

BITSAT Biology Sample Paper – 11

Duration: 60 Minutes

Maximum Marks: 120

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+3 marks**. Each incorrect answer carries **-1** mark. Unattempted questions carry **0** marks.
- Only **one** option is correct for each question.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. A child with blood group O is born to a mother with blood group A and a father with blood group B. What is the probability that their next child will be a male with blood group AB?

- (A) 0.50
- (B) 0.25
- (C) 0.125
- (D) 0.0625

Q2. During standard non-cyclic photophosphorylation, if a plant is temporarily treated with a metabolic inhibitor that blocks the plastoquinone (PQ) binding site on the cytochrome b_6f complex, which of the following events will still occur?

- (A) Reduction of NADP^+ to NADPH
- (B) Synthesis of ATP via the $\text{CF}_0 - \text{CF}_1$ complex
- (C) Photo-oxidation of water molecules at the oxygen-evolving complex
- (D) Translocation of protons from the stroma into the thylakoid lumen

Q3. A researcher extracts a double-stranded DNA molecule and determines



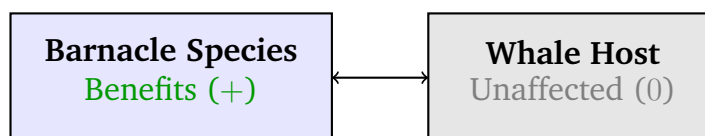
that it contains 32% cytosine. What percentage of the total purine bases in this DNA molecule is represented by adenine?

- (A) 18%
- (B) 32%
- (C) 36%
- (D) 64%

Q4. Which of the following correctly pairs a primary secondary metabolite with its specific category and therapeutic or commercial application?

- (A) Vinblastine – Alkaloid – Anti-cancer drug
- (B) Concanavalin A – Essential oil – Antimicrobial agent
- (C) Carotenoid – Terpenoid – Spice flavoring
- (D) Ricin – Lectin – Dietary supplement

Q5. In a marine ecosystem, a specific species of barnacle grows on the surface of a whale's skin. The barnacle gains a stable substrate and access to nutrient-rich water currents, while the whale is completely unaffected. Which type of population interaction does this scenario represent?



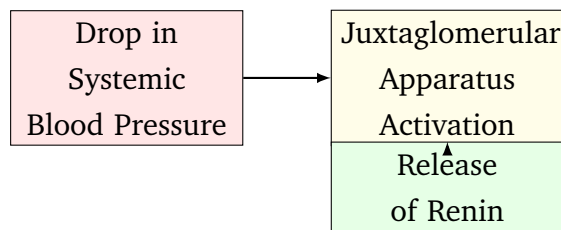
- (A) Mutualism
- (B) Commensalism
- (C) Amensalism
- (D) Parasitism

Q6. A patient presents with structural abnormalities in their tracheal lining, leading to impaired clearance of mucus and trapped particles. This condition is most likely caused by a defect in which type of epithelial tissue?



- (A) Simple cuboidal epithelium
- (B) Pseudostratified ciliated columnar epithelium
- (C) Stratified squamous non-keratinized epithelium
- (D) Simple transitional epithelium

Q7. In a healthy human adult, a sudden and significant drop in systemic blood pressure will immediately trigger which of the following physiological compensatory mechanisms?



- (A) Inactivation of the juxtaglomerular apparatus to halt renin release
- (B) Increased secretion of Atrial Natriuretic Peptide (ANP) from the cardiac atria
- (C) Vasoconstriction of afferent arterioles mediated by high aldosterone levels
- (D) Release of renin to convert circulating angiotensinogen into angiotensin I

Q8. Which of the following floral characteristics is typically associated with a plant species that relies primarily on anemophily for pollination?

- (A) Large, sticky, or heavily sculptured pollen grains
- (B) Intensely fragrant flowers with well-developed nectar guides
- (C) Well-exposed, feathery stigmas and versatile anthers
- (D) Brightly colored petals with fused corolla tubes

Q9. During the microsporogenesis and male gametophyte development in angiosperms, how many total meiotic and mitotic divisions are required for a single functional microspore mother cell to produce mature, three-celled pollen grains?



- (A) 1 meiotic and 1 mitotic division
- (B) 1 meiotic and 2 mitotic divisions
- (C) 2 meiotic and 1 mitotic division
- (D) 1 meiotic and 3 mitotic divisions

Q10. A molecular biology student sets up an in vitro translation system but accidentally omits the aminoacyl-tRNA synthetase specific for methionine. What will be the direct consequence on the translation process?

- (A) Peptide bonds will form normally, but termination will be blocked.
- (B) Translation initiation will fail because the initiator tRNA cannot be charged.
- (C) The ribosome will scan the mRNA but skip all internal AUG codons without stopping.
- (D) Non-specific tRNAs will randomly bind to the start codon instead.

Q11. Choose the correct sequence of taxonomic categories in ascending order for the housefly (*Musca domestica*).

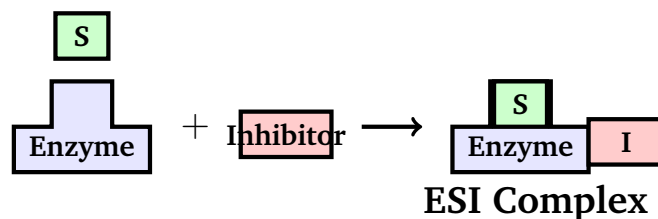
- (A) *Musca* → Muscidae → Diptera → Insecta → Arthropoda
- (B) Muscidae → *Musca* → Diptera → Insecta → Arthropoda
- (C) *Musca* → Diptera → Muscidae → Insecta → Arthropoda
- (D) Muscidae → Diptera → *Musca* → Insecta → Arthropoda

Q12. If a somatic cell with a diploid chromosome number of $2n = 24$ undergoes normal mitosis, what will be the total number of chromosomes and the total number of chromatids present in the cell during anaphase?

- (A) 24 chromosomes and 24 chromatids
- (B) 24 chromosomes and 48 chromatids
- (C) 48 chromosomes and 48 chromatids
- (D) 48 chromosomes and 0 chromatids



- Q13.** In human female reproductive physiology, what causes the rapid block to polyspermy immediately following the binding of the first sperm to the egg plasma membrane?
- (A) Exocytosis of cortical granules leading to the hardening of the zona pellucida
- (B) A rapid depolarization of the oocyte plasma membrane due to an influx of sodium ions
- (C) The immediate completion of Meiosis II by the secondary oocyte
- (D) A sharp drop in intracellular calcium levels within the ooplasm
- Q14.** An enzyme-catalyzed reaction is studied in the presence of a molecule that binds exclusively to the enzyme-substrate complex, reducing both the apparent V_{\max} and the apparent K_m . What type of inhibition is occurring?



- (A) Competitive inhibition
- (B) Non-competitive inhibition
- (C) Uncompetitive inhibition
- (D) Allosteric activation
- Q15.** A transgenic strain of cotton (*Bt* cotton) expresses the Cry1Ac endotoxin. This toxin selectively destroys the midgut epithelium of specific insect pests. Which internal condition within the insect midgut triggers the activation of this protoxin?
- (A) Strongly acidic pH
- (B) Strongly alkaline pH
- (C) High concentration of digestive lipases



(D) Presence of specific mechanical grinding structures

Q16. Which of the following features uniquely distinguishes members of the Class Chondrichthyes from members of the Class Osteichthyes?

- (A) Presence of a ventral heart and a closed circulatory system
- (B) Cartilaginous endoskeleton and the absence of an operculum over the gills
- (C) Possession of a lateral line system for mechanoreception
- (D) Homocercal caudal fin and the presence of an air bladder

Q17. During a standard cardiac cycle in a resting human adult, what is the immediate mechanical consequence of the closure of the atrioventricular (AV) valves?

- (A) The generation of the second heart sound (“dub”) at the start of ventricular diastole
- (B) A rapid rise in intraventricular pressure during isovolumetric contraction
- (C) The immediate opening of the pulmonary and aortic semilunar valves
- (D) The initiation of the atrial systole wave on an electrocardiogram

Q18. A botanist exposes a short-day plant to a long night period that exceeds its critical dark period, which would normally induce flowering. However, the dark period is interrupted exactly in the middle by a brief flash of far-red light followed immediately by a flash of red light. What will be the vegetative response of the plant?

- (A) The plant will flower normally because far-red light always promotes flowering.
- (B) The plant will remain vegetative and fail to flower due to the final red light flash.
- (C) The plant will flower because the two flashes cancel each other out completely.

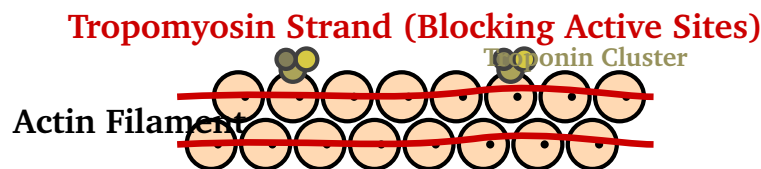


(D) The plant will undergo rapid senescence and die without flowering.

Q19. Which of the following components of the human brain acts as the primary homeostatic regulatory center for body temperature, hunger, thirst, and circadian rhythms?

- (A) Cerebellum
- (B) Thalamus
- (C) Hypothalamus
- (D) Medulla oblongata

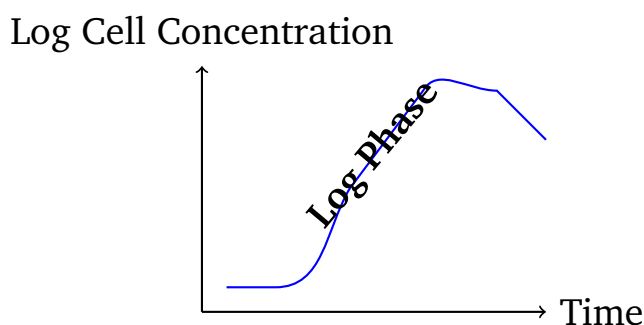
Q20. In an active skeletal muscle fiber, what prevents the binding of myosin cross-bridges to actin filaments when the muscle is completely at rest?



