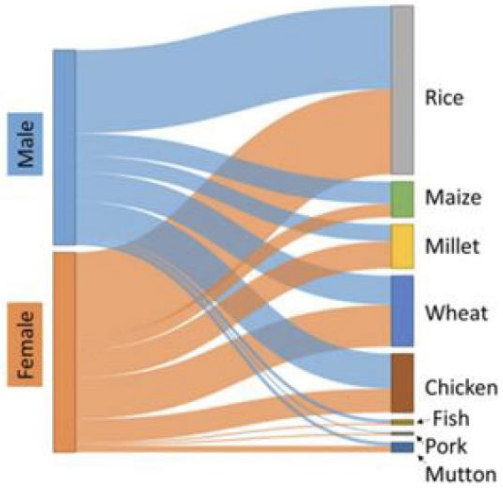
CSIR NET LS DEC 2025
(IFAS SOLVED PAPER)

Part-A: General Aptitude

Question ID: 209355266
The Sankey diagram shows food preferences of males and females. The widths of the bands are proportional to numbers of persons opting for a given food item.



Which one of the following is an **INCORRECT** statement about the food preferences?

1. Chicken is the second most preferred food in males
2. As compared to males, more females prefer wheat
3. As compared to males, more females prefer mutton and millet
4. Fewer females prefer rice than the total number of males preferring maize and millet

Question ID: 209355267
There is an increase of 30% in the number of people coming to a theatre after reducing the entry fee by 25% per person. How much change is expected in the total earnings?

1. 2.5% increase
2. 2.5% decrease
3. Nil
4. 7.5% increase

Question ID: 209355268
Suppose the words GATE, FAST, SAND and READ can be written in numbers as 2938, 6921, 0798 and 5917, but not necessarily in that order. The positions of the letters in a word and the corresponding digits in the respective number are the same. Then the word NEGATE will be written as:

1. 716921
2. 380798
3. 375917
4. 891217

Question ID: 209355269

A person borrowed Rs. 2500/- for 2 years, and Rs. 2000/- for 3 years, with the same simple interest rate. If he paid a total of Rs. 550/- as interest, then the annual rate of interest was:

1. 10%
2. 2%
3. 5%
4. 8%

Question ID: 209355270

A father said to his son, "I was as old as you are when I became your father". If the current age of father is 52 years, the age of son after 10 years will be:

1. 26 years
2. 36 years
3. 20 years
4. 40 years

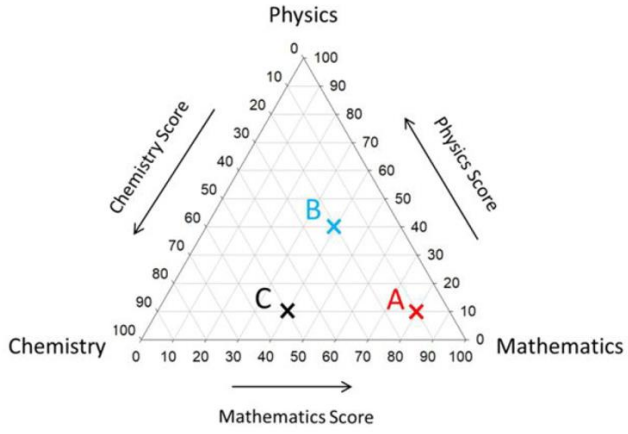
Question ID: 209355271

Numbers of seats for Mathematics, Physics and Biology in a college are in the ratio 2:3:4. What will be the respective ratio if the seats for each subject are increased by 50%?

1. 1:1:1
2. 2:3:4
3. 4:3:2
4. 3:2:4

Question ID: 209355272

The following ternary figure shows the marks obtained by students A, B and C in an exam of 100 marks. Here, C received 10 marks in Physics, 50 marks in Chemistry and 40 marks in Mathematics.



Which one of the following is **CORRECT**?

