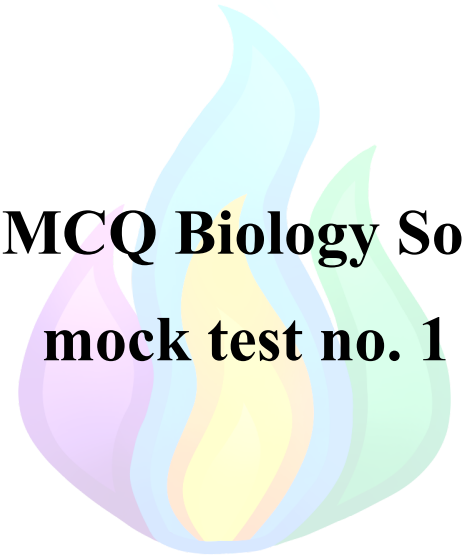

IJSO MCQ Biology Solutions

mock test no. 1

Question Number	Option			
1	A	B	~~C~~	D
2	~~A~~	B	C	D
3	A	~~B~~	C	D
4	A	B	~~C~~	D
5	A	~~B~~	C	D
6	A	B	~~C~~	D
7	A	~~B~~	C	D
8	~~A~~	B	C	D
9	A	B	~~C~~	D
10	A	B	C	~~D~~
11	A	~~B~~	C	D
12	A	~~B~~	C	D
13	A	B	C	~~D~~
14	A	~~B~~	C	D
15	A	B	~~C~~	D

Question Number	Option			
16	A	~~B~~	C	D
17	A	~~B~~	C	D
18	A	~~B~~	C	D
19	A	B	C	~~D~~
20	A	B	C	~~D~~
21	A	~~B~~	C	D
22	A	B	~~C~~	D
23	A	~~B~~	C	D
24	A	B	C	~~D~~
25	A	B	~~C~~	D
26	A	~~B~~	C	D
27	~~A~~	B	C	D
28	A	B	C	~~D~~
29	A	B	~~C~~	D
30	A	~~B~~	C	D

Question 1 – Abiotic Influence in The Arctic Tundra

- The Arctic Tundra is characterized by extremely cold temperatures, which lead to permafrost (permanently frozen ground). This prevents deep root growth and nutrient cycling. The cold also drastically shortens the growing season. Low temperatures and slow decomposition rates mean very few available nutrients in the soil, which is a major challenge for plants.

- Option A is incorrect, as transpiration and high humidity are not characteristics of such cold environments. Transpiration happens in very high temperatures when the stomata must close to prevent water loss.

- Option B is also incorrect because volcanic soil is very fertile, so it would promote growth. Also, because the sun is lower in the sky in the Arctic, there is less UV radiation, so it would not be strong enough to affect plant growth. UV radiation may be beneficial or harmful, so there is not enough information.

- Option D is incorrect because that would set up the perfect environment for these plants to thrive. Low herbivores mean fewer predators, and high soil moisture is perfect for supporting plant growth.

The correct answer is **C**.

Question 2 – Evolutionary Relationships in the Arctic

- Based on the table provided, option A is true because the Arctic tern shares more in common with the ringed seal (vertebral column and amniotic egg) than it does with the Greenland shark (only vertebral column).
- Option B is false because a homologous trait is due to having a common ancestor, and a monophyletic group includes the common ancestor and ALL its descendants.
- However, according to the table, the polar bear has hair/fur, but the arctic tern does not, so they cannot be from the same monophyletic group.
- Option C is false because the polar bear and the ringed seal have the same description, pointing towards them being from the same evolutionary lineage.
- Option D is false, which can simply be deduced from the table.

The correct answer is **A**.

Question 3 – Study of Plant Leaves

Xerophytic plants (like Nerium oleander) often have stomata sunken in pits or primarily on the lower (abaxial) surface to conserve water, meaning higher density on one side or very low overall. The data for C1 and C2 (7,10) shows extremely low stomata on both sides, thus confirming it's from Nerium oleander.

Hydrophytic plants (like Nymphaea alba - water lily) have stomata only on the upper (adaxial) surface because the lower surface is submerged. Sample B has stomatal density 0 on one side and 358 on the other, strongly suggesting Nymphaea alba (B1=0, B2=358 or vice versa).

Plants adapted to high photosynthetic rates, like Eucalyptus spp.: tend to have high stomatal densities on both surfaces for efficient gas exchange. Sample D fits this as well.