- (A) Absence of ATP molecules bound to the myosin heavy chain head
 - (B) The physical blocking of myosin-binding sites on actin by the tropomyosin-troponin complex
 - (C) Saturation of ryanodine receptors by excess calcium ions in the sarcoplasm
 - (D) Conformation change in the Z-disc proteins that separates the filaments
- Q21.** A woman who is a carrier for the X-linked recessive disorder hemophilia marries a phenotypically normal man. What is the probability that their first-born child will be a son who suffers from hemophilia?
- (A) 100%
 - (B) 50%
 - (C) 25%
 - (D) 0%



- Q22.** Which of the following plant growth regulators is synthesized predominantly in root tips and is transported acropetally to promote lateral bud growth and delay leaf senescence?
- (A) Abscisic acid
(B) Gibberellic acid
(C) Indole-3-acetic acid
(D) Zeatin
- Q23.** In an industrial fermentation facility producing recombinant human insulin, which specific phase of the microbial growth curve should be prolonged as much as possible to achieve maximum biomass and high yield of the product before harvesting?



- (A) Lag phase
(B) Exponential (Log) phase
(C) Stationary phase
(D) Decline phase
- Q24.** A population of a specific rodent species is introduced to an isolated island with abundant resources and zero natural predators. Initially, the population growth fits an exponential model. As resources eventually become limited, which parameters will shift in the logistic growth equation $\frac{dN}{dt} = rN \left(\frac{K-N}{K} \right)$?
- (A) As N approaches K , the value of $\frac{dN}{dt}$ approaches zero.
(B) As N approaches K , the intrinsic rate of natural increase (r) becomes negative.



- (C) The carrying capacity (K) will decrease dynamically to match the value of N .
- (D) The population will continue to grow exponentially regardless of K .

Q25. Which of the following options correctly highlights a key structural difference between a typical dicotyledonous root and a monocotyledonous root?

- (A) Dicot roots possess a large and well-developed pith, whereas monocot roots completely lack a pith.
- (B) Dicot roots typically exhibit polyarch xylem bundles, whereas monocot roots show diarch to tetrarch conditions.
- (C) Dicot roots undergo secondary growth via a vascular cambium, whereas monocot roots do not undergo secondary growth.
- (D) Dicot roots possess a heavily suberized exodermis, whereas monocot roots lack an endodermis layer.

Q26. An individual is diagnosed with an autoimmune disorder characterized by the progressive destruction of the myelin sheath surrounding neurons in the central nervous system. Which specific cell type is the target of destruction in this condition?

- (A) Schwann cells
- (B) Oligodendrocytes
- (C) Astrocytes
- (D) Microglial cells

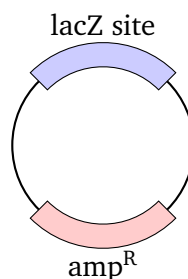
Q27. In a human female, the surge of which hormone from the anterior pituitary gland is directly responsible for triggering ovulation and the subsequent transformation of the ruptured follicle into the corpus luteum?

- (A) Follicle-Stimulating Hormone (FSH)
- (B) Luteinizing Hormone (LH)



- (C) Progesterone
- (D) Human Chorionic Gonadotropin (hCG)

Q28. During the process of gene cloning, a researcher uses a plasmid vector that contains an ampicillin resistance gene (amp^R) and a lacZ gene encoding β -galactosidase. If a foreign gene is successfully ligated into the restriction site located inside the lacZ gene, what will be the phenotype of the transformed *E. coli* cells grown on a medium containing ampicillin and X-gal?



- (A) The cells will die because they lack ampicillin resistance.
 - (B) The cells will survive and form blue-colored colonies.
 - (C) The cells will survive and form white/colorless colonies.
 - (D) The cells will die due to the accumulation of toxic X-gal derivatives.
- Q29.** According to the modern synthetic theory of evolution, which of the following is considered the primary source of brand-new alleles and novel genetic variations within a closed population's gene pool?
- (A) Genetic drift
 - (B) Natural selection
 - (C) Random mutation
 - (D) Non-random mating
- Q30.** A clinician examines a patient with severe swelling of the lower limbs and scrotum. Laboratory tests confirm a chronic infection by a nematode parasite transmitted through the bite of a female *Culex* mosquito. What is the causative agent?



- (A) *Ascaris lumbricoides*
- (B) *Wuchereria bancrofti*
- (C) *Ancylostoma duodenale*
- (D) *Trichinella spiralis*

Q31. During the transport of respiratory gases in human blood, what occurs within erythrocytes as a direct consequence of the “chloride shift” (Hamburger phenomenon) in systemic capillaries near metabolically active tissues?

- (A) Chloride ions diffuse out of the erythrocyte into the plasma to maintain electrical neutrality.
- (B) Bicarbonate ions diffuse out of the erythrocyte into the plasma, while chloride ions move into the erythrocyte.
- (C) Oxyhemoglobin binds tightly to hydrogen ions, increasing its affinity for oxygen.
- (D) Carbonic anhydrase is denatured by the high concentration of internal chloride ions.

Q32. Which of the following options correctly groups organisms that belong exclusively to the Kingdom Fungi and possess a dikaryophase stage during their sexual reproductive cycle?

- (A) *Mucor* and *Rhizopus*
- (B) *Albugo* and *Phytophthora*
- (C) *Neurospora* and *Agaricus*
- (D) *Ustilago* and *Nostoc*

Q33. A biological fluid sample is treated with Ninhydrin reagent and heated, yielding a deep purple color. A separate test with Benedict’s reagent remains blue after heating. What can be concluded about the major macromolecular components of this sample?

- (A) The sample contains reducing sugars but lacks proteins.



- (B) The sample contains proteins or amino acids but lacks reducing sugars.
- (C) The sample contains a high concentration of triacylglycerols and starch.
- (D) The sample consists exclusively of non-reducing disaccharides.

Q34. Which of the following parts of the human blastocyst is structurally responsible for attaching to the endometrial wall during implantation and later contributes to the formation of the embryonic portion of the placenta?

- (A) Inner cell mass
- (B) Trophoblast
- (C) Blastocoel
- (D) Corona radiata

Q35. A mutation occurs in a eukaryotic cell that renders the nucleolus non-functional. Which of the following cellular processes will be directly and most immediately disrupted by this mutation?

- (A) Synthesis of messenger RNA (mRNA) transcripts
- (B) Replication of mitochondrial DNA plasmid molecules
- (C) Transcription and processing of ribosomal RNA (rRNA)
- (D) Attachment of lipid anchors to secretory proteins

Q36. During the light-independent reactions of C_4 plants, the initial fixation of carbon dioxide occurs in a different cell type than the primary catalytic action of the enzyme RuBisCO. In which specific cells do initial CO_2 fixation and the Calvin cycle take place, respectively?

- (A) Bundle sheath cells; Mesophyll cells
- (B) Mesophyll cells; Bundle sheath cells
- (C) Epidermal guard cells; Mesophyll cells



(D) Bundle sheath cells; Vascular cambium cells

Q37. A team of immunologists synthesizes a therapeutic monoclonal antibody designed to neutralize a specific viral surface glycoprotein. Which method is standardly used to produce these highly specific monoclonal antibodies on a commercial scale?

(A) Polymerase Chain Reaction amplification of antibody genes in cell-free systems

(B) Hybridoma technology involving the fusion of B-lymphocytes with myeloma cells

(C) Direct chemical synthesis of heavy and light chains in automated peptide synthesizers

(D) Exposure of live laboratory mice to high doses of ultraviolet radiation

Q38. In a clinical trial, a patient is found to have a severe deficiency of mature T-lymphocytes, while their B-lymphocyte counts remain within normal physiological ranges. This specific immunological defect is most likely linked to congenital atrophy or hypoplasia of which organ?

(A) Spleen

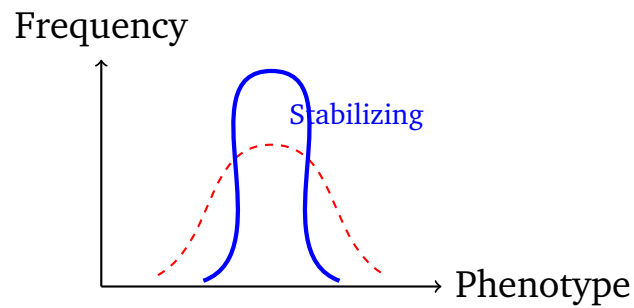
(B) Bone marrow

(C) Thymus

(D) Peyer's patches

Q39. A long-term study of a specific bird population shows that individuals with intermediate tail lengths survive and reproduce at significantly higher rates than individuals with either extremely short or extremely long tails. What mode of natural selection is operating on this population?





- (A) Directional selection
- (B) Disruptive selection
- (C) Stabilizing selection
- (D) Frequency-dependent selection

Q40. Which of the following features is universally shared by all bryophytes but is completely absent in pteridophytes?

- (A) The presence of a dominant, independent, and photosynthetic gametophyte generation
- (B) The possession of well-defined vascular tissues (xylem and phloem)
- (C) The production of heterosporous structures within distinct strobili
- (D) Requirement of free water as a medium for flagellated male gamete transport



Detailed Solutions

Q1.

Solution

Concept: The inheritance of ABO blood groups in humans is determined by three alleles of a single gene: I^A , I^B , and i . The alleles I^A and I^B are codominant, while both are completely dominant over the recessive allele i . Sex determination in humans follows an XX-XY system, where the probability of having a male child is always independent of autosomal genetic traits.

Solution: Step 1: Determine the genotypes of the parents based on the child's phenotype. The child has blood group O, which corresponds to the homozygous recessive genotype ii . To inherit this genotype, the child must receive one recessive allele i from the mother and one recessive allele i from the father.

Step 2: Establish the parental genotypes. The mother has blood group A, meaning her genotype must be heterozygous $I^A i$. The father has blood group B, meaning his genotype must be heterozygous $I^B i$.

Step 3: Analyze the cross for blood groups using a Punnett square. Crossing $I^A i$ with $I^B i$ yields four possible offspring genotypes in equal proportions:

$I^A I^B$ (Blood Group AB)

$I^A i$ (Blood Group A)

$I^B i$ (Blood Group B)

ii (Blood Group O)

The probability of a child having blood group AB ($I^A I^B$) is therefore $\frac{1}{4}$ or 0.25.

