

SCO INTERNATIONAL OLYMPIAD CLASS 11 BIOLOGY SAMPLE QUESTION PAPER SET S

- SCO International Biology Olympiad | Class 11 | Sample/practice question paper
- Prepared from the previous paper with answers, explanations and corrected academic presentation.
- Practice edition for student preparation and school use.

Living World

Cell Biology

Plant Physiology

Human Physiology

Biotechnology

Classification

Genetics & Cell Cycle

Reasoning

Achievers

Global Standard

SCO International Biology Olympiad - Class 11

This PDF-ready booklet is prepared for academic website publication. The layout uses compact inline question labels, not large question-number blocks. All questions, passages, options, answers, and explanations are placed inside the main question block for a clean student-friendly reading flow.

Field	Details
Exam Name	SCO International Biology Olympiad
Class / Grade	Class 11
Paper Type	Objective MCQ with application, case-based, assertion-reason and achievers-level questions
Duration	60 minutes
Number of Questions	50 questions
Answering Rule	Choose only one correct option for each question
Edition	Sample / practice edition with answer key and explanations

Candidate Guidelines

- Read each question carefully before selecting the answer.
- Use only one option as the final answer for every question.
- For assertion-reason questions, judge both statements first and then decide whether the reason explains the assertion.
- No calculator or external help is required for this paper unless the official examination instructions state otherwise.
- This version is designed for website PDF viewing and student practice with explanations.

Section A: Core Concepts and Applied Biology (Q1-Q20)

Q1. A biodiversity study in a remote rainforest uses DNA barcoding to catalog species diversity. Researchers find that 22% of sampled specimens yield DNA sequences that do not match any in current databases. What does this observation most likely suggest about the rainforest's biota?

- A) It has unusually low genetic diversity.
- B) It is dominated by invasive species.
- C) It harbors a high level of cryptic and novel species diversity.
- D) The DNA barcoding method is unreliable in tropical environments.

Answer: C

Explanation: The discovery of a significant proportion of unmatched DNA sequences indicates the presence of many species that have not yet been characterized—suggesting high cryptic and novel species diversity, a common finding in underexplored ecosystems.

Q2. A newly discovered microorganism's 16S rRNA gene sequence shows 92% similarity to known cyanobacteria. Based on modern molecular taxonomy, what is the most likely classification for this organism?

- A) It belongs to a novel family within the Cyanobacteria.
- B) It is a variant of a known species within Cyanobacteria.
- C) It should be classified within the Proteobacteria.
- D) It represents an archaea closely related to methanogens.

Answer: A

Explanation: A 16S rRNA similarity below 95% usually indicates that the organism belongs to a new family or even a new higher taxonomic rank within the group. Thus, this microorganism likely represents a novel lineage within the Cyanobacteria.

Q3. Recent research employing chloroplast genome sequencing has led to the reclassification of several angiosperms. A group of plants previously assigned to a large family is now proposed to form a distinct clade based on unique gene sequences and secondary metabolite profiles. Which method is most critical in validating this reclassification?

- A) Morphological analysis using light microscopy.
- B) Comparative chloroplast DNA sequencing and phylogenetic analysis.
- C) Soil composition analysis of their natural habitat.
- D) Measurement of plant water-use efficiency under drought.

Answer: B

Explanation: Comparative chloroplast DNA sequencing coupled with phylogenetic analysis is essential for resolving evolutionary relationships among plants. Unique gene sequences and metabolite profiles provide strong molecular evidence to support reclassification.

Q4. A comparative study on limb development in vertebrates reveals that similar regulatory gene networks (e.g., Hox genes) are expressed in both amphibian and mammalian limb buds. What evolutionary concept does this finding best support?

- A) Convergent evolution due to similar environmental pressures.
- B) Divergent evolution from a common ancestral limb.
- C) Independent evolution of similar morphological traits.
- D) The founder effect in isolated populations.

Answer: B

Explanation: The shared expression of Hox genes in limb development across diverse vertebrates strongly supports divergent evolution from a common ancestral structure, indicating that similar developmental pathways have been conserved through evolution.

Q5. Field observations in arid regions reveal that certain desert flowering plants have highly reduced leaves and succulent stems. What is the primary adaptive advantage of this morphological trait?

- A) Maximizing light capture for photosynthesis.
- B) Enhancing pollinator attraction through visual signals.
- C) Minimizing water loss and maximizing water storage.
- D) Increasing nutrient absorption from poor soils.

