant drug, originally derived from a fungus, used to prevent organ transplant rejection. It is not a protein produced by recombinant DNA technology in the same way as Humulin.
Streptokinase (Option D): Streptokinase is an enzyme produced by *Streptococcus* bacteria that is used to break down blood clots. It is a therapeutic protein, but Humulin predates it as the first recombinant human protein drug.

Step 5: Conclude the name of the first commercial human insulin. The first commercially produced human insulin via recombinant DNA technology was called Humulin.

Final Answer: Humulin

Answer: (A)

Go Back to Question 94

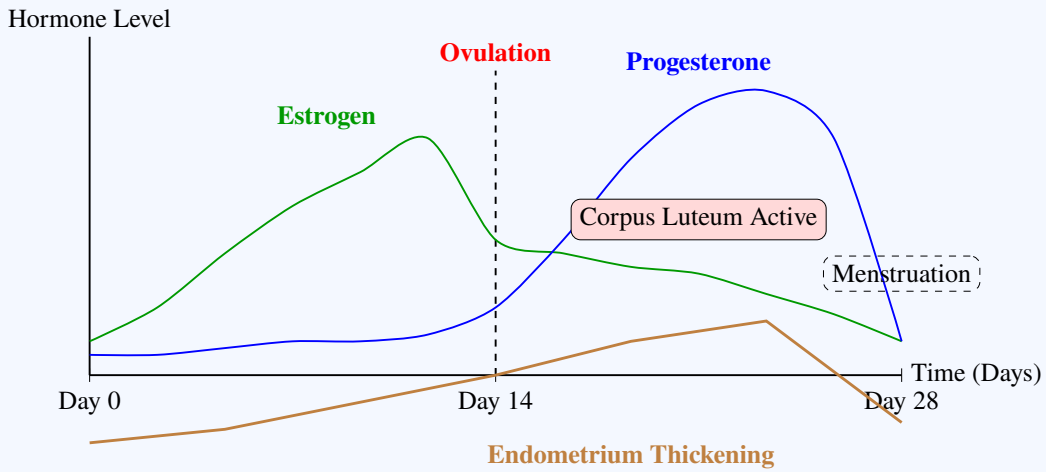
Q95.

Solution

Concept: Pregnancy maintenance involves hormonal support to sustain the uterine lining (endometrium) and prevent its shedding. Several hormones are involved, but one plays a primary role in the early stages.

Solution: Step 1: Understand the hormonal requirements for maintaining pregnancy. After fertilization and implantation, the corpus luteum, initially stimulated by LH, starts producing hormones that maintain the endometrium and prevent menstruation.

Step 2: Recall the functions of important reproductive hormones during early pregnancy:
Estrogen (Option A): Estrogen helps in the growth and proliferation of the endometrium, but it is not the main hormone responsible for maintaining pregnancy in the early stages.
Progesterone (Option B): Progesterone maintains the uterine endometrium by keeping it thick and vascular for implantation and embryo development. It is secreted by the corpus luteum during early pregnancy and prevents breakdown of the endometrium.



Oxytocin (Option C): Oxytocin mainly functions in uterine contractions during childbirth and milk ejection during lactation.
Relaxin (Option D): Relaxin helps relax uterine muscles and ligaments, especially during late pregnancy.

Step 3: Identify the correct hormone. Progesterone is the hormone primarily responsible for maintaining the endometrium and supporting early pregnancy.

Final Answer: Progesterone

Answer: (B)

Go Back to Question 95

Q96.

Solution

Concept: Biodiversity hotspots are regions that are both biologically diverse and are under significant threat from humans. India, with its diverse ecosystems, harbors several such hotspots.

Solution: Step 1: Understand the definition of a biodiversity hotspot. A biodiversity hotspot is a biogeographic region that is both exceptionally rich in endemic species (species found nowhere else) and under severe threat of destruction.

Step 2: Recall the major biodiversity hotspots in India. India is home to several globally recognized biodiversity hotspots. These include:
The Himalayas
The Western Ghats
The Indo-Burma region (partially in India)
The Sundaland region (partially in India, e.g., Nicobar Islands)

Step 3: Evaluate the given geographical regions:
Thar Desert (Option A): While it has unique adaptations and endemic species, it is not typically classified as a global biodiversity hotspot due to lower species richness and endemism compared to other regions.
Western Ghats (Option B): The Western Ghats mountain range in western India is a globally recognized biodiversity hotspot. It is characterized by high levels of species richness and endemism, particularly among amphibians, reptiles, and plants, and faces significant threats from habitat loss and fragmentation.
Indo-Gangetic Plain (Option C): This is a fertile region with high agricultural productivity but is heavily impacted by human activity and lacks the high endemism and species richness that define a hotspot.
Deccan Plateau (Option D): While the Deccan Plateau has diverse habitats, it is not as intensely rich in endemic species or as critically threatened as the Western Ghats in the context of global biodiversity hotspots.