So option A remains to be most suitable for Zea Mays

- To calculate the total stomatal area for Sample A (Zea Mays):
  - Average stomatal density = (156+147)/2 stomata/mm^2
  - Total area of one side of the leaf = 200 cm^2 = 200 * (10 mm)^2 = 20,000 mm^2
  - Total stomata on both sides of the leaf = 2* (156+147)/2 stomata/mm^2 * 20,000 mm^2) =6,060,000 stomata
  - Area of one stomata = 80 μm^2 = 80 * (10^{-3} mm)^2 = 0.00008 mm^2
  - Total area of stomata = 6,060,000 stomata * 0.00008 mm^2/stomata = 484.8 mm^2

Conclusion: Option B is the correct answer, as the total area of the stomata on a Zea Mays leaf is 484.8 mm^2.

The correct answer is **B**.

Question 4 – Osmoregulation in the Digestive System

Diarrhea causes rapid loss of sodium ions because there isn't enough time for reabsorption in the colon. The solution of NaCl and glucose is a common oral rehydration therapy.

- Option A explains that high sodium concentration helps retain some ions, which is partly true, but doesn't explain the role of glucose or the mechanism of reabsorption.
- Option B incorrectly states that glucose and sodium move in opposite directions and that glucose provides energy for Na+ transport. The Na+/glucose cotransporter moves in the same direction, and the energy for Na+ movement comes from its electrochemical gradient, not directly from glucose.
- Option D suggests glucose is only for energy after loss, which is not its primary role in aiding sodium absorption in this context.
- Option C correctly identifies the presence of the Na+/glucose cotransporter in intestinal cells and that both Na+ and glucose move in the same direction. This cotransport system is crucial for efficient sodium reabsorption even during diarrhea, as glucose enhances the uptake of sodium from the gut lumen into the intestinal cells, and water follows by osmosis.

Option C accurately describes the reasoning behind the treatment, highlighting the role of the Na+/glucose cotransporter in facilitating sodium absorption.

The correct answer is **C**.

Question 5 – Plant Water Transport Under Stress

The plant described is adapted to semi-arid regions and prolonged drought. Simply closing stomata is a first line of defense, but deeper adaptations are needed for long-term survival.

- A. Increased transpiration would lead to greater water loss, not survival in drought.
- B. Accumulation of compatible solutes (osmolytes) within cells lowers the solute potential, and thus the overall water potential, of the cell. This allows the plant to absorb water from soil with lower (more negative water potential or to retain water within its cells even when external water potential is very low, thus maintaining turgor pressure and preventing desiccation.
- C. Plants do not actively pump water against a water potential gradient from dry soil; water moves from higher to lower water potential.
- D. While shedding leaves is a dormancy strategy, the question asks for a physiological adaptation beyond closed stomata and slowing metabolic activity that helps avoid desiccation and relates to water potential.

Conclusion: Option B best describes a crucial physiological adaptation for drought survival by manipulating cellular water potential.

The correct answer is **B**.

Question 6 – Virus Strains in the Arctic

The graph shows the number of virus strains identified over time, with a "Line of Best Fit."

- A. While identified in 2010, the question asks for when it first appeared, which might be before identification.
- B. Assuming it took a few years to mutate is a hypothesis, but the graph provides data to infer the start.
- C. The line of best fit extrapolates back to approximately zero strains at the x-axis (Year). Observing the graph, the red line (line of best fit) appears to intersect the x-axis (where the number of strains would be close to zero, indicating the virus's likely first appearance) around the year 2009.
- D. The idea that the mutation rate increases with the number of strains is plausible in general, but the graph shows a relatively linear increase, and extrapolating far back based on "around 1 in 2006" is speculative.

Conclusion: Option C is the most reasonable conclusion based on the graphical data provided, as the line of best fit suggests the virus emerged around 2009.

The correct answer is **C**.

Question 7 – Multilocus Electrophoresis in Arctic Wolf

In multilocus electrophoresis, an offspring inherits one band (allele) from each parent at every locus. To find the correct parent pair, every band in the cub's pattern must be present in either the male or female parent of the pair, or both.