Step 4: Determine the probability of the child's biological sex. The segregation of sex chromosomes (XX from mother and XY from father) establishes that the probability of having a male child (XY) is always $\frac{1}{2}$ or 0.50.

Step 5: Apply the product rule of probability for independent events to find the combined chance of having a child who is both male and has blood group AB:

Total Probability = Probability of Male \times Probability of AB Blood Group

$$\text{Total Probability} = \frac{1}{2} \times \frac{1}{4} = \frac{1}{8} = 0.125$$

Final Answer:

Answer: (C)

[Go Back to Question 1](#)



Q2.

Solution

Concept:

Z-scheme of non-cyclic photophosphorylation and light-dependent reactions in photosynthesis.

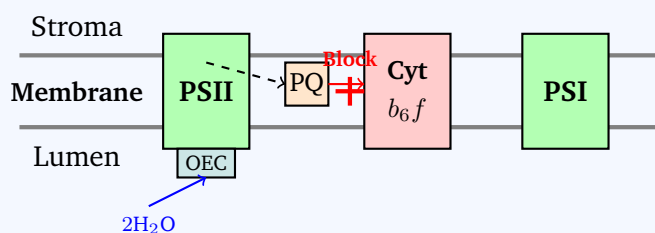
Solution:

Step 1: During non-cyclic photophosphorylation, light energy hits Photosystem II (PSII), exciting electrons. To replace these lost electrons, the Oxygen-Evolving Complex (OEC) splits water ($2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4e^-$). This photo-oxidation happens entirely on the luminal side of PSII.

Step 2: The excited electrons travel from PSII to Plastoquinone (PQ), then to the Cytochrome b_6f complex, Plastocyanin (PC), Photosystem I (PSI), and finally to NADP^+ Reductase to form NADPH.

Step 3: If an inhibitor blocks the PQ binding site on Cytochrome b_6f , downstream electron transport stops. As a result, NADP^+ reduction (Option A) ceases, and protons cannot be pumped into the lumen by PQ/Cytochrome b_6f (Option D).

Step 4: Without the proton gradient, ATP synthesis (Option B) also shuts down. However, the initial excitation of PSII and the subsequent water splitting at the Oxygen-Evolving Complex can still occur initially because it takes place upstream of the block. Therefore, option (C) is correct.



Final Answer: C

Answer: (C)

[Go Back to Question 2](#)



Q3.

Solution

Concept: Chargaff's rules for double-stranded DNA dictate that base pairing is highly specific: Adenine (A) pairs exclusively with Thymine (T), and Cytosine (C) pairs exclusively with Guanine (G). Therefore, the molar concentration of purines (A + G) always equals the molar concentration of pyrimidines (T + C), meaning each group makes up exactly 50% of the total bases.

Solution: Step 1: Extract the given value. The double-stranded DNA molecule contains 32% cytosine (C = 32%).

Step 2: Calculate the guanine content. Because cytosine pairs exclusively with guanine in double-stranded configurations, their percentages are equal:

$$G = C = 32\%$$

Step 3: Determine the total percentage occupied by C and G base pairs:

$$C + G = 32\% + 32\% = 64\%$$

Step 4: Find the combined percentage of the remaining bases, adenine (A) and thymine (T):

$$A + T = 100\% - 64\% = 36\%$$

Since adenine pairs exclusively with thymine, their values are shared equally:

$$A = T = \frac{36\%}{2} = 18\%$$

Step 5: Identify the total percentage of purine bases in the DNA molecule. Purines consist of adenine (A) and guanine (G). By definition, purines constitute exactly half of the total sequence:

$$\text{Total Purines} = A + G = 18\% + 32\% = 50\%$$

Step 6: Calculate the specific proportion of these purine bases that is represented by adenine. The question asks for the percentage of the *total purine bases* represented by adenine:

$$\text{Percentage} = \left(\frac{\text{Adenine}}{\text{Total Purines}} \right) \times 100\%$$

$$\text{Percentage} = \left(\frac{18\%}{50\%} \right) \times 100\% = 36\%$$

Final Answer:

Answer: (C)

[Go Back to Question 3](#)



Q4.

Solution

Concept: Secondary metabolites are biochemical compounds produced by plants, fungi, and microbes that are not directly involved in normal growth, development, or reproduction, but play key ecological roles. Many secondary metabolites possess significant therapeutic value and are classified into distinct chemical groups such as alkaloids, terpenoids, lectins, and essential oils based on their structures.

Solution: Step 1: Evaluate option (A). Vinblastine is an alkaloid isolated from the periwinkle plant (*Catharanthus roseus*). It acts as a mitotic inhibitor by disrupting microtubule formation and is widely utilized as a potent anti-cancer drug. This pairing is entirely correct.

Step 2: Evaluate option (B). Concanavalin A is classified biochemically as a lectin (a carbohydrate-binding protein), not an essential oil. It is commonly used in biochemical research rather than as a commercial antimicrobial agent. Thus, this option is incorrect.

Step 3: Evaluate option (C). Carotenoids are tetraterpenoid pigments responsible for bright yellow, orange, and red coloration in plants. They function primarily as accessory photosynthetic pigments and antioxidants, rather than spice flavorings. Thus, this option is incorrect.

Step 4: Evaluate option (D). Ricin is a highly dangerous toxic protein classified as a lectin, extracted from the seeds of the castor oil plant (*Ricinus communis*). Due to its extreme toxicity and mechanism of inhibiting protein synthesis, it cannot be used as a dietary supplement. Thus, this option is incorrect.

Final Answer: Vinblastine – Alkaloid – Anti-cancer drug

Answer: (A)

[Go Back to Question 4](#)



Q5.

Solution

Concept: In ecology, interspecific interactions describe how populations of different species interact within a community. These relationships are classified based on whether they are beneficial (+), detrimental (–), or neutral (0) to each participating organism.

Solution: Step 1: Analyze the effects of the interaction on each species described in the scenario. There are two organisms involved: the barnacle and the whale.

Step 2: Determine the status of the barnacle. The barnacle attaches to the whale's skin, which provides it with a stable structural substrate, protection from benthic predators, and continuous movement through nutrient-rich water currents to maximize filter feeding. Therefore, the barnacle derives a clear benefit from this relationship (+).

Step 3: Determine the status of the whale. The presence of these small barnacles on the whale's thick skin does not restrict the whale's mobility, cause physiological damage, or deplete its energy reserves. The whale is completely unaffected and unharmed (0).

Step 4: Identify the ecological interaction that corresponds to a (+, 0) relationship.

- Mutualism represents a (+, +) interaction where both benefit.
- Commensalism represents a (+, 0) interaction where one benefits and the other is unaffected.
- Amensalism represents a (–, 0) interaction where one is harmed and the other is unaffected.
- Parasitism represents a (+, –) interaction where one benefits at the expense of the host.

Because the barnacle benefits and the whale remains unaffected, this population interaction is a classic example of commensalism.

Final Answer:

Answer: (B)

[Go Back to Question 5](#)



Q6.

Solution**Concept:**

Structure and specific localization of specialized epithelial tissues in animals.

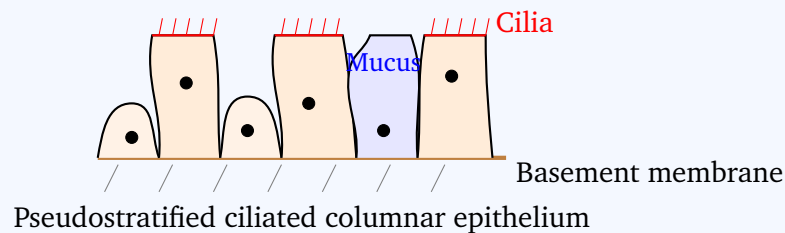
Solution:

Step 1: The trachea (windpipe) requires a mechanism to trap inhaled dust, pathogens, and particles, and sweep them upward away from the lungs. This functions as the mucociliary escalator.

Step 2: The lining responsible for this function consists of cells that appear layered due to nuclei at different levels but all touch the basement membrane (pseudostratified), possess hair-like projections (cilia), and are taller than they are wide (columnar).

Step 3: A defect in pseudostratified ciliated columnar epithelium directly leads to a failure in cilia movement, causing mucus accumulation and impaired clearance of trapped particles.

Step 4: Looking at the other choices: Simple cuboidal is typically for secretion/absorption (e.g., kidney tubules); Stratified squamous non-keratinized provides protection against abrasion (e.g., esophagus); Transitional epithelium allows stretching (e.g., urinary bladder). Thus, option (B) is correct.



Final Answer: B

Answer: (B)

[Go Back to Question 6](#)



Q7.

Solution

Concept: Human blood pressure and fluid volume are regulated by a sensitive multi-organ hormonal system called the Renin-Angiotensin-Aldosterone System (RAAS). When systemic blood pressure drops significantly, renal perfusion falls, triggering compensatory mechanisms to restore homeostatic balance via systemic vasoconstriction and fluid retention.

Solution: Step 1: Analyze the physiological trigger. A sudden, significant drop in systemic blood pressure decreases the stretch on baroreceptors and lowers renal perfusion pressure. This change is detected by the macula densa and baroreceptors in the kidneys.

Step 2: Evaluate the response of the juxtaglomerular (JG) apparatus. Reduced blood pressure directly stimulates the juxtaglomerular cells in the afferent arterioles of the kidneys to release the proteolytic enzyme renin into the bloodstream. This rules out option (A).

Step 3: Trace the enzymatic cascade initiated by renin. Once released, renin cleaves a circulating plasma protein synthesized by the liver, called angiotensinogen, converting it into an inactive decapeptide known as angiotensin I. This perfectly matches the statement in option (D).

Step 4: Assess subsequent steps and rule out incorrect options. Angiotensin I is later converted into the active vasoconstrictor angiotensin II by Angiotensin-Converting Enzyme (ACE). Angiotensin II induces systemic vasoconstriction and stimulates aldosterone secretion from the adrenal cortex to promote sodium and water reabsorption. Atrial Natriuretic Peptide (ANP) (Option B) is secreted in response to high blood pressure and volume, so it would be suppressed here. Afferent arterioles would undergo vasodilation, not vasoconstriction (Option C), to preserve the glomerular filtration rate.