Step 4: Conclude which region is considered a biodiversity hotspot. The Western Ghats are a prominent and well-established biodiversity hotspot in India.

Final Answer: Western Ghats

Answer: (B)

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Q97.

Solution

Concept: The central dogma of molecular biology describes the flow of genetic information within a biological system. It outlines the fundamental processes of gene expression.

Solution: Step 1: Understand the central dogma of molecular biology. The central dogma, as proposed by Francis Crick, describes the fundamental direction of genetic information flow.

Step 2: Recall the primary steps in gene expression.
DNA replication: DNA makes copies of itself. (DNA → DNA)
Transcription: Genetic information from DNA is transcribed into messenger RNA (mRNA). (DNA → RNA)
Translation: The genetic information in mRNA is translated into a sequence of amino acids, forming a protein. (RNA → Protein)

Step 3: Identify the general flow of information according to the central dogma. The standard flow of genetic information is from DNA to RNA and then from RNA to Protein. This sequential transfer of information is fundamental to most biological systems.

Step 4: Evaluate the options based on the central dogma:
Protein to DNA to RNA (Option A): This is reverse flow and incorrect.
RNA to DNA to Protein (Option B): The flow from RNA to DNA is called reverse transcription, which occurs in retroviruses, but it is not the general flow of genetic information.
DNA to RNA to Protein (Option C): This represents transcription followed by translation, which is the primary direction of genetic information flow in most organisms. This aligns with the central dogma. DNA to Protein to RNA (Option D): This pathway is incorrect. DNA does not directly code for protein in this manner, and protein does not typically flow back to RNA.

Step 5: Conclude the correct sequential flow of genetic information. The central dogma states that genetic information generally flows from DNA to RNA to Protein.

Final Answer: DNA to RNA to Protein

Answer: (C)

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Q98.

Solution

Concept: Plant growth is regulated by plant hormones (phytohormones) and responses to external stimuli. Tropisms are directional growth responses to stimuli.

Solution: Step 1: Understand the scenario. The question describes a plant organ's growth being regulated by the unequal distribution of auxin, leading to differential cell elongation in response to a light stimulus. This results in directional growth.

Step 2: Define the types of tropisms:
Geotropism (Option A): This is the directional growth of a plant in response to gravity. Roots typically grow downwards (positive geotropism), and shoots grow upwards (negative geotropism).
Hydrotropism (Option B): This is the directional growth of plant roots in response to moisture gradients, growing towards water.
Phototropism (Option C): This is the directional growth of a plant in response to light. Shoots typically exhibit positive phototropism (growing towards light), which is mediated by the hormone auxin. Unequal distribution of auxin, influenced by light, causes cells on the shaded side to elongate more than those on the illuminated side, bending the stem towards the light. This precisely matches the description.
Thigmotropism (Option D): This is the directional growth response to touch, observed in plants like tendrils, which coil around supporting structures.

Step 3: Match the stimulus and response to the correct term. Growth towards light, mediated by auxin and differential cell elongation, is known as phototropism.

Final Answer: Phototropism

Answer: (C)

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Q99.

Solution

Concept: Forests play a crucial role in the global carbon cycle. They absorb carbon dioxide from the atmosphere during photosynthesis and store it in their biomass. Deforestation disrupts this balance.

Solution: Step 1: Understand the role of forests in the carbon cycle. Forests, through photosynthesis, absorb carbon dioxide (CO_2) from the atmosphere. This CO_2 is converted into organic compounds, effectively removing it from the atmosphere and storing it in the wood, leaves, and roots of the trees and in the soil.

Step 2: Define the ecological terms related to carbon.
Carbon sources (Option A): Carbon sources are reservoirs that release carbon into the atmosphere (e.g., combustion of fossil fuels, respiration). Forests are not carbon sources in this context; they are carbon removers.
Carbon sinks (Option B): Carbon sinks are reservoirs that absorb more carbon from the atmosphere than they release. Forests are significant terrestrial carbon sinks. Deforestation removes these sinks.
Nitrogen reservoirs (Option C): Nitrogen reservoirs are places where nitrogen is stored (e.g., atmosphere, soil). Forests do play a role in the nitrogen cycle, but their primary impact on atmospheric CO_2 is as carbon sinks.
Ozone producers (Option D): Ozone (O_3) is formed in the stratosphere by UV radiation acting on oxygen and in the troposphere by pollution. Forests do not primarily act as ozone producers.

