IISER Biology Sample Paper-5

Duration: 45 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries: **−1** marks.
- Unattempted questions carry **0** marks.
- Only one option is correct for each question.
- Use of mobile phones, smartwatches, calculators, or any electronic gadgets is strictly prohibited.

Q1. Which of the following organelles is present in plant cells but completely absent in typical animal cells?

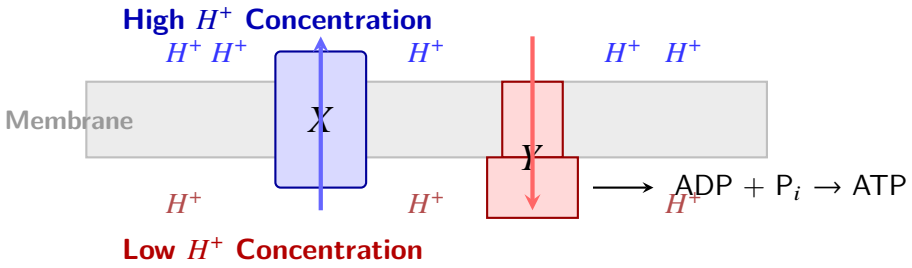
(A) Mitochondrion

(B) Golgi apparatus

(C) Plastids (chloroplasts, chromoplasts, leucoplasts) and a large central vacuole

(D) Ribosome

Q2. Consider a dynamic cellular process governed by active transport and electrochemical gradients across an internal membrane. Identify the process and the true statement regarding the components labeled X and Y.



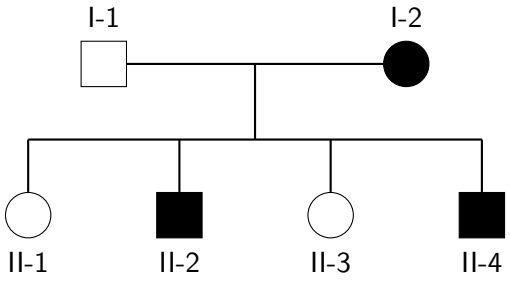
(A) Component X actively hydrolyzes ATP to generate a proton gradient against its thermodynamic equilibrium.

(B) Component Y represents ATP synthase, utilizing the proton motive force (H^+ influx) down its electrochemical gradient to phosphorylate ADP.

(C) The diagram depicts non-cyclic photophosphorylation occurring specifically on the outer mitochondrial membrane.

(D) Uncouplers like 2,4-dinitrophenol would directly accelerate the rate of ATP production at component Y.

Q3. The pedigree chart below demonstrates the inheritance pattern of an extremely rare metabolic anomaly across three consecutive generations in an isolated human settlement.



Deduce the precise mode of genetic inheritance shown above if the trait is fully penetrant.

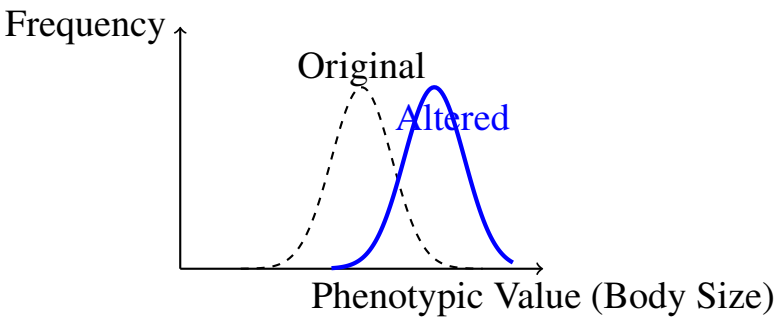
(A) Autosomal Dominant

(B) X-linked Dominant

(C) Autosomal Recessive

(D) Mitochondrial (Maternal) Inheritance

Q4. A population of Drosophila melanogaster under severe selective pressure exhibits a shifts in phenotypic traits. The graph below displays the original phenotypic distribution (dashed line) and the altered distribution after 50 generations (solid line).



Identify the operational mode of natural selection active here and its long-term impact on genetic variance.