- Visually inspect the bands:
    - **Cub (C):** Has bands at various positions.
    - **Compare Pair 1, Pair 2, Pair 3, and Pair 4 with Cub (C**).
    - Look for any band in the cub that cannot be accounted for by either parent in a given pair.
    - **Pair 1:** Does not seem to match all of the cub's bands. For example, the top-most single band in the cub's pattern is not present in Pair 1.
    - **Pair 2:** All of the cub's bands can be accounted for by the combined bands of Pair 2. For every band the cub has, at least one parent in Pair 2 has that band.
    - **Pair 3:** Missing some bands present in the cub.
    - **Pair 4:** Missing some bands present in the cub.

Pair 2 is the most likely parent pair because all the bands present in the cub can be found in the combined electrophoretic patterns of the individuals in Pair 2.

The correct answer is **B**.

Question 8 – Allele Frequency in Arctic Wolves

- This problem requires knowledge of Hardy-Weinberg equilibrium. The formula **p + q = 1** is for allele frequencies, the frequency of dominant alleles (A) and recessive alleles (a), regardless of whether they are part of a homozygous or heterozygous individual. The formula $\mathbf{p^2 + 2pq + q^2}$ is for genotype frequencies. p^2 is homozygous dominant, 2pq is heterozygous, and q^2 is homozygous recessive.
- In total, there are 50 wolves, and 10 have light fur while 40 have dark fur. We can make these frequencies: light fur = 10/50 = 0.2; dark fur = 40/50 = 0.8. It is important to note that those with light fur are only capable of being **homozygous** recessive. However, those with dark fur are capable of being BOTH **homozygous dominant** and **heterozygous**, because the dominant allele masks the recessive one.
- If light fur can only be homozygous recessive, then we can assume it is equal to $q^{2,}$ which means q can be found by taking the square root of 0.2, giving us 0.447. Now that we have q, we can solve for p by subtracting 0.447 from one (p + q = 1). Therefore, p is 0.553. We can plug everything into this equation: $\mathbf{p^2 + 2pq + q^2}$. After calculating, it is evident that this population IS at Hardy-Weinberg equilibrium because all the terms add up to one, with AA being 0.306, Aa being 0.494, and aa being 0.2.

A) This population IS at Hardy-Weinberg equilibrium. The answers also match: AA is 0.30, Aa is 0.50, and aa is 0.2. Therefore, option A is indeed correct.

Options B through D are ALL incorrect, because a population simply cannot be at equilibrium if there is deficiency, advantage, or overdominance. Option B is especially incorrect because one of the key rules of Hardy-Weinberg equilibrium is to have random mating.

The correct answer is **A**.

Question 9 – Effects of Chemical Compounds on Oxygen Concentrations in a Water Body

The graph shows an initial increase in oxygen concentration from Day 1 to Day 3, followed by a sharp decrease from Day 3 to Day 6.

- Initial Increase (Day 1-3): This pattern is typical when nutrient-rich organic waste (like nitrates or phosphates) is introduced into a water body. These nutrients cause an algal bloom (eutrophication), leading to increased photosynthesis and thus higher oxygen production during the day.
- Sharp Decrease (Day 3-6): As the algal bloom eventually dies off, decomposers (bacteria and fungi) consume the dead organic matter. This decomposition is an aerobic process, meaning it consumes large amounts of dissolved oxygen, leading to a significant drop in oxygen levels in the water. This process is known as biological oxygen demand (BOD).

- A. Glucose and other organic compounds would cause an immediate drop in oxygen as decomposers break them down.
- B. Bicarbonates or carbonate ions may increase the photosynthesis rate if carbon compounds are limiting, which does not explain the observed pattern.
- C. Nitrates or phosphate ions are key nutrients that cause eutrophication. This leads to an initial surge in primary production (algal bloom, increasing oxygen), followed by decomposition of dead algae, which consumes oxygen. A real-life example is when fertilizer (which contains high levels of nitrogen) runs off (leeches) into nearby waterbodies, they tend to cause an algal bloom.
- D. Heavy metals like Mercury are toxic and would directly harm aquatic life and disrupt biological processes. They would never cause an increase in photosynthetic rate.

The correct answer is **C**.

Question 10 – Effects of Pollutants in Ecosystems

We have two persistent organic pollutants (POPs), X and Y, and a predatory bird.