Answer: C

Explanation: Reduced leaves decrease the surface area for transpiration, while succulent stems store water. This adaptation is crucial for survival in water-limited desert environments.

Q6. A botanist compares the vascular anatomy of two plant species and finds that one species has a significantly higher density of xylem vessels in its stem. What is the most likely consequence of this anatomical difference?

- A) Increased photosynthetic efficiency.
- B) Enhanced water transport capability under drought conditions.
- C) Improved mechanical support against wind.
- D) Greater storage of secondary metabolites.

Answer: B

Explanation: A higher density of xylem vessels facilitates more efficient water transport, which is particularly beneficial for plants facing water stress.

Q7. Research comparing the cardiovascular systems of birds and mammals shows that birds have a four-chambered heart and a higher heart rate. What is the primary functional advantage of these traits in birds?

- A) Lower metabolic rate.
- B) Enhanced oxygen delivery to meet high metabolic demands during flight.
- C) Reduced blood pressure.
- D) Increased blood viscosity for better clotting.

Answer: B

Explanation: A four-chambered heart ensures complete separation of oxygenated and deoxygenated blood, which, combined with a high heart rate, enables efficient oxygen delivery to support the high metabolic demands of flight.

Q8. In a study on cell division, researchers observe that a mutation in the p53 gene leads to unchecked cell proliferation in cultured human cells. What is the primary role of the p53 protein in normal cells?

- A) To enhance the rate of DNA replication.
- B) To trigger apoptosis or cell cycle arrest in response to DNA damage.
- C) To promote the synthesis of ribosomal RNA.
- D) To stimulate the production of growth factors.

Answer: B

Explanation: p53 is known as the “guardian of the genome” because it monitors DNA integrity. When damage is detected, p53 induces cell cycle arrest or apoptosis, preventing the propagation of mutations.

Q9. A researcher studying enzyme kinetics finds that the reaction rate of an enzyme-catalyzed process does not increase beyond a certain substrate concentration, even when more substrate is added. This observation is best explained by which phenomenon?

- A) Competitive inhibition.
- B) Non-competitive inhibition.
- C) Enzyme saturation (Michaelis-Menten kinetics).
- D) Allosteric activation.

Answer: C

Explanation: At high substrate concentrations, the enzyme's active sites become fully occupied, and the reaction rate reaches a maximum (V_{max}) as described by Michaelis-Menten kinetics.

Q10. In a laboratory experiment, cells treated with a specific inhibitor arrest in the metaphase stage of mitosis. Which of the following cellular structures is most likely disrupted by this inhibitor?

- A) Centrioles.
- B) Mitotic spindle fibers.
- C) Nuclear envelope.
- D) Cytokinetic ring.

Answer: B

Explanation: Mitotic spindle fibers are essential for aligning chromosomes at the metaphase plate. Inhibition of spindle formation prevents proper chromosome segregation, leading to metaphase arrest.

Q11. The pressure-flow hypothesis explains phloem transport in plants. In an experiment, when a sugar solution is artificially introduced into a leaf, the translocation rate increases. Which factor is directly responsible for this observation?

- A) Increased xylem pressure.
- B) Enhanced osmotic pressure in the phloem, creating a steeper pressure gradient.
- C) Reduced transpiration from the leaf.
- D) Increased diffusion of CO_2 in the leaf tissue.

Answer: B

Explanation: Introducing a sugar solution raises the osmotic pressure in the phloem, thereby increasing the pressure gradient that drives the bulk flow of sap, as described by the pressure-flow hypothesis.

Q12. Field trials in nutrient-poor soils reveal that a deficiency in zinc leads to stunted growth and chlorosis in crops. Zinc acts as a cofactor for many enzymes. What is the most likely direct biochemical effect of zinc deficiency in plants?

- A) Decreased synthesis of chlorophyll due to reduced enzyme activity.
- B) Increased production of reactive oxygen species.
- C) Overaccumulation of starch in the leaves.
- D) Enhanced nitrogen fixation in roots.

Answer: A

Explanation: Zinc is a cofactor for enzymes involved in chlorophyll biosynthesis. Its deficiency leads to reduced enzyme activity, resulting in lower chlorophyll production and the observed chlorosis.

Q13. In a controlled laboratory study, scientists expose C_3 plants to increasing light intensities while maintaining high CO_2 levels. They observe that after reaching a certain light intensity, the net photosynthetic rate no longer increases. What is the most plausible explanation for this plateau?