Final Answer: Release of renin to convert circulating angiotensinogen into angiotensin I

Answer: (D)

[Go Back to Question 7](#)



Q8.

Solution

Concept: Anemophily refers to the process of pollination where pollen grains are carried accidentally by wind currents from male anthers to female stigmas. Because wind is a non-directional abiotic vector, anemophilous plants display distinct evolutionary adaptations designed to maximize the chances of pollen capture while minimizing energy expenditure on animal-attracting features.

Solution: Step 1: Identify traits associated with biotic pollination (zoophily/entomophily). Plants that rely on insects or birds for pollination must attract them using visual and olfactory cues. Large, sticky, or heavily textured pollen (A) helps grains attach to animal bodies. Intense fragrances and nectar guides (B), as well as brightly colored petals (D), attract pollinators. These traits do not align with wind pollination.

Step 2: Characterize wind pollination requirements. Because wind currents are random, anemophilous flowers do not spend energy producing colorful petals, sweet nectar, or strong fragrances; their flowers are typically small, green, and inconspicuous.

Step 3: Analyze the reproductive structures required for wind pollination. To successfully catch moving air currents, anthers must be versatile (swinging freely on delicate filaments) to easily release dry, lightweight, and smooth pollen grains. Simultaneously, the female stigmas must be long, well-exposed, and feathery to maximize their surface area and efficiently filter drifting pollen grains out of the air. This corresponds perfectly with option (C).

Final Answer: Well-exposed, feathery stigmas and versatile anthers

Answer: (C)

[Go Back to Question 8](#)



Q9.

Solution

Concept: Microsporogenesis and male gametophyte development are the two consecutive stages required to produce mature male gametes in angiosperms. Microsporogenesis involves the formation of haploid microspores from a diploid mother cell via meiosis, while male gametophyte development involves subsequent mitotic nuclear divisions to yield a functional pollen grain.

Solution: Step 1: Trace the meiotic phase (Microsporogenesis). Inside the anther's pollen sac, a single diploid ($2n$) microspore mother cell (MMC) undergoes a single round of meiotic division (Meiosis I followed by Meiosis II). This single meiotic division yields a tetrad containing four haploid (n) microspores.

Step 2: Trace the first mitotic phase. Each individual haploid microspore separates from the tetrad and expands. Its nucleus undergoes the first asymmetric mitotic division (Mitosis I) to generate two distinct cells within the pollen grain: a large vegetative cell (or tube cell) and a smaller generative cell. At this stage, the pollen grain is in its 2-celled condition.

Step 3: Trace the second mitotic phase. To form a mature, 3-celled pollen grain, the generative cell must undergo a second mitotic division (Mitosis II). This division splits the generative cell into two functional, non-motile male gametes (sperm cells).

Step 4: Sum the total divisions required for a single functional microspore line. The progression from a microspore mother cell to a mature, 3-celled male gametophyte requires exactly 1 meiotic division (to form the microspore) followed by 2 sequential mitotic divisions (the first to form the vegetative and generative cells, and the second to divide the generative cell into two sperm cells).

Final Answer: 1 meiotic and 2 mitotic divisions

Answer: (B)

[Go Back to Question 9](#)



Q10.

Solution

Concept: Translation is the process where a ribosome decodes an mRNA message to synthesize a polypeptide chain. Translation initiation in both prokaryotes and eukaryotes requires a specific initiator tRNA charged with the amino acid methionine ($\text{tRNA}^{\text{fMet}}$ or $\text{tRNA}_i^{\text{Met}}$) to recognize the start codon (AUG). The accurate attachment of an amino acid to its corresponding tRNA molecule is catalyzed exclusively by a specific enzyme called aminoacyl-tRNA synthetase.

Solution: Step 1: Identify the direct enzymatic function that is missing. The student omitted the specific aminoacyl-tRNA synthetase for methionine. This enzyme is solely responsible for recognizing uncharged methionine tRNA and covalently attaching a methionine molecule to its 3' acceptor stem.

Step 2: Determine the state of the transfer RNAs. Without this specific enzyme, the initiator tRNA and any internal methionine tRNAs remain completely uncharged (empty). They cannot carry the required amino acid to the translational machinery.

Step 3: Analyze the impact on translation initiation. Translation initiation requires the assembly of the small ribosomal subunit, the mRNA strand, and the methionine-charged initiator tRNA at the primary AUG start codon. Because the initiator tRNA cannot be charged with methionine, the initiation complex cannot form properly, causing translation initiation to fail entirely.

Step 4: Rule out other options. Elongation and peptide bond formation (A) cannot occur if initiation never begins. Ribosomes do not skip start codons to translate downstream sequences without initiation factors (C), and non-specific tRNAs do not stably bind to unmatched codons due to the strict proofreading of codon-anticodon pairing (D).

Final Answer:

Translation initiation will fail because the initiator tRNA cannot be charged.

Answer: (B)

[Go Back to Question 10](#)



Q11.

Solution

Concept: Biological classification organizes living organisms into a structured hierarchical system of taxonomic categories. An ascending arrangement begins with the most specific taxonomic unit, the species, and moves upward through increasingly broad groups: Genus → Family → Order → Class → Phylum → Kingdom.

Solution: Step 1: Identify the complete taxonomic classification of the common housefly (*Musca domestica*).

- Species: *domestica*
- Genus: *Musca*
- Family: *Muscidae*
- Order: *Diptera*
- Class: *Insecta*
- Phylum: *Arthropoda*
- Kingdom: *Animalia*

Step 2: Arrange the given taxonomic categories in an ascending sequence (from lowest/most specific category to highest/broadest category):

Genus (*Musca*)
→ Family (*Muscidae*)
→ Order (*Diptera*)
→ Class (*Insecta*)
→ Phylum (*Arthropoda*)

Step 3: Match this sequence against the given options. Option (A) lists *Musca* → *Muscidae* → *Diptera* → *Insecta* → *Arthropoda*, which is perfectly aligned with the rules of ascending taxonomic hierarchy. Other options misplace the relative order of the family (*Muscidae*) or order (*Diptera*).

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

Answer: (A)

[Go Back to Question 11](#)



Q12.

Solution

Concept: Mitosis is an equational cell division process where a single somatic cell divides to produce two genetically identical daughter cells. Throughout the stages of mitosis, the structural configuration of chromosomes changes from duplicated states (consisting of two joined sister chromatids) to unduplicated individual states, which alters chromosome and chromatid counts during specific phases.

Solution: Step 1: Establish the baseline starting condition of the cell. The somatic cell has a diploid chromosome number of $2n = 24$. During interphase (S phase), DNA replication occurs. This doubles the amount of DNA, but the total chromosome count remains 24 because the identical copies remain physically joined at the centromere as sister chromatids.

Step 2: Analyze the configuration during prophase and metaphase. In these stages, the cell contains 24 chromosomes, with each chromosome composed of 2 sister chromatids, yielding a total of 48 chromatids.

Step 3: Analyze the structural changes during anaphase. At the transition to anaphase, the mitotic spindle fibers pull on the kinetochores, splitting the centromeres. This separates the sister chromatids from each other.

Step 4: Calculate the revised chromosome and chromatid counts during anaphase. As soon as sister chromatids separate and begin moving toward opposite poles of the cell, each individual chromatid is structurally defined as an independent, single-chromatid chromosome. Consequently, the number of individual chromosomes within the single cellular boundary temporarily doubles:

$$\text{Total Chromosomes in Anaphase} = 24 \times 2 = 48$$

Because there are no longer any paired sister chromatids joined at a centromere, the count of distinct chromatids drops to zero. All genetic material is now accounted for as independent chromosomes.

Final Answer: 48 chromosomes and 0 chromatids

Answer: (D)

[Go Back to Question 12](#)



Q13.

Solution

Concept: During human fertilization, preventing polyspermy (the entry of multiple sperm into a single egg) is critical to safeguard the normal diploid genetic balance of the resulting zygote. Oocytes achieve this via two sequential defense mechanisms: a fast block and a slow block.

Solution: Step 1: Differentiate between the fast and slow blocks to polyspermy. The fast block occurs within seconds of sperm binding and is driven by an electrical change. The slow block takes longer and involves physical structural modifications to the outer layers of the egg.

Step 2: Analyze the mechanism of the fast block. The binding of the first sperm head to specific receptors on the oocyte plasma membrane instantly triggers the opening of ion channels. This allows a rapid influx of sodium ions (Na^+) from the extracellular environment into the egg cytoplasm (ooplasm).

Step 3: Relate the ion influx to membrane potential. This sudden influx of positive sodium ions shifts the resting membrane potential of the oocyte plasma membrane from a negative state (around -70 mV) to a positive state (around $+20$ mV). This rapid depolarization changes the membrane surface properties, preventing additional sperm from fusing with the egg membrane. This corresponds to option (B).

Step 4: Rule out incorrect options. The exocytosis of cortical granules and the hardening of the zona pellucida (Option A) describe the slow, permanent mechanical block to polyspermy, which is triggered by an increase in intracellular calcium, not a decrease (Option D). The completion of Meiosis II (Option C) occurs after fertilization is initiated but does not drive the immediate fast block to polyspermy.

Final Answer:

A rapid depolarization of the oocyte plasma membrane due to an influx of sodium ions

Answer: (B)

[Go Back to Question 13](#)



Q14.

Solution

Concept: Enzyme inhibitors reduce the rate of enzymatic reactions by altering how substrates bind to enzymes or how efficiently the enzyme converts substrate to product. These inhibitors are classified as competitive, non-competitive, or uncompetitive based on their binding sites and their specific effects on kinetic parameters like the maximum reaction velocity (V_{\max}) and the Michaelis constant (K_m).

Solution: Step 1: Analyze the binding behavior of the inhibitor. The problem states that the molecule binds exclusively to the enzyme-substrate (ES) complex, meaning it cannot bind to the free enzyme (E) before the substrate attaches.

Step 2: Determine the effect on V_{\max} . Because the inhibitor binds to the ES complex to form an inactive ESI complex, it removes productive enzyme-substrate complexes from the active pool. Increasing the substrate concentration cannot overcome this inhibition, which reduces the apparent maximum velocity (V_{\max}) of the reaction.