- **Pollutant X**: Highly lipophilic, very stable, accumulates in fatty tissues (exhibits bioaccumulation and biomagnification).
- **Pollutant Y**: Less lipophilic than X, but can bind to proteins in muscle tissue. It can be metabolized in the liver to Pollutant Z.
- **Pollutant Z (metabolite of Y):** Lipophilic and accumulates in fat.
- The question asks for the highest concentration of the combined total of X, Y (including unmetabolized), and Z.
- Since X is highly lipophilic and accumulates in fat, and Z (the metabolite of Y) is also lipophilic and accumulates in fat, adipose (fat) tissue will be the primary storage site for both.
- While Y can bind to muscle proteins, the combined total concentration will be dominated by the substances that accumulate most efficiently, which are the lipophilic ones in fat.
- Liver tissue (C) is where metabolism of Y occurs, but it's not necessarily the storage site for the highest combined total concentration of all three, especially as the fat-soluble components are moved to fat tissue for long-term storage.
- Brain tissue (A) is also fatty, but often protected by a blood-brain barrier, though lipophilic substances can cross. However, general adipose tissue is the main storage for lipophilic toxins.
- Feather samples (B) might contain some pollutants, but they are not the primary storage site for circulating or metabolized lipophilic compounds.

Conclusion: Option D (Adipose tissue) is where you would expect to find the highest combined total concentration of Pollutant X, Pollutant Y (unmetabolized), and Pollutant Z, due to their lipophilic nature and the role of fat as a storage depot for such compounds.

The correct answer is **D**.

Question 11 – Thermoregulatory Systems of Arctic Fox

The Arctic fox's paws are in contact with extremely cold ground. The specialized vascular arrangement described (arterial blood flowing towards paws near venous blood returning from paws) is a classic example of a countercurrent heat exchange system.

- A. Vasodilation would increase heat loss to the environment, which is counterproductive for preventing heat loss in cold conditions.
- B. In a countercurrent heat exchange system, heat from the warm arterial blood moving away from the core is transferred to the cooler venous blood returning to the core. This pre-cools the arterial blood before it reaches the extremities, minimizing heat loss to the environment from the paws. Simultaneously, the venous blood is warmed before returning to the core, reducing the energy needed to maintain core body temperature.
- C. While waste product removal is important, it's not the primary benefit of this specific countercurrent heat exchange for thermoregulation.
- D. Specialized valves might exist, but the core mechanism described is about heat exchange, not just flow diversion.

Conclusion: Option B provides the most accurate and detailed explanation of how countercurrent heat exchange in the Arctic fox's paws helps conserve body heat in freezing conditions.

The correct answer is **B**.

Question 12 – Properties of Histone

The question mentions that histone acetylation involves adding an acetyl group to the ε-amino group of lysine, a positively charged residue. This means histone acetylation neutralizes the positive charge on lysine and weakens the ionic interactions with negatively charged phosphate groups in the DNA Backbone. This results in a looser chromatin structure known as euchromatin. Keep in mind, this is a reversible, epigenetic change, not a permanent DNA mutation. Let us consider the options:

- A. This option says that histone acetylation promotes heterochromatin formation by stabilizing nucleosome-nucleosome interactions, but this describes histone deacetylation (removal of the acetyl group), which is the opposite of what the question is asking for. This results in a tighter chromatin structure, heterochromatin, not euchromatin. Option A is incorrect.

- B. This option shows us that it facilitates euchromatin expansion by disrupting histone-DNA ionic bonds, which is exactly what histone acetylation does. Therefore, this option is correct because it creates a looser structure.

- C. This option is incorrect because it demonstrates that histone acetylation leads to histone tail ubiquitination, triggering chromatin looping and long-range enhancer silencing. This does not fit, because increasing chromatin looping creates a tighter structure, the opposite of what we need to make euchromatin.

- D. This option shows us that this induces methylation of CpG islands within promoter regions, permanently inactivating associated transcriptional loci. But CpG methylation is a DNA modification; it is not a result of histone acetylation. It is associated with gene silencing, not activation.

The correct answer is **B**.

Question 13 – Population Genetics in the Hare Population

Step 1)

Assign genotypes to phenotypes: CG – Gray fur; CW – White fur; CGCW – Speckled White with Gray fur

Step 2)

Use this formula for gene frequencies (CG and CW): **p + q = 1**.

Use this one for genotype frequencies (CGCG, CWCW, and CGCW): $\mathbf{p^2 + 2pq + q^2 = 1}$.