1. A's marks in Chemistry are more than C's marks in Physics
2. B has scored equal in Mathematics and Physics
3. A has scored 20 in Chemistry
4. A has scored 80 in Chemistry

Question ID: 209355273

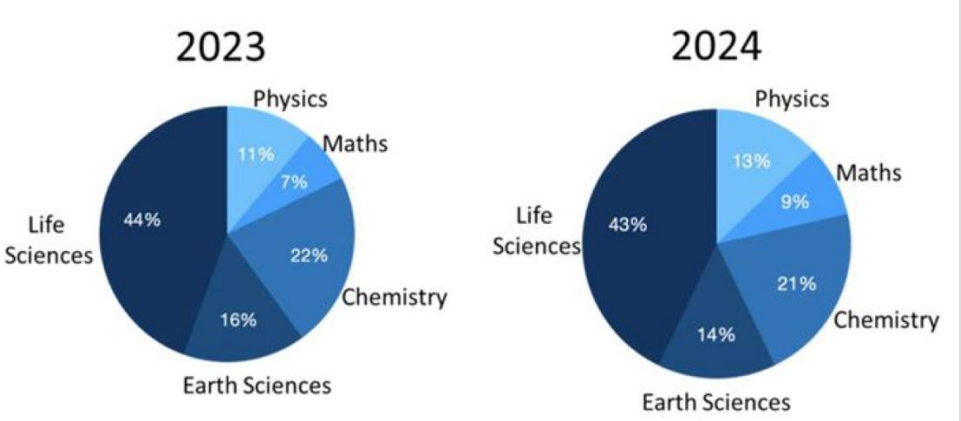
Restaurants A, B, C, and D give the following offers:
A: one mocktail free for every two purchased
B: one mocktail free for every three purchased
C: two mocktails free for every six purchased
D: 30% discount on each mocktail If all have the same marked price, in which restaurant would you pay the least if you drank eight mocktails?

1. A
2. B
3. C
4. D

Question ID: 209355274
Sachin sees one-fourth of his body (height) when he stands in front of a vertical mirror at a distance of 20 cm from it. How much of his body will he see if he steps back and stands 40 cm from the mirror?

1. half
2. one-fourth
3. one-eighth
4. full

Question ID: 209355275
The pie charts show placement percentages of graduates of five different subjects for two consecutive years:



In the year 2024, the number of Maths students who got placed was double that of the previous year. Which of the following is the closest to the percentage change in the number of Life Sciences students placed in the year 2024?

1. decreased by 1%
2. increased by 50%
3. decreased by 50%
4. increased by 20%

Question ID: 209355276
The unit's place digit is half the ten's place digit in a two-digit number N. If we swap the digits, the number gets reduced by 18. The number N is:

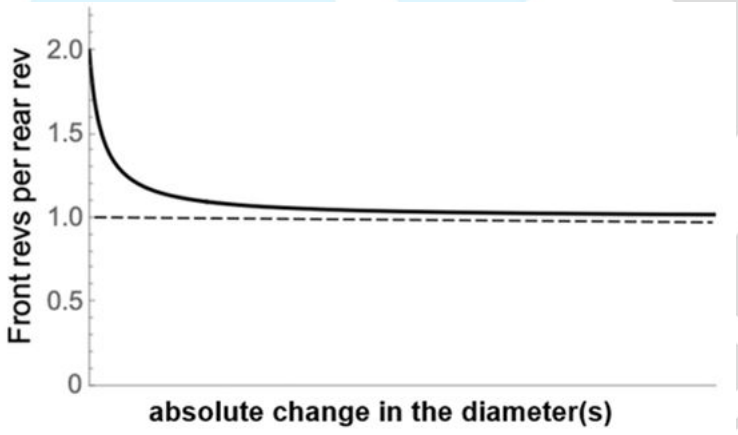
1. 24

2. 42
3. 48
4. 84

Question ID: 209355277
A boatman on a bank of a river has to carry a dog, a cat and a container full of milk to the other bank in a boat, one at a time. The cat cannot be left alone with the milk or with the dog on either bank. What is the minimum number of times the boatman has to cross the river to carry all to the other bank?

1. 3
2. 5
3. 7
4. 8

Question ID: 209355278
With a certain set of diameters, a tractor's front wheels make 2 revolutions (revs) for every 1 revolution of the rear wheels. The effect of changing wheel diameter(s) is shown in the following plot:



In this context, which of the following statements is **CORRECT**?