Step 3: Determine the effect on K_m . By binding to and stabilizing the ES complex, the inhibitor shifts the chemical equilibrium of substrate binding forward (Le Chatelier's principle). This increases the apparent binding affinity between the enzyme and substrate, which lowers the Michaelis constant (K_m), the substrate concentration required to reach half-maximal velocity.

Step 4: Identify the inhibition type. A parallel decrease in both apparent V_{\max} and apparent K_m caused by exclusive binding to the enzyme-substrate complex is the classic kinetic signature of uncompetitive inhibition.

Final Answer:

Uncompetitive inhibition

Answer: (C)

[Go Back to Question 14](#)



Q15.

Solution

Concept: Bt cotton is a genetically modified pest-resistant plant that expresses delta-endotoxin crystal proteins derived from the soil bacterium *Bacillus thuringiensis*. This endotoxin is synthesized as an inactive, non-toxic precursor molecule (protoxin) to protect the host plant and bacterium from damage, requiring highly specific physiological conditions within an insect's gut to become active.

Solution: Step 1: Understand the state of the toxin in the plant tissue. The Cry1Ac protein exists inside Bt cotton as an insoluble, crystalline protoxin that is completely harmless to the plant cells and non-target organisms.

Step 2: Identify the trigger for activation in susceptible insect pests. When a targeted insect pest, such as the cotton bollworm, ingests the transgenic plant tissue, the protoxin enters its digestive tract and reaches the midgut region.

Step 3: Analyze the chemical environment of the insect midgut. The midgut of these specific insect larvae is characterized by a strongly alkaline pH (typically ranging between 9.0 and 11.0). This highly alkaline environment is required to solubilize the crystalline protoxin.

Step 4: Trace the downstream toxic mechanism. Once solubilized, midgut proteases cleave the protoxin, converting it into an active, truncated toxin. This active toxin binds to specific cadherin-like receptors on the surface of the midgut epithelial cells, creating pores that cause osmotic lysis, gut perforation, starvation, and death of the insect. Acidic environments (Option A) or mechanical grinding (Option D) do not activate the protoxin.

Final Answer: Strongly alkaline pH

Answer: (B)

[Go Back to Question 15](#)



Q16.

Solution

Concept: The Infraphylum Vertebrata is divided into different classes of fish based on skeletal composition, respiratory anatomy, scales, and buoyancy mechanisms. The two primary groups are Class Chondrichthyes (cartilaginous fishes) and Class Osteichthyes (bony fishes).

Solution: Step 1: Evaluate common vertebrate features. A ventral heart, a closed circulatory system (Option A), and a mechanoreceptive lateral line system (Option C) are shared by members of both Chondrichthyes and Osteichthyes, meaning they cannot be used to uniquely distinguish the two classes.

Step 2: Analyze features characteristic of Class Osteichthyes. Bony fishes typically possess a rigid endoskeleton made of bone, a protective bony operculum covering their gill slits, a homocercal caudal fin, and a gas-filled swim bladder (air bladder) to control buoyancy (Option D).

Step 3: Analyze features characteristic of Class Chondrichthyes. Cartilaginous fishes, such as sharks, rays, and skates, possess an endoskeleton composed entirely of flexible cartilage. Anatomically, their gill slits are exposed to the external environment and completely lack a protective operculum covering. Additionally, they lack an air bladder and must swim continuously to avoid sinking. Therefore, the combination of a cartilaginous endoskeleton and the absence of an operculum uniquely distinguishes Chondrichthyes from Osteichthyes.

Final Answer: Cartilaginous endoskeleton and the absence of an operculum over the gills

Answer: (B)

[Go Back to Question 16](#)



Q17.

Solution

Concept:

Phases of the cardiac cycle and valve mechanics.

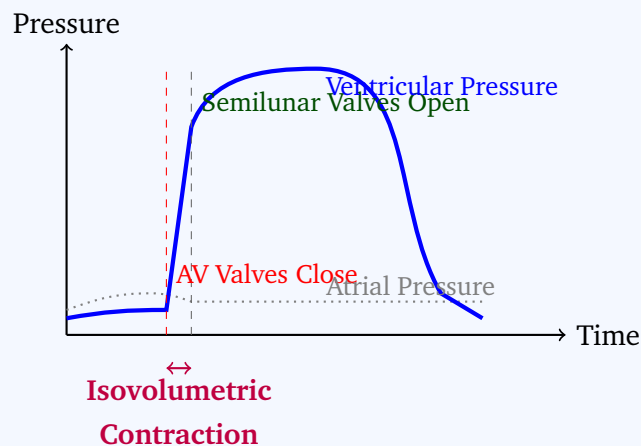
Solution:

Step 1: The cardiac cycle transitions from atrial systole to ventricular systole as the ventricles begin to contract. As ventricular pressure rises slightly above atrial pressure, blood forces the atrioventricular (AV) valves (tricuspid and mitral) to snap shut.

Step 2: The closure of the AV valves produces the first heart sound, or “lub”. At this precise moment, the semilunar valves (aortic and pulmonary) are still closed because ventricular pressure has not yet surpassed the pressure in the aorta and pulmonary artery.

Step 3: Because both sets of valves (AV and semilunar) are closed, the ventricles form a completely sealed chamber. As the ventricular myocardium continues to contract rhythmically, the volume of blood inside cannot change.

Step 4: This phase is known as **isovolumetric contraction**. The immediate mechanical consequence is a sharp, rapid spike in intraventricular pressure. Once this pressure exceeds arterial pressure, the semilunar valves open, ending the isovolumetric phase. Therefore, option (B) is correct.



Final Answer:

Answer: (B)

[Go Back to Question 17](#)



Q18.

Solution

Concept: Photoperiodism in plants is regulated by a specialized photoreceptor pigment system called phytochrome, which exists in two interconvertible forms: phytochrome red (P_r , inactive, absorbs red light at ~ 660 nm) and phytochrome far-red (P_{fr} , active, absorbs far-red light at ~ 730 nm). Short-day plants (SDPs) require a continuous dark period exceeding a critical threshold, during which P_{fr} slowly reverts to P_r to allow flowering to proceed.

Solution: Step 1: Understand the baseline requirement for short-day plants. For an SDP to flower, the active form P_{fr} must drop below a specific threshold. This occurs during an uninterrupted long night as P_{fr} naturally reverts into P_r . High levels of P_{fr} act as a molecular inhibitor of flowering in short-day plants.

Step 2: Analyze the effects of light flashes during the dark period. Phytochromes are photoreversible. Exposing the plant to a flash of light instantly changes the ratio of these pigments based on the wavelength of the final flash.

Step 3: Trace the specific sequence of light flashes given in the problem. The continuous night is interrupted by a flash of far-red light, which converts any remaining P_{fr} into P_r . However, this is immediately followed by a final flash of red light. This final flash converts P_r back into the active P_{fr} form.

Step 4: Determine the physiological outcome based on the final state. Because the final flash in the sequence was red light, the phytochrome system is left predominantly in the active P_{fr} form at the end of the interruption. In short-day plants, the presence of P_{fr} during the critical dark period blocks the flowering pathway. Consequently, the night is perceived as short, the flowering signal is suppressed, and the plant will remain vegetative and fail to flower.

Final Answer: The plant will remain vegetative and fail to flower due to the final red light flash.

Answer: (B)[Go Back to Question 18](#)

Q19.

Solution**Concept:**

Functional anatomy of the human brain and homeostatic control centers.

Solution:

Step 1: Homeostasis refers to the maintenance of a stable internal environment within the body despite external fluctuations.

Step 2: The hypothalamus, located below the thalamus and directly above the brainstem, serves as the main integration center for the autonomic nervous system and endocrine system.

Step 3: It contains specialized nuclei that monitor blood temperature, osmotic pressure (thirst), nutrient levels (hunger), and receives inputs from the retina to regulate the suprachiasmatic nucleus (circadian rhythms).

Step 4: Looking at the other regions: The Cerebellum coordinates voluntary movements and balance; the Thalamus acts as a sensory relay station; the Medulla oblongata regulates vital autonomic functions like heart rate and respiration. Thus, option (C) is correct.

Final Answer:

Answer: (C)

[Go Back to Question 19](#)



Q20.

Solution

Concept: Skeletal muscle contraction operates via the sliding filament mechanism, which depends on the interaction between thin actin filaments and thick myosin filaments. In a resting muscle fiber, this interaction must be physically prevented to avoid spontaneous contraction and maintain structural relaxation.

Solution: Step 1: Understand the molecular architecture of the thin filament. The thin filament is composed of a helical actin strand associated with two regulatory proteins: tropomyosin and troponin. Tropomyosin forms a long, continuous strand that wraps around the actin filament.

Step 2: Analyze the configuration of these proteins in a resting muscle state. When the muscle fiber is at rest, intracellular calcium (Ca^{2+}) levels in the sarcoplasm are kept very low because calcium is actively pumped into the sarcoplasmic reticulum.

Step 3: Determine the structural position of tropomyosin. Without calcium bound to troponin, the tropomyosin strand is held in a position that physically covers the specific myosin-binding active sites on the actin molecules.

Step 4: Correlate this positioning with the inhibition of cross-bridge formation. Because these active sites are covered, the myosin heads cannot attach to actin to form cross-bridges, preventing the sliding of filaments. Contraction can only begin when an action potential triggers calcium release, which binds to troponin and shifts tropomyosin away from the binding sites. This confirms that option (B) is correct.

Final Answer:

The physical blocking of myosin-binding sites on actin by the tropomyosin-troponin complex

Answer: (B)[Go Back to Question 20](#)

Q21.

Solution

Concept: Hemophilia is an X-linked recessive genetic disorder. Because males are hemizygous for the X chromosome (XY), possessing a single mutated allele on their X chromosome will cause them to express the disease phenotype. Females possess two X chromosomes (XX), meaning a recessive mutation must be present on both alleles to cause the disorder; otherwise, a single mutated allele results in a phenotypically normal carrier.

Solution: Step 1: Identify the genotypes of the parents. The woman is a phenotypically normal carrier for hemophilia, which means her genotype is $X^H X^h$, where X^H represents the normal dominant allele and X^h represents the recessive hemophilia allele. The man is phenotypically normal, meaning his genotype must be $X^H Y$.