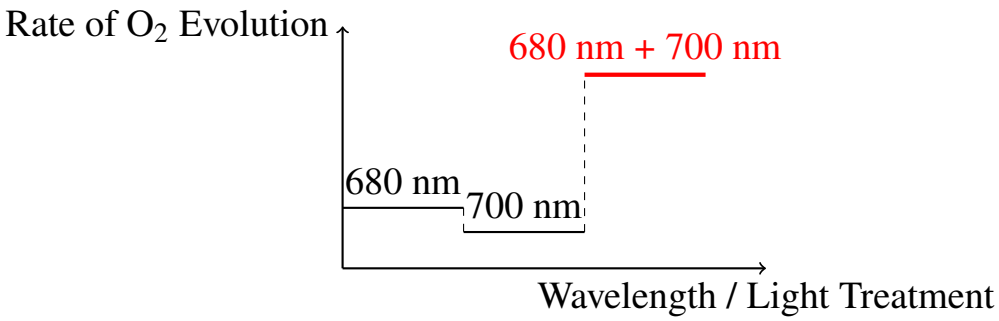
(A) Disruptive selection; increases phenotypic variance by splitting the population into distinct extreme morphs.

(B) Stabilizing selection; favors mean phenotypes while exponentially reducing genetic diversity.

(C) Directional selection; shifts the mean phenotypic value toward one extreme while eliminating individuals at the counter-peak.

(D) Balancing selection; maintains steady state polymorphic alleles via frequency-dependent mechanics.

Q5. An elegant experiment tracking the kinetics of photosynthetic electron transport under alternating monochromatic beams of light generated the dynamic quantum yield tracking graph shown below:



Which classical photosynthetic phenomenon does this outcome substantiate, and what fundamental architectural aspect of the light-dependent reactions does it directly validate?

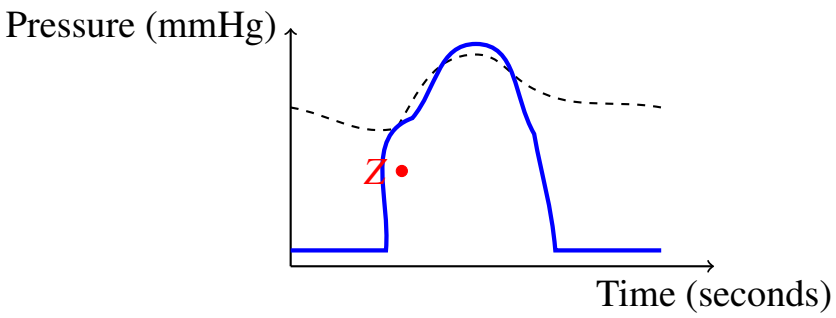
(A) Emerson Enhancement Effect; it demonstrates that two distinct photosystems (PS I and PS II) operate in tandem to achieve maximum quantum efficiency.

(B) Red Drop Effect; it demonstrates that chlorophyll molecules fail to absorb light when energized past 680 nm.

(C) Warburg Effect; it displays the severe competitive inhibition of oxygenase activity on RuBisCO complexes under red illumination.

(D) Calvin Cycle Saturation; it highlights the rate-limiting step of carbon fixation within the chloroplastic stroma.

Q6. The physiological changes in cardiac pressures during a singular cardiac cycle are mapped in the TikZ coordinate frame below, depicting pressure alterations within the Left Ventricle (solid line), Left Atrium (dotted line), and Aorta (dashed line).



Analyze the precise mechanistic event taking place exactly at the intersection point labeled Z.

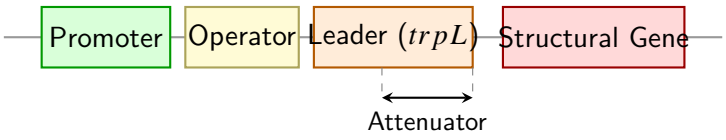
(A) The closure of the aortic semilunar valve, generating the second heart sound (S_2).

(B) The opening of the aortic semilunar valve, initiating the ventricular ejection phase.

(C) The closure of the bicuspid (mitral) valve, generating the first heart sound (S_1) at the start of isovolumetric contraction.

(D) The opening of the tricuspid valve, filling the right ventricular compartment rapidly.

Q7. A molecular biologist designs an elegant plasmid construct to test transcriptional attenuation. The arrangement of regulatory sequences is schematically represented in the linear map below.



Under states of excess intracellular Tryptophan, what structural conformation does the transcribed Leader RNA assume, and what is its consequence on RNA Polymerase activity?

(A) It forms a 2-3 hairpin structure loop, allowing RNA polymerase to continue uninterrupted transcription.

(B) It forms a 3-4 stem-loop structure followed by a poly-U tract, which acts as an intrinsic Rho-independent terminator, stalling the transcription complex.