- A) Stomatal closure limits CO_2 uptake.
- B) RuBisCO enzyme becomes saturated with CO_2 , limiting further carbon fixation.
- C) Excess light leads to photoinhibition of the chloroplasts.
- D) Increased photorespiration reduces the efficiency of photosynthesis.

Answer: B

Explanation: At high light intensities, RuBisCO-responsible for carbon fixation-becomes saturated with CO_2 , causing the net photosynthetic rate to plateau even when additional light is available.

Q14. In a study comparing dark respiration in two plant species, one species shows a consistently 30% higher respiration rate at the same temperature. What is the most likely physiological consequence of this difference in terms of energy balance?

- A) The species with higher respiration will have a higher net photosynthetic rate.
- B) The species with higher respiration requires more energy input to maintain growth.
- C) The species with higher respiration will accumulate more starch.
- D) The species with higher respiration will exhibit lower transpiration rates.

Answer: B

Explanation: A higher respiration rate increases the plant's energy consumption for maintenance and metabolism, meaning it requires more energy input (via photosynthesis or nutrient uptake) to support growth.

Q15. A mutant strain of Arabidopsis is found to be dwarf due to impaired gibberellin synthesis. What is the primary developmental process affected by reduced gibberellin levels?

- A) Cell division in the root apical meristem.
- B) Cell elongation in the stem.
- C) Chloroplast biogenesis.
- D) Flower initiation and timing.

Answer: B

Explanation: Gibberellins are plant hormones that promote cell elongation. A deficiency in gibberellin synthesis primarily affects the elongation of stem cells, leading to a dwarf phenotype.

Q16. A clinical study finds that individuals with lactose intolerance have reduced activity of the lactase enzyme in the small intestine. How does this biochemical deficiency most directly affect nutrient absorption?

- A) It leads to enhanced protein absorption.
- B) It causes undigested lactose to be fermented by gut bacteria, producing gas and discomfort.
- C) It increases the absorption of fats due to compensatory mechanisms.
- D) It results in higher blood glucose levels post-ingestion.

Answer: B

Explanation: Lactose intolerance results from low lactase activity, so lactose is not properly digested and is instead fermented by gut bacteria, producing gas and associated gastrointestinal symptoms.

Q17. High-altitude populations often exhibit physiological adaptations that enhance oxygen uptake. Which adaptation most directly increases the efficiency of alveolar gas exchange?

- A) Increased lung volume.
- B) Higher capillary density in the alveolar walls.
- C) Lower blood pH to facilitate oxygen release.
- D) Increased tidal volume during respiration.

Answer: B

Explanation: A higher capillary density around the alveoli increases the surface area available for gas exchange, allowing for more efficient oxygen uptake even in low-oxygen environments.

Q18. In endurance athletes, measurements indicate a 25% increase in stroke volume compared to non-athletes. What physiological adaptation is most likely responsible for this increased stroke volume?

- A) A higher resting heart rate.
- B) Increased myocardial contractility and ventricular chamber enlargement.
- C) Reduced blood volume due to dehydration.
- D) Decreased sympathetic nervous system activity.

Answer: B

Explanation: Endurance training typically results in an enlarged ventricular chamber and enhanced myocardial contractility, both of which contribute to a higher stroke volume.

Q19. A long-term study of individuals on high-protein diets shows elevated blood urea nitrogen (BUN) levels. Which renal adaptation best explains the body's response to increased nitrogenous waste?

- A) Increased glomerular filtration rate (GFR) to enhance waste clearance.
- B) Decreased renal blood flow to conserve water.
- C) Increased reabsorption of urea in the proximal tubule.
- D) Enhanced secretion of creatinine in the distal tubule.

Answer: A

Explanation: An increased GFR allows the kidneys to clear more nitrogenous waste (such as urea) from the blood, helping maintain homeostasis despite high protein intake.

Q20. Biomechanical studies on sprinters reveal that a greater proportion of fast-twitch muscle fibers correlates with increased sprinting performance. What is the primary reason for the superior performance of fast-twitch fibers in explosive movements?

- A) They contain more mitochondria, enabling sustained aerobic metabolism.
- B) They contract more rapidly and generate higher force over short durations.
- C) They have a higher capillary density for improved oxygen delivery.
- D) They rely primarily on fatty acid oxidation for energy production.