It is given that CGCG (q^2) 9% = 0.09 frequency; so, if we take the square root, we get q (CG) = 0.3. That means CW (p) = 0.7 and therefore p^2 = 0.49. CWCG (heterozygotes) = 2pq = 2(0.3)(0.7) = 0.42. Finally, 0.09 + 0.49 + 0.42 = 1, indicating this population is indeed at Hardy-Weinberg equilibrium.

The probability of Hares with Speckled White with Gray fur is 0.42

Step 3)

Assign genotypes to Phenotypes: L – Long tail; l – Short tail

Step 4)

It is given that ll (q^2) is 16%, which equals 0.16. Using the formula p + q = 1, l is 0.4. We can then find that L is 0.6. Then, using $p^2 + 2pq + q^2 = 1$, we can find long tail hares which are LL and Ll, which is 0.36 + 0.48 = 0.84 or 1 – 0.16 = 0.84.

Step 5)

To find the probability of a hare having a speckled coat AND a long tail, we need to use the probability product rule and multiply out two values: 0.42 x 0.84, which equals 0.35.

The correct answer is **D**.

Question 14 – Dysregulation of Cyclin D and G1/S Checkpoint

This problem is testing your knowledge of cell cycle regulation.

- A. is incorrect, because the prefix hypo- means less, but there is MORE phosphorylation of Rb, not less.
- B. is CORRECT, because phosphorylation of Rb inactivates it, and because there is overexpression of Cyclin D, there is more phosphorylation of Rb. Due to the phosphorylation, there will be hyperactivation of E2F and sped up entry to S-phase, which is characteristic of neoplastic formation of cancer.
- C. is incorrect because neither p21 nor CDK2 are mentioned in the problem.
- D. is incorrect because it jumps ahead to the actual process of mitosis. The preamble is focusing on interphase, the preparation of the cell for mitosis.

The correct answer is **B**.

Question 15 – Analysis of Leaf Cross Section

This problem is testing your knowledge of plant adaptations and niches.Looking at the cross-section, we can already identify that there are two distinct layers of the mesophyll: palisade and spongy. Only dicots or C4 plants feature such differentiation in the mesophyll. It is also evident that this forms Kranz anatomy - a ring of bundle sheath cells forming a wreath-like structure. This arrangement allows for spatial separation of carbon capture and fixation by phosphoenolpyruvate (PEP), characteristic of C4 plant adaptations.

- A. is incorrect because C3 plants do not feature such Kranz anatomy
- B. is incorrect because CAM plants also do not feature Kranz anatomy. They have temporal separation of carbon fixation (stomata are closed during the day and open at night) so there is no spatial differentiation.
- C. is correct because it accurately describes that this is Kranz anatomy, perfect for allowing phosphoenolpyruvate to enhance photosynthesis in bright and hot conditions.
- D. is incorrect because monocots do not feature such mesophyll differentiation.

The correct answer is **C**.

Question 16 – Comparison of Hepatic Portal Veins and Systemic Veins

- A. is incorrect because portal veins only take blood from one organ to another, not directly to or from the heart.
- B. is correct because the hepatic portal vein takes blood from the gastrointestinal tract to the liver, where biomolecules are filtered BEFORE dissemination.
- C. is incorrect because the hepatic portal vein has nothing to do with renal clearance; it takes blood from the GI tract straight to the liver.
- D. is incorrect because portal veins lack valves. They rely on a low-pressure system for blood transportation.

The correct answer is **C**.

Question 17 – Structural Neurobiology of Reflex Arcs

The key thing to keep in mind for this question is that reflex arcs are designed to be split-second fast. Anything slowing down signal transmission is likely not part of said reflex arc:

- A. is incorrect because the preamble clearly states that sensory neurons are pseudounipolar, not bipolar. Secondly, bipolar neurons would slow down the transmission of impulses by making it go through the soma (cell body), which is not myelinated.
- B. is correct because the preamble states that sensory neurons are pseudounipolar, and pseudounipolar neurons are very efficient because signals do not have to go through a cell body, as seen in the diagram. One branch travels directly to the CNS to be interpreted.
- C. is incorrect because multipolar neurons are slower than pseudounipolar neurons; they have multiple dendritic extensions making signal transmission less fast as required for reflex arcs.
- D. is incorrect because it builds on to option C. Multipolar neurons are not suitable for reflex arcs for that very reason of dendritic redundancy.

The correct answer is **B**.