Step 2: Determine the possible genetic combinations for their offspring using a Punnett square cross ($X^H X^h \times X^H Y$). The cross yields four distinct genotypic outcomes in equal proportions:

$X^H X^H$ (Phenotypically normal female)

$X^H X^h$ (Phenotypically normal carrier female)

$X^H Y$ (Phenotypically normal male)

$X^h Y$ (Hemophilic male)

Step 3: Analyze the specific probability requested. The question asks for the probability that their *first-born child* will be a *son who suffers from hemophilia*.

Step 4: Calculate the final probability from the total pool of potential offspring. Out of the four equally probable total outcomes, exactly one combination corresponds to a hemophilic son ($X^h Y$). Therefore, the mathematical probability is 1 out of 4, which equals $\frac{1}{4}$ or 25%.

Final Answer:

Answer: (C)

[Go Back to Question 21](#)



Q22.

Solution

Concept: Plant growth regulators (PGRs) are specialized organic chemical compounds that regulate physiological processes in plants at very low concentrations. Cytokinins are a specific group of phytohormones characterized by their ability to promote cell division (cytokinesis) and modify apical dominance by stimulating lateral bud development.

Solution: Step 1: Analyze the specific functional traits given in the question. The plant hormone is synthesized predominantly in root tips, moves acropetally (upward from the root system to the shoot), promotes the growth of lateral buds, and acts to delay leaf senescence.

Step 2: Evaluate the options against these traits.

- Abscisic acid (A) is a stress hormone synthesized widely that promotes senescence and stomatal closure.
- Gibberellic acid (B) primarily promotes stem elongation and seed germination.
- Indole-3-acetic acid (C) is a primary auxin synthesized in shoot apices that moves basipetally to enforce apical dominance, inhibiting lateral buds.

Step 3: Identify the characteristics of cytokinins. Cytokinins are synthesized in active regions like root tips and travel upward to shoots. They directly counteract auxins by promoting lateral bud growth and delay aging (the Richmond-Lang effect).

Step 4: Match the specific compound. Zeatin is a naturally occurring cytokinin originally isolated from corn kernels (*Zea mays*). It perfectly matches all the physiological criteria listed, making option (D) correct.

Final Answer:

Answer: (D) [Go Back to Question 22](#)



Q23.

Solution

Concept: A typical bacterial or microbial growth curve in a closed batch culture system consists of four distinct consecutive phases: lag phase, exponential (log) phase, stationary phase, and decline (death) phase. In industrial biotechnology, maximizing the yield of a targeted recombinant protein requires maintaining the culture at a stage where cell division, metabolic activity, and biomass accumulation are optimized.

Solution: Step 1: Analyze the biological characteristics of each phase.

- **Lag Phase:** Cells are adjusting to the new medium, synthesizing necessary enzymes, but not yet dividing. Biomass yield is low.
- **Exponential (Log) Phase:** Cells divide at their maximum constant rate under the given environmental conditions. Growth is balanced, and metabolic activity is uniform, leading to rapid biomass accumulation.
- **Stationary Phase:** The growth rate slows as nutrients deplete and toxic metabolites accumulate. The rate of cell division equals the rate of cell death, and secondary metabolites are typically produced.
- **Decline Phase:** Nutrient depletion and toxicity cause cell death rates to exceed division rates, causing biomass to degrade.

Step 2: Relate the culture phase to product manufacturing. Recombinant human insulin is typically produced as a primary metabolite tied directly to cellular growth and biomass accumulation.

Step 3: Determine the optimal operational strategy. To achieve maximum biomass and a high yield of recombinant human insulin before harvesting, the fermentation facility should prolong the exponential (log) phase as much as possible, often by transitioning from a batch to a continuous or fed-batch system.

Final Answer: Exponential (Log) phase

Answer: (B)

[Go Back to Question 23](#)



Q24.

Solution

Concept: Population ecology models population growth using specific mathematical equations. When resources are unlimited, populations grow exponentially. However, in real-world environments with finite resources, growth follows a logistic model described by the differential equation:

$$\frac{dN}{dt} = rN \left(\frac{K - N}{K} \right)$$

where N is the population size, r is the intrinsic rate of natural increase, and K is the carrying capacity of the environment.

Solution: Step 1: Define the mathematical terms in the logistic growth equation. The term $\frac{dN}{dt}$ represents the overall rate of population growth over time. The expression $\left(\frac{K-N}{K}\right)$ reflects the environmental resistance, representing the proportion of available resources that remain unused.

Step 2: Analyze what happens as the population grows and resources become limited. The population size (N) increases, climbing higher and closer to the fixed carrying capacity (K).

Step 3: Evaluate the mathematical limit as N approaches K ($N \rightarrow K$). When N becomes nearly equal to K , the value of the numerator ($K - N$) drops toward 0.

Step 4: Calculate the effect on the population growth rate.

$$\lim_{N \rightarrow K} \left(\frac{K - N}{K} \right) = 0$$

Substituting this back into the full equation:

$$\frac{dN}{dt} = rN(0) = 0$$

This demonstrates that as the population size reaches carrying capacity, the growth rate ($\frac{dN}{dt}$) approaches zero, causing the growth curve to level off into a stable plateau. The intrinsic rate r remains a constant potential (ruling out B), and K is a fixed property of the environment (ruling out C).

Final Answer: As N approaches K , the value of $\frac{dN}{dt}$ approaches zero.

Answer: (A)

[Go Back to Question 24](#)



Q25.

Solution

Concept: The internal anatomy of angiosperm roots varies distinctly between dicotyledonous and monocotyledonous plants. These structural differences involve the organization of the vascular bundles (xylem and phloem), the presence or absence of a secondary lateral cambium, and the size and development of the central ground tissue (pith).

Solution: Step 1: Evaluate option (A). Dicot roots possess a very small, inconspicuous, or completely absent central pith, whereas monocot roots contain a large, well-developed central pith. This statement is backward, making option (A) incorrect.

Step 2: Evaluate option (B). Dicot roots typically display a limited number of vascular bundles, characteristically ranging from diarch (two) to tetrarch (four) conditions. Monocot roots contain numerous vascular bundles, a condition known as polyarch (typically more than six bundles). This statement is also backward, making option (B) incorrect.

Step 3: Evaluate option (D). Both dicot and monocot roots possess a well-defined, single-layered endodermis with suberized Casparian strips. Thus, stating that monocot roots lack an endodermis is anatomically false.

Step 4: Evaluate option (C). Dicot roots develop a secondary vascular cambium from the parenchyma cells located just below the phloem strands and portions of the pericycle. This allows them to undergo secondary growth and increase in thickness over time. In contrast, monocot roots completely lack a vascular cambium and do not undergo secondary thickening. This stands as a definitive, correct anatomical difference.

Final Answer:

Dicot roots undergo secondary growth via a vascular cambium, whereas monocot roots do not undergo secondary growth.

Answer: (C)

[Go Back to Question 25](#)



Q26.

Solution

Concept: Nervous tissue consists of neurons, which transmit electrical impulses, and neuroglial (glial) cells, which provide vital structural and physiological support. The myelin sheath is a lipid-rich insulating layer that wraps around axons to increase the speed of action potential conduction. This sheath is synthesized by two distinct types of glial cells depending on the anatomical division of the nervous system.

Solution: Step 1: Identify the key clinical features of the diagnosis. The patient has an autoimmune disorder characterized by the progressive destruction of the myelin sheath specifically within the Central Nervous System (CNS), which is the pathological hallmark of Multiple Sclerosis.

Step 2: Differentiate between myelinating glial cells based on their locations.

- **Schwann Cells:** Form the myelin sheath around axons exclusively within the Peripheral Nervous System (PNS). A single Schwann cell wraps around a single axon segment.
- **Oligodendrocytes:** Form the myelin sheath around axons exclusively within the Central Nervous System (CNS). A single oligodendrocyte can extend processes to myelinate segments of multiple neighboring axons.

Step 3: Evaluate the target of destruction. Because the prompt states that the autoimmune destruction occurs within the central nervous system, the target cells must be oligodendrocytes, making option (B) correct.

Step 4: Rule out other options. Astrocytes (C) maintain the blood-brain barrier, and microglial cells (D) act as specialized immune phagocytes; neither synthesized the myelin insulation.

Final Answer:

Answer: (B)

[Go Back to Question 26](#)



Q27.

Solution

Concept: The human female ovarian and menstrual cycles are regulated by complex hormonal feedback loops involving the hypothalamus, the anterior pituitary gland, and the ovaries. Ovulation is the mid-cycle event where a mature Graafian follicle ruptures to release a secondary oocyte, triggered by a specific surge of gonadotropic hormones.

Solution: Step 1: Analyze the hormonal changes leading up to mid-cycle. During the follicular phase, developing ovarian follicles secrete increasing amounts of estrogen. High levels of estrogen eventually exert a positive feedback effect on the hypothalamus and anterior pituitary gland.

Step 2: Identify the primary hormone surge. This positive feedback triggers a rapid, sharp increase in the secretion of gonadotropins around day 14 of a standard 28-day cycle. The most dramatic increase is seen in Luteinizing Hormone (LH), an event termed the "LH surge."

Step 3: Correlate the LH surge with physiological outcomes. The sudden spike in LH induces the completion of meiosis I in the primary oocyte, weakens the structural wall of the mature Graafian follicle, and directly triggers ovulation (the release of the secondary oocyte).

Step 4: Trace the post-ovulatory role of LH. Following ovulation, LH stimulates the remaining granulosa and theca cells of the ruptured follicle to undergo luteinization, transforming the empty structure into the corpus luteum, which secretes progesterone. This confirms that Luteinizing Hormone (Option B) is directly responsible for both events.

Final Answer:

Answer: (B)

[Go Back to Question 27](#)



Q28.

Solution

Concept: In recombinant DNA technology, cloning vectors use selectable markers and reporter genes to distinguish between transformed and non-transformed host cells, as well as between recombinant and non-recombinant vectors. Blue-white screening is a common selection technique that utilizes the reporter gene *lacZ*, which encodes the active enzyme β -galactosidase.

Solution: Step 1: Analyze the structure of the cloning plasmid vector. The plasmid contains two key genetic elements: an ampicillin resistance gene (amp^R) and a functional *lacZ* gene containing a specific restriction site.