(C) It facilitates immediate binding of the Rho factor, which physically unwinds the DNA-RNA hybrid template.

(D) It loop-represses the promoter site upstream, preventing the initial binding of the σ^{70} subunit.

Q8. In an ecosystem ecology survey tracking secondary productivity within a standard temperate forest biome, the energetic transformations are quantified. If the Gross Primary Productivity (GPP) of the system equals 2.4×10^4 kcal/m^2/yr and Autotrophic Respiration (R_A) accounts for exactly 60% of that energy pool, what is the maximum possible net energy remaining available to the primary consumer trophic level assuming a standard ecological transfer efficiency of 10% across the herbivore threshold?

(A) 1.44×10^4 kcal/m^2/yr

(B) 9.60×10^3 kcal/m^2/yr

(C) 9.60×10^2 kcal/m^2/yr

(D) 1.44×10^3 kcal/m^2/yr

Q9. During microsporogenesis in angiosperms, a single functional microspore mother cell undergoes meiosis to yield pollen grains. Consider an angiosperm species with a diploid chromosome status of $2n = 24$. Identify the precise count of total bivalents discernible during Zygotene of Prophase I, and the total count of

chromosomes present within each functional generative cell of a mature shedding pollen grain respectively.

(A) 24 bivalents and 24 chromosomes

(B) 12 bivalents and 12 chromosomes

(C) 12 bivalents and 24 chromosomes

(D) 6 bivalents and 12 chromosomes

Q10. The physiological response of a long-day plant (LDP) and a short-day plant (SDP) to varying photoperiods is evaluated. Which of the following treatments would successfully trigger flowering in a typical Short-Day Plant (SDP)?

(A) A critical dark period interrupted by a brief flash of Red light (660 nm).

(B) A critical dark period interrupted sequentially by a flash of Red light followed immediately by a flash of Far-Red light (730 nm).

(C) A photoperiod cycle where the continuous dark duration is less than the critical dark threshold requirement.

(D) A continuous dark period interrupted by an intensive flash of blue light midway through its course.

Q11. During human embryonic development, the blastocyst must precisely establish contact with the maternal uterine wall for successful implantation. Which specific cellular layer of the blastocyst undergoes rapid proliferative differentiation to invade the endometrial stroma, and which hormone does it preferentially secrete to rescue the corpus luteum from regression?

(A) Inner Cell Mass; Luteinizing Hormone (LH)

(B) Epiblast; Human Placental Lactogen (hPL)

(C) Syncytiotrophoblast; Human Chorionic Gonadotropin (hCG)

(D) Cytotrophoblast; Progesterone

Q12. An analytical study of global biodiversity distributions seeks to validate the classic Species-Area relationship proposed by Alexander von Humboldt. On a double-logarithmic scale, the relationship is linear: $\log S = \log C + Z \log A$. If

an ecologist samples an exceptionally large continental area containing highly diverse taxonomic assemblages across an entire landmass, what is the expected numerical range for the slope value (Z)?

(A) 0.1 to 0.2

(B) 0.6 to 1.2

(C) 1.5 to 3.0

(D) Exactly 0.05

Q13. A population is in genetic equilibrium according to the Hardy-Weinberg principle. If the frequency of a recessive phenotypic trait (caused by a homozygous recessive genotype aa) in this population is 0.09, what is the percentage frequency of the heterozygous (Aa) carriers within this stable population?

(A) 9%

(B) 30%

(C) 42%

(D) 70%

(E) 21%

Q14. In multi-step recombinant DNA engineering, researchers utilize different restriction endonucleases. Restriction Enzyme Alpha generates cohesive (sticky) ends with a 5'-overhang, whereas Restriction Enzyme Beta creates completely blunt ends. Which of the following statements correctly evaluates the downstream enzymatic ligation dynamics using T4 DNA Ligase?

(A) Blunt-end fragments derived via Enzyme Beta ligate at a significantly faster rate and higher efficiency because they do not require hydrogen bond stabilization between base pairs.

(B) Cohesive-end fragments require significantly higher concentrations of T4 DNA ligase and the addition of crowding agents compared to blunt-end modifications.

(C) Cohesive ends demonstrate higher ligation efficiency because the complementary transient base-pairing stabilizes the DNA-enzyme complex, reducing the activation energy required for phosphodiester bond synthesis.