Step 3: Explain the impact of deforestation. When forests are cleared (deforested), the stored carbon is often released back into the atmosphere through burning or decomposition. Furthermore, the removal of trees eliminates the capacity of these areas to absorb CO_2 in the future. This leads to an increase in atmospheric CO_2 levels and contributes to global warming.

Step 4: Conclude the role of forests concerning atmospheric carbon dioxide. Forests act as carbon sinks, absorbing CO_2 from the atmosphere. Their removal therefore increases atmospheric CO_2.

Final Answer: Carbon sinks

Answer: (B)

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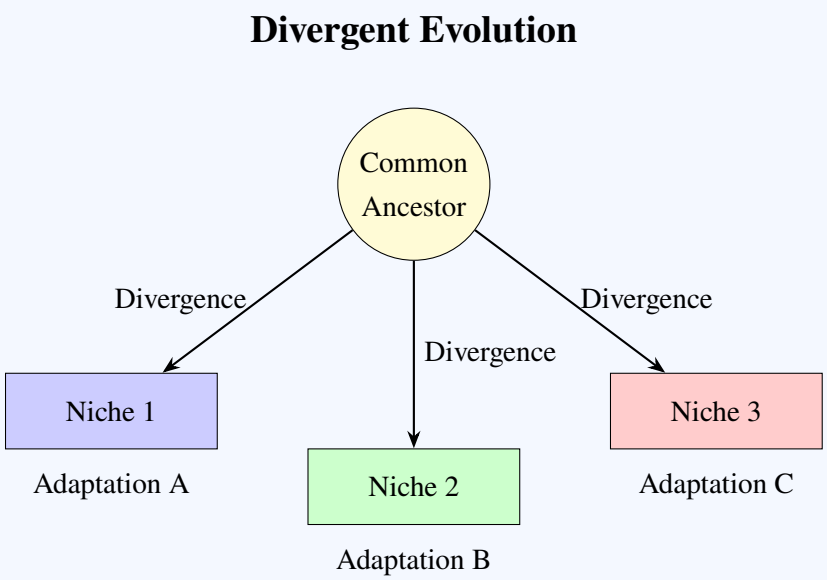
Q100.

Solution

Concept: Evolutionary biology explains the diversification of life on Earth. Different patterns of evolution lead to different relationships between species and their adaptations.

Solution: Step 1: Understand the scenario. Related organisms developing different adaptations in different ecological niches suggests that they evolved from a common ancestor and gradually became different over time.

Step 2: Define the evolutionary patterns:
Convergent evolution (Option A): Unrelated organisms develop similar adaptations due to similar environmental conditions, producing analogous structures.
Divergent evolution (Option B): Organisms from a common ancestor evolve different adaptations while occupying different ecological niches, leading to homologous structures. This matches the given scenario.



Parallel evolution (Option C): Related organisms independently develop similar traits due to similar environmental pressures.
Artificial selection (Option D): Humans selectively breed organisms for desirable traits.

Step 3: Identify the correct pattern. The evolution of related organisms into different forms adapted to different ecological niches is called divergent evolution.

Final Answer: Divergent evolution

Answer: (B)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	B	4	B	5	C
6	B	7	B	8	B	9	A	10	C
11	B	12	C	13	B	14	C	15	D
16	B	17	C	18	B	19	C	20	B
21	C	22	B	23	C	24	B	25	C
26	B	27	B	28	B	29	B	30	B
31	B	32	C	33	B	34	B	35	C
36	B	37	C	38	C	39	B	40	B
41	B	42	B	43	B	44	C	45	B
46	C	47	C	48	C	49	B	50	C
51	D	52	B	53	C	54	C	55	C
56	C	57	B	58	B	59	B	60	C
61	C	62	B	63	C	64	A	65	C
66	C	67	B	68	B	69	B	70	B
71	B	72	C	73	C	74	B	75	C
76	C	77	C	78	C	79	B	80	B
81	B	82	C	83	A	84	B	85	B
86	C	87	B	88	B	89	B	90	D
91	B	92	C	93	A	94	A	95	B
96	B	97	C	98	C	99	B	100	B