Answer: B

Explanation: Fast-twitch muscle fibers are specialized for rapid, powerful contractions, making them ideal for explosive activities such as sprinting. Their metabolic profile favors anaerobic energy production, which is crucial for high-intensity, short-duration performance.

Section B: Contemporary Biology and Case Applications (Q21-Q30)

Q21. A research team studying an understudied tropical ecosystem collects 1,200 specimens and finds that 35% of these yield novel DNA barcodes, meaning their sequences are not found in current databases. If the collected sample represents 5% of the estimated total species diversity in the region, what is the minimum percentage of total estimated diversity that is directly represented by the novel barcode observations?

- A) 1.75%
- B) 5%
- C) 7%
- D) 17.5%

Answer: A

Explanation: Novel barcode observations = 35% of 1,200 = 420. If 1,200 specimens represent 5% of total estimated diversity, the total estimate is $1,200 / 0.05 = 24,000$. The minimum directly observed novel share is $420 / 24,000 \times 100 = 1.75\%$. The true proportion may be higher if unsampled taxa also include novel species, but the minimum supported by the given data is 1.75%.

Q22. A new phylogenetic study compares whole-genome sequences of 50 plant species. One clade shows an average nucleotide divergence of 18% among its members, while another shows only 5%. What does the higher divergence most likely indicate about that clade's evolutionary history?

- A) It is more recently evolved.
- B) It underwent a rapid radiation event long ago.
- C) It experienced extensive horizontal gene transfer.
- D) It has been subject to intense stabilizing selection.

Answer: B

Explanation: A higher average nucleotide divergence (18%) indicates that the species in that clade have had more time to accumulate genetic differences. A rapid radiation event that occurred a long time ago would allow for significant divergence. In contrast, recent evolution would produce lower divergence. Horizontal gene transfer is less common in plants, and intense stabilizing selection would typically reduce divergence.

Q23. In a desert environment, researchers have identified two closely related succulent species. Species A has a stem water storage capacity of 120 ml per cm³, while species B stores 90 ml per cm³. Assuming both species face similar water deficits, what is the most likely ecological consequence of this difference?

- A) Species A will grow faster due to increased water availability.
- B) Species B will have a higher survival rate during prolonged drought.
- C) Species A may outcompete species B in extreme drought conditions.
- D) Species B will develop deeper root systems to compensate.

Answer: C

Explanation: A higher water storage capacity per unit volume allows Species A to retain more water during periods of scarcity, giving it an advantage in extreme drought conditions. This advantage can lead to competitive exclusion of the species with lower water storage capacity (Species B).

Q24. A recent study on migratory birds measured muscle fiber composition and found that birds with 70% fast-twitch fibers exhibited a 25% higher maximum speed during short flights compared to birds with 40% fast-twitch fibers. What is the primary biomechanical reason for this difference?

- A) Fast-twitch fibers generate greater force over short durations.
- B) Fast-twitch fibers enhance aerobic metabolism during long flights.
- C) Fast-twitch fibers require less oxygen, improving endurance.
- D) Fast-twitch fibers promote greater mitochondrial density.

Answer: A

Explanation: Fast-twitch muscle fibers contract quickly and powerfully, allowing for explosive bursts of speed. They are less efficient for sustained activity but are ideal for short, high-intensity efforts. The higher proportion of these fibers directly correlates with higher maximum speeds.

Q25. Field studies on pollination reveal that a specific orchid has evolved a unique labellum structure that vibrates in response to wind. Detailed biomechanical analysis shows that this vibration increases the probability of pollen transfer by 40%. What is the most plausible adaptive advantage of this trait?

- A) It reduces the energy expenditure of the plant.
- B) It increases the surface area for nectar production.
- C) It enhances cross-pollination by attracting windborne pollinators.
- D) It improves pollen dispersal by mechanically shaking off pollen grains.

Answer: D

Explanation: The vibrating labellum likely serves to dislodge pollen grains more effectively, increasing the chance that they adhere to visiting pollinators. This mechanical adaptation enhances pollen dispersal and thus improves reproductive success.

Q26. A pre-university research project investigates the mutation rate during cell division in a particular cancer cell line. If the normal mutation rate is 1 mutation per 10⁹ nucleotides per division, but the cancer cells exhibit a rate of 1 mutation per 10⁷ nucleotides per division, what is the fold increase in the mutation rate?