(D) T4 DNA Ligase is completely incapable of joining fragments generated via Enzyme Beta without the pre-addition of synthetic homopolymer tails.

Q15. In human nephron physiology, the countercurrent multiplier mechanism relies heavily on the distinct differential permeability profiles of the loop of Henle. Which of the following accurately outlines the permeability attributes of the descending and ascending limbs of the loop of Henle to water and electrolytes?

(A) Descending limb is highly permeable to electrolytes but completely impermeable to water; Ascending limb is highly permeable to water but impermeable to electrolytes.

(B) Descending limb is highly permeable to water but virtually impermeable to electrolytes; Thin and thick ascending limbs are completely impermeable to water but actively/passively transport electrolytes out into the medullary interstitium.

(C) Both limbs are freely and equally permeable to water and urea, depending solely on the systemic concentration of atrial natriuretic peptide (ANP).

(D) Descending limb actively pumps sodium ions out, while the ascending limb absorbs water under the continuous influence of Aldosterone.

Detailed Solutions

Q1.

Solution

Concept:

Eukaryotic cell compartmentalization varies considerably between biological kingdoms. Plant and animal cells share standard metabolic machinery like mitochondria and ribosomes, but possess unique structures that reflect their evolutionary adaptations, autotrophic or heterotrophic lifestyles, structural rigidities, and osmotic regulation requirements.

Solution:

(a) Plastids are double-membrane enclosed structures unique to plant cells and algae. They encompass chloroplasts for carrying out photosynthesis, chromoplasts for carotenoid pigment storage, and leucoplasts or amyloplasts for starch synthesis. Animal cells completely lack these biosynthetic capabilities.

(b) Plant cells contain an enormous, centrally located vacuole bounded by a membrane called the tonoplast. This organelle maintains turgor pressure against the cellulose cell wall, provides structural support, and regulates cytoplasmic water potential.

(c) Animal cells possess small, transient, and scattered vacuoles if present at all, and completely lack any variant of plastids due to their heterotrophic nutritional strategy.

(d) Mitochondria are ubiquitous across both kingdoms to generate adenosine triphosphate via aerobic respiration.

(e) Ribosomes and Golgi apparatus complexes are universally essential components for protein translation and post-translational peptide modification in all eukaryotic cell lines.

Final Answer: Plastids and a large central vacuole are present in plants and completely absent in typical animal cells.

Answer: (C)

Go Back to Question 1

Q2.

Solution

Concept:

Chemiosmosis describes the process where energy stored inside an electrochemical proton gradient across a biological membrane drives adenosine triphosphate production. This fundamental mechanism operates inside both inner mitochondrial membranes during respiration and chloroplastic thylakoid systems during the light-dependent stage of photosynthesis.

Solution:

(a) The provided graphic displays a high relative proton concentration in the upper space and a lower concentration below, creating an active proton motive force across the biological lipid bilayer.

(b) Element X represents a component of the electron transport chain or an upstream active proton pump. This protein structure works to transport hydrogen ions across the membrane barrier to generate the gradient.

(c) Element Y represents the multi-subunit enzyme complex known as ATP synthase. This protein features a transmembrane channel that permits hydrogen ions to diffuse down their established electrochemical gradient.

(d) As protons flow back down through the channel of element Y, the thermodynamic energy is captured mechanically to phosphorylate adenosine diphosphate and inorganic phosphate into adenosine triphosphate.

(e) Chemical uncouplers dissipate this vital electrochemical gradient by making the inner membrane leaky to protons, which rapidly ceases adenosine triphosphate synthesis at element Y.

Final Answer: Component Y represents ATP synthase, which utilizes the proton motive force to phosphorylate ADP into ATP.

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept:

Pedigree analysis relies on tracing phenotypes through generations to evaluate the transmission patterns of alleles. Dominant traits manifest in every consecutive generation, whereas recessive characteristics routinely skip generations when heterozygous carriers mask the allele, appearing suddenly among progeny from unaffected or carrier parents.

Solution:

(a) The pedigree shows an affected female individual in the first generation mating with an unaffected male individual. This union produces a mixture of affected and unaffected progeny in the second generation.

(b) In the second generation, unaffected individuals mating with other individuals outside the lineage give rise to affected offspring in the third generation, revealing that the allele was hidden.

(c) This pattern where unaffected parents produce affected offspring is a classic hallmark of genetic recessiveness, as dominant phenotypes require at least one parent to actively display the trait.