1. Only the rear wheel diameter is decreased
2. Both the rear and front wheel diameters are decreased equally
3. Both the rear and front wheel diameters are increased equally
4. The rear wheel diameter decreased, and the front wheel diameter increased equally

Question ID: 209355279
The following bus schedule is seen at a bus stop located somewhere in between town A and town B:

- Town A - 00:10, then every 20 mins
- Town B - 00:15, then every 20 mins If a person arrives at this bus stop at some random time, the probability that the next bus is for town B is:

1. 1/2
2. 1/4
3. 1/3
4. 3/4

Question ID: 209355280
An auditorium has 8 seats in the first row, with every row to follow having 4 more seats than its preceding row. The total capacity is 416. What is the minimum number of rows needed to seat 150 people?

1. 8
2. 5
3. 3
4. 2

Question ID: 209355281
With only one match, between teams B and C, remaining in a tournament where each win fetches two points and a loss none, team A observes that they will become champions with more points than any other team if B wins, but not necessarily if B loses. Then:

1. A is leading B by one point
2. B is leading C by one point
3. B is leading C by at least two points
4. A is leading C by at most two points

Question ID: 209355282
Consider the following information regarding a 3-digit PIN:

6	8	9	→ One number is correct and correctly placed
7	3	8	→ Nothing is correct
9	0	6	→ Two numbers correct but wrongly placed
6	1	5	→ One number is correct but wrongly placed
7	8	0	→ One number is correct but wrongly placed

The correct PIN is:

1. 059
2. 601
3. 590
4. 859

Question ID: 209355283
A box contains 20 black, 22 white, and 24 red socks. If a person draws socks at random one by one without looking, what is the minimum number of socks she must pick to be certain of having at least one pair of black socks?

1. 3
2. 4
3. 44
4. 48

Question ID: 209355284

A cellphone tower with signals reaching up to 500 m is set up on a conical hill of height 1.5 km and base radius 2 km. Assuming the tower's height to be negligible compared to the hill, the area served by the tower in Km^2 is (the area of the curved surface of a right circular cone is π x base radius x slant height):

1. 0.2π
2. 0.25π
3. 4π
4. 5π

Question ID: 209355285

Suppose a tap mixes hot water and cold water in a ratio that depends linearly on the proportion of opening. Water out of the tap has temperature 40^OC when the tap is half-open, and at 50^OC when it is three-fourths open. To get water at 50^OC, the tap should be _____:

1. one-eighth open
2. one-fourth open
3. three-eighths open
4. five-eighths open

Section: PART-B

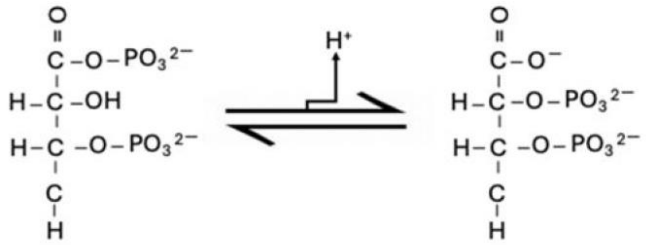
Question ID: 209355286

Given below are pairs of sugars.
A. D-glucose and D-fructose
B. D-galactose and D-glucose
C. α-D-glucose and β-D-glucose
D. D-ribose and D-ribulose
Which one of the following options represents the correct combination of anomer and epimer pairs, respectively?

1. A and C
2. B and D
3. C and B
4. A and D

Answer (3)
Explanation :Anomers are a specific type of epimer that differ in configuration at the hemiacetal or hemiketal carbon; therefore, alpha-D-glucose and beta-D-glucose (Pair C) are anomers. Epimers are diastereomers that differ at only one chiral center; thus, D-galactose and D-glucose (Pair B) are C-4 epimers.

Question ID: 209355287
Which one of the following enzymes catalyzes the biochemical reaction given below?



1. Phosphoenolpyruvate mutase
2. Phosphoglycerate kinase
3. Pyruvate dehydrogenase phosphatase
4. Bis-phosphoglycerate mutase

Answer (4)
Explanation: The biochemical reaction shows the conversion of 1,3-bisphosphoglycerate to 2,3-bisphosphoglycerate. This specific isomerization process, which is a key part of the Rapoport-Luebering shunt in red blood cells to regulate oxygen affinity, is catalyzed by the enzyme bis-phosphoglycerate mutase.