- A) 10-fold
- B) 50-fold
- C) 100-fold
- D) 1000-fold

Answer: C

Explanation: The normal rate is 1/10⁹ and the cancer cell rate is 1/10⁷. Dividing the latter by the former gives:

$$(1/10^7) \div (1/10^9) = 10^9/10^7 = 10^2 = 100.$$

Thus, there is a 100-fold increase in mutation rate.

Q27. A study of a plant enzyme involved in photosynthesis shows that its Michaelis constant (K_m) is 0.5 mM. Under saturating light conditions, doubling the substrate concentration from 1 mM to 2 mM increases the reaction rate by only 10%. What does this observation suggest about the enzyme's kinetics?

- A) The enzyme operates near V_{max} at 1 mM substrate concentration.
- B) The enzyme is inhibited by substrate at high concentrations.
- C) The enzyme follows zero-order kinetics with respect to substrate.
- D) The enzyme exhibits cooperative binding.

Answer: A

Explanation: When substrate concentration is well above the K_m (here, 1 mM is twice K_m), the enzyme is nearly saturated, meaning further increases in substrate concentration cause only minimal increases in reaction rate. This is typical of Michaelis-Menten kinetics when $[S] \gg K_m$.

Q28. In a controlled experiment, scientists expose C_3 plants to increasing light intensities. At light intensities above $2000 \mu\text{mol photons m}^{-2} \text{s}^{-1}$, the net photosynthetic rate plateaus. What is the most likely biochemical explanation for this observation?

- A) RuBisCO becomes saturated with CO_2 .
- B) The thylakoid membranes are damaged by excessive light.
- C) The electron transport chain is operating at maximum capacity.
- D) Stomatal closure limits CO_2 uptake.

Answer: A

Explanation: At high light intensities, the enzyme RuBisCO, which fixes CO_2 , becomes saturated. Even if additional light is available, the rate of carbon fixation cannot increase because RuBisCO's catalytic capacity is maximized.

Q29. In high-altitude adaptation studies, researchers measure alveolar oxygen partial pressures and find that one population exhibits a 15% increase in alveolar surface area compared to sea-level populations. According to Fick's law of diffusion, how does this anatomical change affect the rate of oxygen diffusion, assuming all other factors remain constant?

- A) Increases the diffusion rate by 15%.
- B) Increases the diffusion rate by 30%.
- C) Increases the diffusion rate by 50%.
- D) Increases the diffusion rate by 15-fold.

Answer: A

Explanation: Fick's law states that the diffusion rate is directly proportional to the surface area. A 15% increase in alveolar surface area directly translates to a 15% increase in the diffusion rate, assuming constant diffusion distance and concentration gradient.

Q30. Recent experiments on mammalian nerve fibers have revealed that increasing the myelin sheath thickness by 30% increases conduction velocity by approximately 25%. Which of the following best explains this observation?

- A) Increased myelin thickness reduces ion leakage, enhancing the saltatory conduction process.
- B) Increased myelin thickness decreases the diameter of the axon, thereby speeding conduction.
- C) Increased myelin thickness leads to more action potentials per unit time.
- D) Increased myelin thickness elevates the number of ion channels at the nodes of Ranvier.

Answer: A

Explanation: Thicker myelin improves the insulation of the axon, reducing ion leakage and allowing the action potential to jump more efficiently between the nodes of Ranvier (saltatory conduction). This leads to increased conduction velocity. The other options do not accurately reflect the underlying physiology of myelination.

Section C: Reason and Assertion (Q31-Q40)

Q31. Assertion (A): The CRISPR-Cas9 system is widely adopted for genome editing in plants because it is both cost-effective and highly specific.

Reason (R): CRISPR-Cas9 relies on a customizable guide RNA that base-pairs with target DNA, allowing precise recognition without the need for complex protein-DNA interactions.

Answer: A

Explanation: Both statements are true. The use of guide RNA in CRISPR-Cas9 indeed confers high specificity and ease of design, which explains its cost-effectiveness and broad adoption in plant genome editing.

Q32. Assertion (A): DNA polymerase's proofreading activity is essential for minimizing replication errors in eukaryotic cells.

Reason (R): DNA polymerase possesses a 3'→5' exonuclease activity that detects and excises mismatched nucleotides before proceeding with DNA synthesis.

Answer: A

Explanation: Both the assertion and reason are correct; the proofreading function via 3'→5' exonuclease activity is the primary mechanism by which DNA polymerase reduces the mutation rate during replication.