(d) The anomaly appears in both male and female offspring from unaffected parents, which rules out strict sex-linked inheritance models like Y-linkage or X-linked dominant modes.

(e) Maternal or mitochondrial inheritance is excluded because an affected mother in generation one failed to pass the condition to all of her immediate children.

Final Answer: The mode of genetic inheritance shown in the pedigree chart is Autosomal Recessive.

Answer: (C)

Go Back to Question 3

Q4.

Solution

Concept:

Natural selection operates on phenotypic variance within populations through three primary mechanical modes: stabilizing selection, directional selection, and disruptive selection. Each mode shifts the population mean or changes the overall phenotypic distribution depending on environmental pressures and survival advantages.

Solution:

(a) The provided coordinate graph charts a clear lateral displacement of the peak population phenotype over fifty generations under selective pressures.

(b) The original population distribution, indicated by the dashed curve, centers around an intermediate body size value before the introduction of environmental stress.

(c) After fifty generations, the altered solid curve reveals that the entire distribution has migrated toward a larger phenotypic value, favoring individuals at one extreme.

(d) Directional selection acts by continuously selecting against individuals at one phenotypic extreme while favoring individuals located at the opposite extreme, causing a steady directional shift.

(e) This dynamic reduces overall genetic variance over time because individuals displaying alternative morphs are progressively eliminated from the breeding pool.

Final Answer: Directional selection shifts the mean phenotypic value toward one extreme while eliminating alternative phenotypes.

Answer: (C)

Go Back to Question 4

Q5.

Solution

Concept:

The light-dependent reactions of photosynthesis rely on the coordinated operation of two distinct pigment complexes. These are known as Photosystem I and Photosystem II, which absorb light maximally at seven hundred nanometers and six hundred eighty nanometers respectively to drive linear electron transport.

Solution:

(a) The provided step graph shows that illumination with a single wavelength of six hundred eighty nanometers or seven hundred nanometers yields relatively low baseline rates of oxygen evolution.

(b) When both wavelengths of light are applied simultaneously to the photosynthetic tissue, the resulting rate of oxygen evolution increases synergistically rather than additively.

(c) This classic phenomenon is known as the Emerson Enhancement Effect, which historically proved that photosynthesis requires two distinct systems operating in tandem.

(d) Photosystem II absorbs light at lower wavelengths to split water molecules, generating oxygen gas and transferring electrons down a transport chain to Photosystem I.

(e) Photosystem I absorbs light at higher wavelengths to further energize those electrons, optimizing quantum efficiency and metabolic output when both systems are active together.

Final Answer: The Emerson Enhancement Effect validates that two distinct photosystems operate in tandem during photosynthesis.

Answer: (A)

Go Back to Question 5

Q6.

Solution

Concept:

The mammalian cardiac cycle is governed by precise pressure transformations within the heart chambers and major vessels. These fluctuations dictate the opening and closing dynamics of the atrioventricular and semilunar valves, ensuring unidirectional blood flow and generating characteristic heart sounds.

Solution:

(a) The provided coordinate chart tracks pressure within the left ventricle, left atrium, and the aorta over the course of one complete heartbeat.

(b) Point Z marks the exact intersection where ventricular pressure rises sharply and crosses above the corresponding pressure curve of the left atrium.

(c) When ventricular pressure exceeds atrial pressure at the onset of systole, blood is forced backward against the leaflets of the bicuspid valve.

(d) This physical force triggers the immediate closure of the bicuspid valve, preventing regurgitation and producing the first low-pitched heart sound known as S1.

(e) This event initiates the phase of isovolumetric contraction, where ventricular pressure climbs rapidly with all valves closed before opening the aortic semilunar valve.

Final Answer: The closure of the bicuspid valve occurs at point Z, generating the first heart sound.

Answer: (C)

Go Back to Question 6

Q7.

Solution

Concept:

Transcriptional attenuation is a prokaryotic regulatory mechanism that couples translation directly to ongoing transcription. The tryptophan operon utilizes a leader sequence containing an attenuator region to halt transcription early if the specific amino acid is already abundant within the cell.

Solution:

(a) The leader region contains four distinct segments capable of forming base-paired hairpin loops, depending on the movement of a ribosome translating the leader peptide.

(b) When intracellular tryptophan levels are high, the ribosome moves rapidly across the control codons and covers segment two of the nascent RNA molecule.

(c) This prevents segment two from pairing with segment three, forcing segment three to base pair with segment four as transcription continues.