Question 18 – Plant Dependency on Bees

- A. is incorrect; seed dispersal is done by wind, water, and animals that eat the fruit of the plant.
- B. is correct, bees pollinate plants by carrying the sperms from the anther (nectar) to the female organ (the stigma).
- C. is incorrect; seeds germinate on their own with the help of the right conditions, including perfect temperature, moisture, and oxygen
- D. is incorrect, secondary growth is initiated by the plant hormone cytokinin, as it promotes lateral growth (simultaneously counteracting apical growth)

The correct answer is **B**.

Question 19 – Effects of Artificial Lighting On Flowering Plants

This question requires some background knowledge. We must understand how photoperiodism (the biological response plants have, to changing lengths of day and night) affects short-day and long-day plants and how red light and far-red light impact various plants:

- **Short-day plants** flower when the **night is long** (there is uninterrupted darkness during that period)
- **Long-day plants** flower when the **night is short** (darkness is interrupted frequently)
- **Red light** interrupts the dark period and **prevents** short-day plants from flowering
- **Far-red light** (730–740 nm) can **reverse** the effect of red light if given immediately after, still allowing short-day plants to flower

With that in mind, let's look at the options:

- A. is incorrect because this is a short-day plant, so it prefers long uninterrupted darkness, and red light creates a significant interruption.
- B. is incorrect because this is a long-day plant, so it prefers interruptions, but the red light is cancelled out by the far-red light.
- C. is incorrect because the far-red light will cancel the red light, not giving the interruption that long-day plants require.
- D. is correct because the far-red light cancels all the red light, keeping the short-day plant uninterrupted.

The correct answer is **D**.

Question 20 – Effects of Phototropins on Plants

It is key to remember that the question is asking for what statement is BEST supported by the DATA. It could be factually correct, but that doesn't mean it fully and directly supports the statement.

- A. is incorrect because the apoplast is the entire network of extracellular space where solutes move freely. If this were the case, auxin would be evenly distributed, but that is disputed by graph (a).
- B. is incorrect because the data shows NOT where the auxin is made, but where it ends up. The statement itself is factually incorrect because auxin is manufactured in the meristem and only redistributed in the apex.
- C. is incorrect because, as shown in the data, the amount of auxin has not changed; it has only been redistributed. Therefore, light is NOT destroying auxin, it is just chasing it away.
- D. is correct because in graph (a), where there is no barrier, it is evident that auxin moves away from the light.

The correct answer is **D**.

Question 21 – Cold-Resistant Adaptation in Plants

This question relies mainly on reading comprehension as opposed to actual knowledge of the topic.

- A. is incorrect, because it says, “chloroplast membrane SATURATION to stabilize photosynthetic membranes,” BUT in the text, it clearly states that desaturase activity leads to more UNSTATURATED fatty acids.
- B. is correct because it accurately matches the information provided in the text, including non-photochemical quenching to prevent photoinhibition, cryo-stabilization, and that of unsaturated fatty acids.
- C. is incorrect because anti-freeze proteins, not reduced aquaporin expression, minimize ice formation.
- D. is incorrect because it again mentions SATURATION when the text clearly states that UNSATURATED fatty acid membranes are an important adaptation.

The correct answer is **B**.

Question 22 – Thermoregulation in Humans

This problem once again requires reading comprehension and analysis skills.

- A. is incorrect because vasodilation allows the body to lose MORE heat through the skin, which is ineffective when keeping the body warm.
- B. is incorrect because protecting the body against the cold via BAT and skeletal stimulation is a sympathetic process. The body is working hard to protect itself; this is not the "rest and digest" of parasympathetic processes.
- C. is correct because, according to the text, norepinephrine drives vasoconstriction, which is key for retaining heat. Furthermore, it correctly addresses that BAT is done in such a way that heat is released without generating ATP. That was clearly stated in the text.
- D. is incorrect because B2-adrenergic receptors and spinal thermoreceptors are not addressed in the text. Furthermore, it says spinal thermoreceptors act INDEPENDENTLY of the hypothalamus, which completely contradicts the text.

The correct answer is **C**.

Question 23 – Endosymbiosis in the Nitroplast

This question requires some data analysis and understanding of the endosymbiotic theory, as well as the fact that mitochondria and chloroplasts are involved.