Q33. Assertion (A): The conserved expression of Hox genes during embryonic development across diverse animal phyla is evidence of deep homology.

Reason (R): Hox genes regulate the anterior-to-posterior body plan and are highly conserved at both sequence and function across the animal kingdom.

Answer: A

Explanation: Both statements are true, and the reason correctly explains that the conservation of Hox genes underlies the similar developmental mechanisms (deep homology) seen in a wide range of animals.

Q34. Assertion (A): In C_3 plants exposed to high light intensities, the net photosynthetic rate eventually plateaus despite further increases in light.

Reason (R): RuBisCO, the enzyme responsible for carbon fixation, becomes saturated with CO_2 , limiting the rate of the photosynthetic process.

Answer: A

Explanation: Both the assertion and reason are correct. At high light intensities, the enzyme RuBisCO reaches saturation, so additional light does not lead to increased CO_2 fixation, thereby causing the photosynthetic rate to level off.

Q35. Assertion (A): A population bottleneck leads to reduced genetic diversity and an increased risk of inbreeding in subsequent generations.

Reason (R): A dramatic reduction in population size causes a random loss of alleles, which decreases the overall gene pool available for future breeding.

Answer: A

Explanation: Both statements are true, and the reason correctly explains the genetic consequences of a bottleneck event on a population.

Q36. Assertion (A): RNA interference (RNAi) is an effective method for silencing gene expression in functional genomics studies.

Reason (R): Within the RNA-induced silencing complex (RISC), the Argonaute protein uses a guide RNA to bind and cleave target mRNA molecules, preventing protein synthesis.

Answer: A

Explanation: Both the assertion and reason are true, and the reason accurately describes the molecular mechanism by which RNAi leads to gene silencing.

Q37. Assertion (A): High-altitude populations often exhibit anatomical adaptations, such as increased alveolar surface area, that enhance oxygen uptake.

Reason (R): According to Fick's law of diffusion, an increase in the surface area available for gas exchange directly increases the rate of oxygen diffusion into the blood.

Answer: A

Explanation: Both statements are correct, and the reason provides the mechanistic explanation for how an increased alveolar surface area improves oxygen uptake.

Q38. Assertion (A): Fast-twitch muscle fibers are critical for explosive movements in animals.

Reason (R): Fast-twitch fibers generate high forces quickly by relying on anaerobic metabolism, even though they fatigue more rapidly than slow-twitch fibers.

Answer: A

Explanation: Both the assertion and reason are true; the rapid contraction and high force output of fast-twitch fibers-despite their lower endurance-explain their key role in explosive movements.

Q39. Assertion (A): Horizontal gene transfer (HGT) significantly contributes to the spread of antibiotic resistance among bacterial populations.

Reason (R): HGT mechanisms, such as conjugation, transformation, and transduction, allow bacteria to acquire resistance genes from unrelated species, facilitating rapid adaptation.

Answer: A

Explanation: Both statements are true, and the reason correctly explains the role of HGT in promoting antibiotic resistance across diverse bacterial species.

Q40. Assertion (A): Epigenetic modifications like histone acetylation typically lead to increased gene expression.

Reason (R): Acetylation of histone tails reduces their positive charge, decreasing the affinity between histones and DNA and thereby permitting greater access for transcription factors.

Answer: A

Explanation: Both the assertion and reason are true; histone acetylation indeed loosens chromatin structure, facilitating transcription and resulting in increased gene expression.

Section D: Achievers Section - Higher Order Biology (Q41-Q50)

Q41. Assertion (A): The rate of enzyme-catalyzed reactions in living cells increases with temperature up to an optimum point.

Reason (R): According to the Arrhenius equation, increasing temperature raises the kinetic energy of molecules, thereby increasing collision frequency and the proportion of collisions that overcome the activation energy barrier.

Answer: A

Explanation: Both statements are true. The Arrhenius equation explains how reaction rates increase with temperature until the enzyme denatures. Thus, the reason correctly explains the assertion.

Q42. Assertion (A): The green color of plants is due to the fact that chlorophyll absorbs light most strongly in the blue and red regions of the spectrum.

Reason (R): Photons in the blue and red wavelengths possess energies that are ideal for driving the photochemical reactions of photosynthesis, while green light is reflected, making it less useful for these reactions.

Answer: A

Explanation: Both statements are true. Chlorophyll's absorption spectrum peaks in the blue and red regions, and the energy from these photons is sufficient for photosynthesis. The reason accurately explains why green light is less absorbed.