(d) The pairing of segments three and four creates a stable stem-loop structure followed by a sequence of uracil residues, forming an intrinsic terminator.

(e) This physical conformation destabilizes the RNA polymerase complex, causing it to fall off the template before transcribing the operational structural genes.

Final Answer: The leader RNA forms a 3-4 stem-loop structure that acts as an intrinsic terminator to stall transcription.

Answer: (B)

Go Back to Question 7

Q8.

Solution

Concept:

Ecosystem energetics models help track the thermodynamic efficiency of trophic distributions within biological communities. Net Primary Productivity represents the balance of energy captured by autotrophs remaining after accounting for metabolic respiration losses, which ultimately acts as the biological resource base accessible to primary consumers.

Solution:

(a) Gross Primary Productivity serves as the total chemical energy synthesized via photosynthesis per unit area over a specific time window.

(b) Autotrophic respiration accounts for exactly sixty percent of this total pool, which means that forty percent remains conserved as Net Primary Productivity.

(c) Multiplying twenty-four thousand by forty percent establishes that the Net Primary Productivity equals exactly nine thousand six hundred calories.

(d) Ecological transfer efficiency determines that only ten percent of this remaining carbohydrate baseline is effectively incorporated into primary consumer biomass.

(e) Calculating ten percent of nine thousand six hundred yields a absolute maximum value of nine hundred sixty available calories.

Final Answer: The maximum possible net energy remaining available to the primary consumer trophic level is 9.60×10^2 kcal/m^2/yr.

Answer: (C)

Go Back to Question 8

Q9.

Solution

Concept:

Plant reproduction requires reductional cell divisions to generate haploid genetic lineages within reproductive tissues. Chromosome dynamics during microsporogenesis govern how diploid sporophytic cells yield the genetic complements found inside functioning gametophytic units like microspores and pollen grains.

Solution:

(a) Diploid tissue houses twenty-four individual chromosomes, meaning that the foundational haploid set contains exactly twelve separate chromosomes.

(b) During Zygotene of Prophase I, homologous chromosome partners line up lengthwise and synapse to assemble chromosomal configurations called bivalents.

(c) The total count of bivalents corresponds exactly to the fundamental haploid number, establishing a total of twelve observable pairs.

(d) Meiosis finishes by forming four distinct haploid microspores that undergo specialized asymmetric mitotic karyokinesis to produce pollen components.

(e) This division creates a vegetative nucleus alongside a smaller generative entity, both preserving the unaltered haploid number of twelve chromosomes.

Final Answer: There are 12 bivalents discernible during Zygotene and 12 chromosomes present within each functional generative cell.

Answer: (B)

Go Back to Question 9

Q10.

Solution

Concept:

Photoperiodism relies on reversible conformation changes in phytochrome switch systems that monitor night durations to control seasonal flowering events. Short-Day Plants require a continuous, uninterrupted dark cycle that extends past an absolute critical duration to activate reproductive genetic switches.

Solution:

(a) Phytochromes alternate between an inactive red-absorbing state and a biologically active far-red-absorbing configuration based on specific light exposures.

(b) Illuminating a Short-Day Plant with a flash of red light during the dark period converts phytochromes into the active form, suppressing flowering behavior.

(c) Exposing the plant tissue to a sequential flash of far-red light reverses this conformation change back to the inactive state.

(d) This immediate far-red exposure neutralizes the disruptive impact of the preceding red light blast, preserving the required long-night biological signal.

(e) Disruptions using alternative light regimes or brief light periods fail to trigger flowering if the long night signal is broken without reversal.

Final Answer: A critical dark period interrupted sequentially by a flash of Red light followed immediately by a flash of Far-Red light triggers flowering.

Answer: (B)

Go Back to Question 10

Q11.

Solution

Concept:

Embryonic implantation involves targeted cellular interactions between developing blastocyst structures and responsive maternal uterine tissues. Specialized outer epithelial layers drive physical tissue invasion while secreting essential chemical signals to maintain the maternal pregnancy state.

Solution:

(a) The outer boundary of a human blastocyst differentiates into an external trophoblast layer during initial attachment phases.

(b) Contact with the endometrium stimulates the outer trophoblast to form a specialized multinucleated zone called the syncytiotrophoblast.

(c) This highly invasive cellular structure breaks down local maternal extracellular matrix to embed the embryo into the uterine wall.