Step 2: Evaluate the outcome of successful foreign gene ligation. When the foreign DNA fragment is successfully integrated into the restriction site within the *lacZ* gene, it breaks the continuity of the coding sequence. This phenomenon is called insertional inactivation. As a result, the *lacZ* gene becomes non-functional, and the transformed host cell can no longer synthesize active β -galactosidase.

Step 3: Analyze cell survival on the selection medium. The growth medium contains the antibiotic ampicillin and the chromogenic substrate X-gal. Because the ampicillin resistance gene (amp^R) was not disrupted during cloning, all successfully transformed *E. coli* cells will survive and grow on the ampicillin medium. This rules out options (A) and (D).

Step 4: Determine colony coloration. Functional β -galactosidase breaks down X-gal into an insoluble blue product, forming blue colonies. However, because the recombinant cells have undergone insertional inactivation of the *lacZ* gene, they cannot process X-gal. Consequently, these recombinant colonies remain white or colorless, allowing for easy visual identification (Option C).

Final Answer:

Answer: (C)

[Go Back to Question 28](#)



Q29.

Solution

Concept: The modern synthetic theory of evolution (Neo-Darwinism) integrates Darwinian natural selection with Mendelian genetics and molecular biology to explain how populations evolve. It identifies several evolutionary forces that alter allele frequencies within a gene pool, distinguishing between processes that rearrange or filter existing genetic material and processes that generate entirely new genetic information.

Solution: Step 1: Define the role of each listed evolutionary mechanism.

- **Genetic Drift:** Random fluctuations in allele frequencies within small, isolated populations. It does not generate new alleles; it alters the frequencies of existing ones.
- **Natural Selection:** The differential survival and reproduction of individuals based on their phenotypes. It acts as an environmental filter on existing genetic variation, reducing or increasing allele frequencies but never creating new ones.
- **Non-random Mating:** Alters genotypic frequencies (such as increasing homozygosity) but does not create new alleles.

Step 2: Identify the source of brand-new genetic variation. Spontaneous, random mutations are permanent changes in the nucleotide sequence of an organism's DNA.

Step 3: Conclude the primary source. Mutations are the absolute primary source of completely new alleles and novel genetic variations within a closed population's gene pool. Without mutation, phenotypic variation would be limited to the recombination of existing alleles, making option (C) correct.

Final Answer:

Answer:

[Go Back to Question 29](#)



Q30.

Solution

Concept: Human parasitic diseases are caused by various pathogenic organisms, including protozoans, platyhelminthes, and nematodes. Identifying a parasitic disease requires correlating the clinical symptoms, the structural classification of the pathogen, and the specific biological vector responsible for transmitting the infection.

Solution: Step 1: Analyze the clinical presentation. The patient exhibits severe swelling (edema) in the lower limbs and the scrotum. This clinical manifestation is known as lymphatic filariasis or elephantiasis.

Step 2: Identify the transmission vector and pathogen class. The pathogen is a nematode parasite (roundworm) transmitted to humans through the bite of an infected female *Culex* mosquito.

Step 3: Evaluate the listed causative agents.

- *Ascaris lumbricoides* (A) is an intestinal roundworm transmitted via contaminated food or water, causing ascariasis.
- *Ancylostoma duodenale* (C) is the human hookworm that infests the small intestine, primarily causing iron-deficiency anemia.
- *Trichinella spiralis* (D) causes trichinosis, typically contracted by consuming undercooked meat containing encysted larvae.

Step 4: Identify the filarial nematode. *Wuchereria bancrofti* is a filarial roundworm transmitted by *Culex* mosquitoes. The adult worms live in the human lymphatic vessels, blocking lymph drainage and leading to the chronic tissue swelling described. This matches all criteria in the prompt.

Final Answer:

Answer: (B)

[Go Back to Question 30](#)



Q31.

Solution

Concept: The transport of respiratory gases in human blood requires specific physiological shifts within erythrocytes (red blood cells) to facilitate the movement of carbon dioxide (CO_2) from metabolically active tissues to the lungs. The chloride shift, or Hamburger phenomenon, is an electrochemical compensatory mechanism that occurs across the erythrocyte membrane in systemic capillaries.

Solution: Step 1: Trace the entry of carbon dioxide into systemic capillaries. Cells in metabolically active tissues produce CO_2 as a waste product of cellular respiration. This CO_2 diffuses across the endothelial wall into the blood plasma and enters the erythrocytes.

Step 2: Analyze the enzymatic reaction inside the erythrocyte. Inside the red blood cell, the enzyme carbonic anhydrase rapidly catalyzes the hydration of carbon dioxide into carbonic acid:



Carbonic acid spontaneously dissociates into hydrogen ions (H^+) and bicarbonate ions (HCO_3^-):



Step 3: Trace the movement of bicarbonate ions. As bicarbonate ions accumulate within the erythrocyte, they begin to diffuse down their concentration gradient, moving out of the red blood cell and into the surrounding blood plasma via an anion exchange transport protein (band 3).

Step 4: Describe the compensatory chloride shift. The continuous loss of negatively charged bicarbonate ions (HCO_3^-) creates a potential electrical imbalance across the cell membrane. To maintain electrical neutrality, chloride ions (Cl^-) diffuse in the opposite direction, shifting from the plasma into the erythrocyte. This matches option (B).

Final Answer: Bicarbonate ions diffuse out of the erythrocyte into the plasma, while chloride ions move into the erythrocyte.

Answer: (B)

[Go Back to Question 31](#)



Q32.

Solution

Concept: The Kingdom Fungi is classified into distinct divisions based on structural morphology, life cycles, and types of reproductive spores. A key feature of sexual reproduction in higher fungi is the presence of a dikaryophase, a stage where plasmogamy (cell fusion) is not immediately followed by karyogamy (nuclear fusion). This results in cells that contain two distinct, compatible haploid nuclei ($n + n$) per compartment.

Solution: Step 1: Identify which fungal groups exhibit a prolonged dikaryophase. The dikaryophase stage occurs characteristically during the sexual cycles of members belonging to the classes Ascomycetes (sac fungi) and Basidiomycetes (club fungi). Lower fungi do not exhibit this phase.

Step 2: Evaluate option (A) and (B). *Mucor* and *Rhizopus* are Zygomycetes, and *Albugo* is an Oomycete (historically grouped with Phycomycetes). In these lower fungi, plasmogamy is followed immediately by karyogamy, meaning they completely lack a dikaryophase stage. Thus, these options are incorrect.

Step 3: Evaluate option (D). While *Ustilago* is a Basidiomycete, *Nostoc* is a photosynthetic cyanobacterium belonging to the Kingdom Monera, not a fungus. Thus, this option is incorrect.

Step 4: Evaluate option (C). *Neurospora* is a well-known model organism belonging to Ascomycetes, and *Agaricus* is a common mushroom belonging to Basidiomycetes. Both groups exhibit a distinct, prolonged dikaryotic phase ($n + n$) during sexual reproduction before nuclear fusion occurs to form a diploid zygote.

Final Answer: *Neurospora* and *Agaricus*

Answer: (C)

[Go Back to Question 32](#)



Q33.

Solution

Concept: Biochemical qualitative tests utilize specific colorimetric chemical reagents to detect the presence or absence of major classes of macromolecules, such as carbohydrates, proteins, and lipids, within biological fluid samples.

Solution: Step 1: Analyze the results of the first chemical test. The biological fluid sample is treated with Ninhydrin reagent and heated, yielding a deep purple color (Ruhemann's purple). The Ninhydrin test is highly specific for detecting alpha-amino acids, free amino groups, peptides, and proteins. A positive purple result confirms that the sample contains proteins or free amino acids.

Step 2: Analyze the results of the second chemical test. A separate portion of the fluid sample is treated with Benedict's reagent and heated, but the solution remains completely blue.

Step 3: Interpret the Benedict's test result. Benedict's reagent contains copper(II) sulfate. In the presence of reducing sugars (such as glucose, fructose, maltose, or lactose), the blue Cu^{2+} ions are reduced to insoluble red copper(I) oxide (Cu_2O). Because the reagent remained blue, the sample lacks detectable reducing sugars.

Step 4: Synthesize the findings into a single conclusion. Combining both results indicates that the biological fluid sample contains proteins or amino acids (positive Ninhydrin test) but lacks reducing sugars (negative Benedict's test), which matches option (B).

Final Answer: The sample contains proteins or amino acids but lacks reducing sugars.

Answer: (B)

[Go Back to Question 33](#)



Q34.

Solution**Concept:**

Structure of the human blastocyst and the mechanism of implantation.

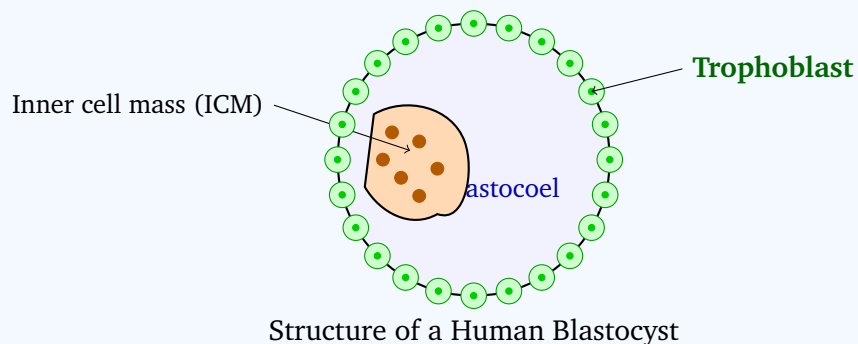
Solution:

Step 1: Around 5–6 days after fertilization, the developing embryo reaches the blastocyst stage, which is a hollow ball of cells.

Step 2: The blastocyst is composed of three main structures: an outer single layer of cells called the **trophoblast**, an internal fluid-filled cavity called the **blastocoel**, and an internal cluster of cells called the **inner cell mass** (embryoblast).

Step 3: The outer trophoblast layer specializes in releasing lytic enzymes to breach the endometrial lining, anchoring the blastocyst to the uterine wall during implantation.

Step 4: As development progresses, the trophoblast differentiates into the chorion and ultimately forms the fetal/embryonic component of the placenta. Therefore, option (B) is correct.