Q43. Assertion (A): The chemiosmotic mechanism in mitochondria couples electron transport to ATP synthesis.

Reason (R): The electron transport chain creates a proton gradient across the inner mitochondrial membrane, and the potential energy stored in this gradient drives ATP synthesis via ATP synthase.

Answer: A

Explanation: Both the assertion and the reason are correct; the chemiosmotic theory precisely describes how the proton motive force is converted into chemical energy (ATP).

Q44. Assertion (A): The efficiency of photosynthesis is partly limited by the energy gap of reaction center pigments in photosystems.

Reason (R): Only photons with energy greater than or equal to the pigment's energy gap (as determined by $E = hc/\lambda$) can excite electrons to initiate photochemical reactions.

Answer: A

Explanation: Both statements are true. The energy of incoming photons must be sufficient to overcome the energy gap of the pigment, which is why photosynthetic efficiency is inherently limited by this quantum requirement.

Q45. Assertion (A): UV radiation commonly causes mutations in DNA by inducing the formation of thymine dimers.

Reason (R): UV photons, particularly in the UV-C range, have sufficient energy (as given by $E = hc/\lambda$) to form covalent bonds between adjacent thymine bases, resulting in dimerization.

Answer: A

Explanation: Both the assertion and the reason are true. The energy of UV-C photons is high enough to induce thymine dimer formation, which is a well-documented mechanism of UV-induced DNA damage.

Q46. Assertion (A): Mitochondria have a double membrane and contain their own circular DNA, supporting the endosymbiotic theory.

Reason (R): The inner mitochondrial membrane is thought to have evolved from the plasma membrane of an ancestral proteobacterium, as evidenced by similarities in lipid composition and gene sequences.

Answer: A

Explanation: Both statements are true and the reason correctly explains the assertion by linking mitochondrial structure and genetics to an ancestral endosymbiotic event.

Q47. Assertion (A): The Beer-Lambert law is widely used to quantify chlorophyll concentration in plant extracts.

Reason (R): The law states that the absorbance of light by a solution is directly proportional to the concentration of the absorbing species and the path length of the light through the solution.

Answer: A

Explanation: Both the assertion and the reason are true; the Beer-Lambert law underpins spectrophotometric analysis by relating absorbance to chlorophyll concentration.

Q48. Assertion (A): Cancer cells often exhibit the Warburg effect, preferring glycolysis over oxidative phosphorylation even in the presence of oxygen.

Reason (R): Due to mitochondrial dysfunction and rapid energy requirements, cancer cells favor glycolysis, which, although less efficient in ATP yield, supports anabolic growth and produces lactate as a byproduct.

Answer: A

Explanation: Both statements are true. The Warburg effect describes the metabolic reprogramming in cancer cells, and the reason accurately reflects one of the biochemical rationales for this shift.

Q49. Assertion (A): Hemoglobin exhibits cooperative binding of oxygen, enhancing oxygen delivery to tissues.

Reason (R): The binding of oxygen to one subunit of hemoglobin induces conformational changes that increase the affinity of the remaining subunits for oxygen, as modeled by the Hill equation.

Answer: A

Explanation: Both statements are true; cooperative binding in hemoglobin is well-documented, and the Hill equation quantitatively describes this effect.

Q50. Assertion (A): In prokaryotic cells, the rate of diffusion of small molecules across the cell membrane is crucial for nutrient uptake and waste elimination.

Reason (R): According to Fick's first law, the rate of diffusion is directly proportional to the concentration gradient and the available membrane surface area, and inversely proportional to the diffusion distance (membrane thickness).

Answer: A

Explanation: Both the assertion and the reason are correct; Fick's law explains the physical basis of diffusion, which is a critical process for cellular function in prokaryotes.

Answer Key

Q	Ans.	Q	Ans.	Q	Ans.	Q	Ans.	Q	Ans.
1	C	2	A	3	B	4	B	5	C
6	B	7	B	8	B	9	C	10	B
11	B	12	A	13	B	14	B	15	B
16	B	17	B	18	B	19	A	20	B
21	A	22	B	23	C	24	A	25	D
26	C	27	A	28	A	29	A	30	A
31	A	32	A	33	A	34	A	35	A
36	A	37	A	38	A	39	A	40	A
41	A	42	A	43	A	44	A	45	A
46	A	47	A	48	A	49	A	50	A