- A. has correctly identified that chloroplasts and mitochondria are endosymbiotic, but is incorrect because the data does not support (or even bring up) that endosymbionts have double membranes.
- B. has correctly identified that chloroplasts and mitochondria are endosymbiotic and is correct because the data does support the fact that the nitroplast relies on host nuclear-encoded proteins for essential functions.
- C. incorrectly identifies that the Golgi apparatus is endosymbiotic. Furthermore, antibiotic sensitivity is a variable thing, which means that it is challenging to generalize to all endosymbionts.
- D. incorrectly identifies that the Golgi apparatus is endosymbiotic.

Please note: some options sound plausible, but we are always looking for the BEST one!

The correct answer is **B**.

Question 24 – Pedigree Analysis

This question requires knowledge, logic, and application of pedigree analysis.

Note that the preamble does not provide much key information needed to solve the problem; focus on the pedigree itself. Please refer to our pedigree lesson if you are unfamiliar.

Let's look at all the options i) → vi)

i) *Correct.* The trait appears in every generation and affects both males and females. Affected fathers pass it to both sons and daughters, consistent with autosomal dominant inheritance.

ii) *Incorrect.* X-linked recessive traits typically skip generations and affect more males than females. This contradicts statement i).

iii) *Incorrect.* Individual 1 has one affected parent, so they could inherit either the dominant or recessive allele, making heterozygosity possible.

iv) *Incorrect.* Since only one parent is affected (likely Bb or BB), the offspring can be either heterozygous or homozygous, not necessarily homozygous.

v) *Incorrect.* Individual 4's parents include one unaffected (homozygous recessive) and one affected (likely Bb or BB), so the offspring could be homozygous recessive. A Punnett square can help visualize this.

vi) *Correct.* If an individual 5 marries someone who is homozygous (either dominant or recessive), their children can be homozygous, depending on the genotypes.

The correct answer is **D**.

Question 25 – Thermoregulation in Humans

- A. is incorrect, because the brain requires the most energy, it cannot just divert to other organs - it also doesn't directly explain how that is a thermoregulatory mechanism.
- B. is incorrect because enhanced vasodilation is used when it is very hot, not cold. Vasoconstriction is used instead to prevent heat loss through the skin.
- C. is correct because vasoconstriction is a key thermoregulatory mechanism used to retain heat in the body.
- D. is incorrect because increased blood flow to the extremities promotes heat loss

The correct answer is **C**.

Question 26 – Renal Physiology, Impact of Afferent Arteriole Constriction

- A. is incorrect because constriction leads to resistance, DECREASING the glomerular filtration rate.
- B. is correct because constriction increases resistance, leading to LOWER blood pressure downstream (past) the point of constriction, including the glomerulus.
- C. is incorrect, because the Bowman's capsule surrounds the glomerulus; if there is lower blood pressure in the glomerulus, that must be the same for the Bowman's capsule.
- D. is incorrect because increased osmotic pressure leads to lowered levels of glucose reabsorption in the proximal tubule, but constriction of the afferent arteriole leads to DECREASES osmotic pressure

Question 27 – Chronic Radiation Exposure and Plant Growth

Decreased ABA (abscisic acid) in exposed trees reduces their ability to tolerate desiccation (II) because ABA is crucial for drought response. While decreased auxin typically promotes lateral branching, severe chronic radiation stress can lead to stunted overall growth, potentially resulting in a plant appearing to have a single, less developed main stem (I).

The correct answer is **A**.

Question 28 – Role of Cryoprotectants in the Cold

Cryoprotectants like glycerol work by stopping large, damaging ice crystals from forming inside cells, which would otherwise rupture cell membranes. They allow organisms to survive freezing without cell damage.

The correct answer is **D**.

Question 29 –Membrane Structure Adapted for the Cold

Polyunsaturated fatty acids (PUFAs) have kinks that prevent phospholipids from packing tightly. This lowers the temperature at which the cell membrane becomes stiff, ensuring it remains fluid enough for vital protein functions even in cold environments.

The correct answer is **C**.

Question 30 – Varying Enzyme Activity

- Trypsin features a deep pocket with a negatively charged residue, enabling it to fit and stabilize the side chains of basic amino acids, whereas elastase has a considerably smaller pocket that is partly obstructed by large, neutral side chains, limiting it to small amino acid residues.
- The key difference lies in their active site structures. Trypsin has a large, negatively charged pocket that attracts and binds basic amino acids, while elastase has a smaller, obstructed pocket that only fits small, neutral amino acids, determining their specific cutting patterns.

The correct answer is **B**.