Question ID: 209355288
Which one of the following corresponds to the angle of rotation per residue in a 3_{10} helix and helix, respectively?
1. 100^0 and 120^0

2. 30^0 and 60^0
3. 60^0 and 30^0
4. 120^0 and 100^0

Answer (4)

Explanation: The angle of rotation per residue in a protein helix is derived from the number of residues per full 360-degree turn. A 3_{10} helix has 3.0 residues per turn, resulting in 120 degrees of rotation (360/3), while a 3.6_{13} helix (alpha-helix) has 3.6 residues per turn, resulting in 100 degrees of rotation (360/3.6).

Question ID: 209355289

Which one of the following vitamins contains a transition metal ion as a part of its structure?

1. Vitamin C
2. Vitamin D3
3. Vitamin B12
4. Vitamin E

Answer (3)

Explanation: Vitamin B12, also known as cobalamin, is unique among the listed vitamins because it contains a transition metal ion, Cobalt (Co), coordinated at the center of its corrin ring structure. Vitamins C, D3, and E are organic molecules that do not contain transition metal ions as part of their essential chemical structure.

Question ID: 209355290

Which one of the following is NOT a disease caused by a virus?

1. Small pox
2. Tetanus
3. Rubella
4. Measles

Answer (2)

Explanation: Tetanus is caused by the bacterium *Clostridium tetani*, which produces a neurotoxin; therefore, it is a bacterial disease rather than a viral one. Smallpox, Rubella, and Measles are all classic examples of diseases caused by different specific families of viruses.

Question ID: 209355291

Which one of the following histone marks is NOT an indicator of heterochromatin?

1. H3K9 trimethylation
2. MacroH2A
3. H2AX
4. H4K20 trimethylation

Answer (3)

Explanation: H2AX is a histone H2A variant that is specifically recruited to sites of DNA double-strand breaks for repair signaling, rather than being a marker for heterochromatin. Conversely, H3K9 trimethylation, H4K20 trimethylation, and MacroH2A are established epigenetic marks or variants found in condensed, transcriptionally silent heterochromatin.

Question ID: 209355292

Which one of the following events are likely to result in delayed or defective cytokinesis?

1. Stabilization of mitotic cyclins
2. Activation of formin and myosin II
3. Stimulation of RhoA by centralspindlin
4. Activation of RhoA by Rho-GEF

Answer (1)
Explanation: Cytokinesis requires the inactivation of Cdk1, which is triggered by the degradation of mitotic cyclins. If mitotic cyclins are stabilized, Cdk1 remains active and continues to inhibit the assembly and function of the contractile ring, thereby resulting in delayed or defective cytokinesis.

Question ID: 209355293
The cytosolic proteins, Ras and Rab, are anchored to the cytosolic face of the plasma membrane by prenylation. Prenylation typically occurs at which amino acid of the protein?

1. Cysteine residue at or near the C-terminus
2. Cysteine residue at or near the N-terminus
3. Glycine residue at or near the C-terminus
4. Glycine residue at or near the N-terminus

Answer (1)
Explanation: Prenylation is a lipid modification that involves the covalent attachment of farnesyl or geranylgeranyl isoprenoids to a protein. This specific chemical reaction occurs at the sulfur atom of a cysteine residue located within a conserved CAAX motif at or near the C-terminus of proteins like Ras and Rab.

Question ID: 209355294
Which one of the enzymatic activities is NOT present in bacterial RecA?

1. ATP hydrolysis activity
2. Strand-exchange activity
3. Nucleolytic activity
4. Proteolytic activity

Answer (4)
Explanation: Bacterial RecA is a multifunctional protein essential for recombination and DNA repair, possessing activities for ATP hydrolysis, strand exchange, and DNA binding. While it facilitates the self-cleavage of the LexA repressor by acting as a co-protease, it does not have intrinsic proteolytic (protease) activity or nucleolytic activity itself.

Question ID: 209355295
Which one of the following statements correctly describes the role of Proliferating Cell Nuclear Antigen (PCNA) in eukaryotic DNA replication?

1. It catalyzes RNA primer synthesis.
2. It acts as a sliding clamp that increases DNA polymerase processivity.
3. It removes RNA primers from Okazaki fragments.
4. It unwinds parental DNA.