(d) The syncytiotrophoblast actively produces human chorionic gonadotropin hormone to sustain embryonic viability.

(e) This hormone travels via the bloodstream to rescue the corpus luteum from degeneration, ensuring continuous progesterone synthesis.

Final Answer: The Syncytiotrophoblast undergoes rapid proliferative differentiation to invade the endometrial stroma and secretes Human Chorionic Gonadotropin.

Answer: (C)

Go Back to Question 11

Q12.

Solution

Concept:

Biogeography models use mathematical species-area functions to analyze patterns of biodiversity distribution across different geographic scales. The regression slope value reflects how species richness scales alongside expanding land dimensions within isolated habitats or massive continental landmasses.

Solution:

(a) The logarithmic species-area equation plots as a straight line where the variable Z represents the regression coefficient slope.

(b) Small local regions or specific habitat fragments typically yield standard Z values that fall strictly between one tenth and two tenths.

(c) Sampling immense continental spaces containing highly diverse habitats reveals much steeper scaling relationships.

(d) Extensive geographical surveys that cross varied biomes cause the value of Z to increase significantly due to habitat diversity.

(e) These comprehensive continental scale inventories yield regression coefficients that fall within a range of six tenths to one and two tenths.

Final Answer: The expected numerical range for the slope value (Z) across an exceptionally large continental area is 0.6 to 1.2.

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept:

Population genetics relies on Hardy-Weinberg mathematical models to calculate allele frequencies and genotype distributions within stable gene pools. Tracking recessive phenotypic values allows researchers to determine individual carrier rates across successive generations.

Solution:

(a) The total homozyous recessive trait frequency equals the squared value of the recessive allele frequency in the population.

(b) Setting the value of q squared to nine hundredths and taking the square root gives a recessive allele frequency of three tenths.

(c) Subtracting three tenths from one reveals that the dominant allele frequency in this population equals seven tenths.

(d) Heterozygous individuals are represented by the mathematical term two times p times q within the expanded binomial expression.

(e) Multiplying two by seven tenths and three tenths yields forty-two hundredths, which translates to forty-two percent carrier frequency.

Final Answer: The percentage frequency of the heterozygous (Aa) carriers within this stable population is 42%.

Answer: (C)

Go Back to Question 13

Q14.

Solution

Concept:

Recombinant DNA technology uses ligase enzymes to create phosphodiester bonds between adjacent nucleotides in double-stranded DNA molecules. Structural variations at fragment ends modify matching alignments, altering overall link stability and changing downstream joining efficiencies.

Solution:

(a) Restriction enzyme digestion produces either stepped ends with single-stranded overhangs or flat ends without exposed single strands.

(b) Overhanging configurations allow complementary bases to pair through transient hydrogen bonds, stabilizing the terminal junctions.

(c) This temporary base pairing alignment lowers the overall activation energy required for the ligase enzyme to bond the backbones.

(d) Blunt ends lack single-stranded regions, preventing hydrogen bonding and relying entirely on random collisions to align with target molecules.

(e) Cohesive ends demonstrate much greater joining efficiencies than blunt ends due to these favorable structural dynamics during ligation.

Final Answer: Cohesive ends demonstrate higher ligation efficiency because the complementary transient base-pairing stabilizes the DNA-enzyme complex.

Answer: (C)

Go Back to Question 14

Q15.

Solution

Concept:

Renal filtration uses countercurrent multiplier systems inside nephron loops to establish solute concentration gradients within medullary tissues. Differential water and electrolyte transfer capacities across loop segments enable precise blood volume regulation and urine concentration control.

Solution:

(a) The descending segment feature specialized water channel proteins that promote rapid water movement while restricting salt transport.

(b) Tubular fluid loses water as it moves downward into hypertonic medullary tissue, increasing internal solute concentration.

(c) The ascending segment lacks water channels and remains completely waterproof throughout its length.

(d) Ascending structures actively pump sodium and chloride ions out into medullary spaces using specialized membrane proteins.

(e) This salt removal reduces internal fluid concentration while keeping medullary tissue hypertonic to power water reabsorption.

Final Answer: The descending limb is highly permeable to water but virtually impermeable to electrolytes, whereas the ascending limb is completely impermeable to water but transports electrolytes out.

Answer: (B)

Go Back to Question 15

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	B	3	C	4	C	5	A
6	C	7	B	8	C	9	B	10	B
11	C	12	B	13	C	14	C	15	B