Final Answer:

Answer: (B)

[Go Back to Question 34](#)



Q35.

Solution

Concept: The nucleus of a eukaryotic cell contains distinct sub-compartments that manage genetic transcription and structural assembly. The nucleolus is a highly organized, dense, non-membrane-bound sub-nuclear structure centered around the nucleolar organizer regions (NORs) of chromosomes, specializing in the production of translational machinery.

Solution: Step 1: Identify the direct physiological function of the nucleolus. The nucleolus functions as a cellular factory for the transcription of ribosomal RNA (rRNA) genes and the subsequent processing and assembly of these transcripts with imported ribosomal proteins into mature small and large ribosomal subunits.

Step 2: Analyze the impact of a loss-of-function mutation in the nucleolus. If a mutation renders the nucleolus non-functional, the transcription of the 45S pre-rRNA precursor by RNA polymerase I is blocked. Consequently, the cell cannot process this transcript into the structural 18S, 5.8S, and 28S rRNA components.

Step 3: Determine the immediate downstream consequence. Without these rRNA structural strands, ribosomal subunit assembly stops entirely, preventing the formation of functional ribosomes in the cytoplasm.

Step 4: Rule out alternate options. Messenger RNA (mRNA) transcription (A) is carried out by RNA polymerase II in the nucleoplasm outside the nucleolus. Mitochondrial DNA replication (B) is an independent process that occurs within the mitochondrial matrix. Lipid anchoring of secretory proteins (D) takes place in the endoplasmic reticulum and Golgi apparatus. Therefore, the transcription and processing of ribosomal RNA is the process most directly and immediately disrupted.

Final Answer: Transcription and processing of ribosomal RNA (rRNA)

Answer: (C)

[Go Back to Question 35](#)



Q36.

Solution

Concept: C_4 plants have evolved structural and biochemical adaptations to minimize photorespiration, a wasteful process that occurs when the enzyme RuBisCO binds to oxygen instead of carbon dioxide. These plants separate the initial capture of carbon dioxide from the primary catalytic action of RuBisCO using a specialized internal anatomy known as Kranz anatomy.

Solution: Step 1: Describe the initial carbon fixation step in C_4 plants. Atmospheric carbon dioxide (CO_2) enters the leaf through the stomata and diffuses into the outer mesophyll cells. Here, it is dissolved into bicarbonate (HCO_3^-) and initially fixed by the enzyme Phosphoenolpyruvate carboxylase (PEP carboxylase), which has no affinity for oxygen.

Step 2: Identify the product of initial fixation. PEP carboxylase attaches the carbon to a 3-carbon molecule (PEP) to form a 4-carbon organic acid, oxaloacetate (OAA), which is typically converted into malate.

Step 3: Trace the transport of the fixed carbon. The malate is shuttled through plasmodesmata from the outer mesophyll cells into the deeper, thick-walled bundle sheath cells that surround the vascular bundles.

Step 4: Describe the decarboxylation and the Calvin cycle phase. Inside the bundle sheath cells, the malate is broken down to release a concentrated stream of free CO_2 . This high local concentration of carbon dioxide saturates the enzyme Ribulose-1,5-bisphosphate carboxylase-oxygenase (RuBisCO), which drives the standard light-independent Calvin cycle (C_3 cycle) to synthesize sugars efficiently. Thus, initial fixation occurs in mesophyll cells, and the Calvin cycle takes place in bundle sheath cells, matching option (B).

Final Answer:

Answer: (B)

[Go Back to Question 36](#)



Q37.

Solution

Concept: Monoclonal antibodies are highly specific antibodies produced in large quantities that target a single, specific epitope on an antigen. Generating these uniform antibodies commercially requires creating an immortal cell line capable of synthesizing a single antibody clone indefinitely, a technique achieved through specialized cell fusion methods.

Solution: Step 1: Define the core challenge of antibody production. Normal B-lymphocytes synthesize highly specific antibodies, but they are short-lived and cannot be maintained in continuous cell cultures. Conversely, myeloma (cancerous B-cell) cells are immortal and divide rapidly in vitro, but they do not produce targeted antibodies.

Step 2: Describe Hybridoma technology. Developed by Georges Köhler and César Milstein, hybridoma technology overcomes this limitation by fusing these two cell types. An animal is immunized with a target antigen (such as a viral surface glycoprotein) to stimulate the production of specific B-lymphocytes. These plasma B-cells are harvested from the spleen and fused with myeloma cells using polyethelene glycol (PEG).

Step 3: Explain selection and cloning. The resulting hybrid cells, called hybridomas, are cultured on a selective HAT medium where unhybridized cells die. The surviving hybridomas inherit immortality from the myeloma parent and the ability to secrete a specific monoclonal antibody from the B-lymphocyte parent. This makes option (B) the standard method for large-scale commercial production.

Step 4: Rule out incorrect options. PCR (A) amplifies DNA sequences but cannot synthesize functional, glycosylated proteins. Automated chemical synthesis (C) is impractical for full-length, complex antibody proteins, and UV radiation (D) causes damaging genetic mutations rather than facilitating cell fusion.

Final Answer: Hybridoma technology involving the fusion of B-lymphocytes with myeloma cells

Answer: (B)[Go Back to Question 37](#)

Q38.

Solution

Concept: The human immune system relies on primary lymphoid organs to produce and mature the lymphocytes responsible for adaptive immunity. While all lymphocytes originate from pluripotent hematopoietic stem cells in the bone marrow, their maturation, selection, and functional differentiation take place in distinct anatomical sites.

Solution: Step 1: Analyze the clinical phenotype of the patient. The patient has a severe deficiency of mature T-lymphocytes (T-cells), while their B-lymphocyte (B-cell) counts remain normal.

Step 2: Trace B-lymphocyte development. B-cells originate and undergo their complete structural maturation inside the bone marrow. Because the patient's B-cell counts are normal, bone marrow function (Option B) is preserved.

Step 3: Trace T-lymphocyte development. Immature T-cell progenitor cells leave the bone marrow via the bloodstream and travel to a separate primary lymphoid organ: the thymus.

Step 4: Correlate thymic function with the clinical defect. Inside the cortex and medulla of the thymus, T-cell progenitors undergo differentiation, express T-cell receptors (TCRs), and pass positive and negative selection processes to become mature, functional helper and cytotoxic T-lymphocytes. If an individual suffers from congenital atrophy or hypoplasia of the thymus (such as in DiGeorge syndrome), T-cell maturation is blocked, leading to a selective, severe deficiency of mature T-cells. Spleen (A) and Peyer's patches (D) are secondary lymphoid organs where mature cells interact with antigens; they are not the primary sites of T-cell maturation.

Final Answer:

Answer: (C)

[Go Back to Question 38](#)



Q39.

Solution

Concept: Natural selection alters phenotypic distributions within populations over generations based on the relative fitness of different traits. Depending on which phenotypes are favored by environmental pressures, natural selection operates via three primary modes: directional selection, disruptive selection, or stabilizing selection.

Solution: Step 1: Identify the phenotypic extremes and the intermediate form in the population. The trait under study is tail length in birds. The phenotypic range consists of extremely short tails, extremely long tails, and intermediate tail lengths.

Step 2: Analyze the survival and reproductive rates (fitness) associated with these phenotypes. The long-term study shows that birds with intermediate tail lengths survive and reproduce at significantly higher rates than individuals with either extremely short or extremely long tails.

Step 3: Define the modes of natural selection to match this pattern.

- **Directional Selection:** Favors individuals at one phenotypic extreme, shifting the population mean over time.
- **Disruptive Selection:** Favors individuals at both extremes while selecting against the intermediate phenotypes, splitting the population into two distinct morphs.
- **Stabilizing Selection:** Favors the intermediate, average phenotype while selecting heavily against both phenotypic extremes.

Step 4: Conclude the operating mode. Because environmental pressures select against both phenotypic extremes and favor the average trait value, the variance of the trait decreases while the mean remains constant. This process is the classic definition of stabilizing selection, making option (C) correct.

Final Answer: Stabilizing selection

Answer: (C)

[Go Back to Question 39](#)



Q40.

Solution

Concept: Plant kingdom classification separates land plants into groups based on evolutionary adaptations, including vascular tissue presence, reproductive strategies, and the alternating dominance of the gametophyte (n) and sporophyte ($2n$) generations. Bryophytes (amphibians of the plant kingdom) represent an earlier evolutionary lineage compared to pteridophytes (vascular cryptogams).

Solution: Step 1: Evaluate option (B). Bryophytes are non-vascular plants that lack specialized xylem and phloem structures, whereas pteridophytes possess well-developed vascular tissues. Thus, this feature is absent in bryophytes, making option (B) incorrect.

Step 2: Evaluate option (C). Heterosporous structures and distinct strobili (cones) are advanced reproductive features found in some pteridophytes (like *Selaginella*) and gymnosperms, but are completely absent in bryophytes. Thus, option (C) is incorrect.

Step 3: Evaluate option (D). Both bryophytes and pteridophytes are archegoniate plants that rely on a film of free water to allow flagellated male gametes (antherozoids) to swim toward the female archegonium for fertilization. Because this requirement is shared by both groups, it does not distinguish bryophytes from pteridophytes, making option (D) incorrect.

Step 4: Evaluate option (A). In bryophytes, the dominant, independent, long-lived, and photosynthetic phase of the life cycle is the haploid gametophyte. The sporophyte is physically dependent on the gametophyte for structural support and nutrition. In contrast, in pteridophytes, the dominant and independent phase is the diploid sporophyte, while the gametophyte (prothallus) is small and transient. Therefore, a dominant, independent, photosynthetic gametophyte generation is universally shared by all bryophytes but completely absent in pteridophytes.

Final Answer: The presence of a dominant, independent, and photosynthetic gametophyte generation

Answer: (A)[Go Back to Question 40](#)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	C	3	C	4	A	5	B
6	B	7	D	8	C	9	B	10	B
11	A	12	D	13	B	14	C	15	B
16	B	17	B	18	B	19	C	20	B
21	C	22	D	23	B	24	A	25	C
26	B	27	B	28	C	29	C	30	B
31	B	32	C	33	B	34	B	35	C
36	B	37	B	38	C	39	C	40	A