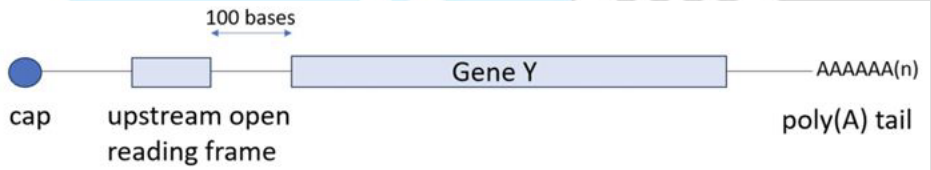
Answer (2)
Explanation: PCNA (Proliferating Cell Nuclear Antigen) is a trimeric protein that forms a ring structure around the DNA during eukaryotic replication. It acts as a sliding clamp that anchors DNA polymerase to the template strand, which prevents the polymerase from dissociating and vastly increases its processivity during synthesis.

Question ID: 209355296
An antibiotic, that mimics aminoacyl-tRNAs, gets incorporated into the polypeptide chain and prematurely terminates elongation. The following statements are made based on this observation:
A. It enters the ribosome through the A-site.
B. It enters the ribosome through the P-site.
C. A part of its structure resembles the carboxy terminus of amino acids and is available for making a peptide bond.
D. A part of its structure resembles the amino terminus of amino acids and is available for making a peptide bond.
Which one of the following options represents all correct statements?

1. A and B
2. A and D
3. B and D
4. A and C

Answer (2)
Explanation: Puromycin is an antibiotic that mimics the 3' end of an aminoacyl-tRNA and enters the ribosome through the A-site (Statement A). Because it possesses a structure resembling the amino terminus of an amino acid (Statement D), it accepts the growing peptide chain from the P-site tRNA, leading to a stable peptide-puromycin product that dissociates and causes premature termination.

Question ID: 209355297
Yeast gene Y has an mRNA with the structure shown below. Both the upstream open reading frame (uORF) and the coding region of gene Y have start and stop codons.



Which one of the following will you remove to maximize translation of gene Y?

1. Cap
2. Start codon of the uORF
3. Stop codon of the uORF
4. Poly(A) tail

Answer (2)
Explanation: In eukaryotic mRNA, an upstream Open Reading Frame (uORF) typically functions as a regulatory element that inhibits the translation of the primary downstream coding region. The ribosome initiates at the first start codon it encounters; by removing the start codon of the

uORF, the scanning 40S ribosomal subunit will bypass the regulatory uORF and proceed directly to the start codon of Gene Y, thereby maximizing its translation efficiency.

Question ID: 209355298
Which one of the following statements is FALSE regarding how retroviruses and DNA viruses can lead to cancer in host cells?

1. Rous sarcoma virus contains an oncogene derived from a host proto-oncogene, which allows it to rapidly induce tumours.
2. Slow-acting retroviruses cause cancer by integrating near host proto-oncogenes, activating their expression and leading to cell proliferation.
3. DNA viruses can cause cancer if their DNA becomes integrated into the host genome and expresses viral oncogenes, which stimulate cell growth and proliferation.
4. Retroviruses cause cancer only by directly mutating host DNA, without the need for integration or activation of proto-oncogenes.

Answer (4)
Explanation: This statement is false because retroviruses generally cause cancer through mechanisms involving the integration of their viral DNA into the host genome, such as "insertional mutagenesis" near proto-oncogenes or by carrying viral oncogenes derived from host cells. Retroviruses do not typically induce cancer by acting as direct mutagens that cause random mutations in host DNA without the intermediate step of genomic integration or the activation of specific oncogenic pathways.

Question ID: 209355299
Which one of the following components of the immune system is NOT effective for the clearance of large parasites like worms?

1. Basophils
2. Eosinophils
3. NK cells
4. Mast cells

Answer (3)
Explanation: Large multicellular parasites, such as helminth worms, are too large to be engulfed by phagocytes and are instead targeted by the "Type 2" immune response involving eosinophils, mast cells, and basophils which release toxic granules to damage the parasite's tegument. Natural Killer (NK) cells are primarily specialized for the surveillance and destruction of virally infected host cells and tumor cells by recognizing altered MHC class I expression, making them ineffective for the clearance of large extracellular parasites.

Question ID: 209355300
Which one of the following molecules does NOT directly transduce signals to neighbouring cells?

1. Beta catenin
2. Connexin
3. BMP7
4. Dopamine

Answer (1)
Explanation: Beta-catenin is a multifunctional protein that acts as a structural component in cell-to-cell adhesion at adherens junctions and as a transcription factor in the Wnt signaling pathway once it translocates to the nucleus. Unlike connexins which form gap junctions, or BMP7 and dopamine which are secreted ligands that bind to receptors on adjacent cells, beta-catenin remains intracellular and does not act as a direct extracellular signal or conduit for transducing signals to neighboring cells.

Question ID: 209355301
Choose the INCORRECT statement regarding the synthesis of reactive oxygen species (ROS) upon pathogen infection in plants.

1. Plasma membrane-spanning NADPH oxidase is involved in the synthesis of ROS.
2. NADPH oxidases are encoded by respiratory burst oxidase homolog genes in Arabidopsis (Atrboh).
3. Activation of NADPH oxidase does not require the action of calcium-dependent protein kinases (CDPKs).
4. Apoplastic peroxidase enzymes (PRX) are involved in ROS production.

Answer (3)
Explanation: The activation of the plant NADPH oxidase (specifically the Respiratory Burst Oxidase Homolog, or Rboh) is a highly regulated process essential for the "oxidative burst" during pathogen defense. This activation strictly requires the binding of calcium ions to EF-hand motifs on the enzyme and is further modulated by phosphorylation events carried out by calcium-dependent protein kinases (CDPKs), meaning the statement that it does not require CDPK action is incorrect.

Question ID: 209355302
Which one of the following options is the correct sequence of gene expression for successful axis specification in Drosophila?

1. Fushi tarazu; giant; hairy; gooseberry
2. Hedgehog; hunchback; runt; paired
3. Odd-skipped; knirps; hairy; armadillo
4. Krüppel; hairy; fushi tarazu; wingless

Answer (4)
Explanation: The establishment of the Drosophila body axis follows a strict hierarchical cascade of gene expression. The sequence begins with maternal effect genes, followed by gap genes such as Krüppel, then pair-rule genes like hairy and fushi tarazu which define segments, and finally segment polarity genes like wingless which establish the boundaries and polarity within each individual segment. Option 4 correctly reflects this temporal and functional order of Krüppel (Gap) to wingless (Segment Polarity).

Question ID: 209355303
In developing mouse brain, when gene yfg is deleted from hippocampal cell-type 'A', the number of neighbouring cell-type 'B' increases by five-fold. From this information. which one of the following statements accurately describes yfg functioning in wildtype 'A' cells?

1. It promotes 'B' proliferation.

2. It has no role in 'B' proliferation.
3. It inhibits 'B' proliferation.
4. It induces yfg expression in 'B' cells.

Answer (3)
Explanation: The experimental data shows that the deletion of the gene *yfg* from cell-type 'A' leads to a significant (five-fold) increase in the population of neighboring cell-type 'B'. This indicates that in the normal (wildtype) state, the presence and function of *yfg* in cell-type 'A' acts as a negative regulator or inhibitor that keeps the proliferation of cell-type 'B' in check, either through direct cell-cell contact or the secretion of inhibitory factors.

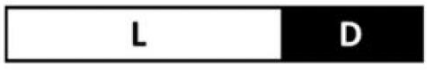
Question ID: 209355304
Which one of the following options represents the correct order of events during newt limb regeneration following amputation?

1. Wound epidermis formation, remodelling of extracellular matrix, blastema formation, and differentiation
2. Blastema formation, remodelling of extracellular matrix, differentiation and wound epidermis formation
3. Blastema formation, wound epidermis formation, extracellular matrix remodelling and differentiation
4. Extracellular matrix remodelling, wound epiderrnis formation, blastema formation and differentiation

Answer (1)
Explanation: Newt limb regeneration begins with the rapid migration of epithelial cells to form a "wound epidermis," followed by the breakdown of the mature tissue's scaffold through "remodelling of the extracellular matrix". This allows for the accumulation of undifferentiated progenitor cells to form a "blastema," which eventually undergoes proliferation and "differentiation" to replace the missing structures in the correct anatomical pattern.

Question ID: 209355305
Which one of the following light treatments (L, light; D, dark) promotes flowering in short-day plants?

1. 

2. 

3. 

4. 

1. Option 1
2. Option 2
3. Option 3
4. Option 4

Answer (1)
Explanation: Short-day plants (which are technically "long-night" plants) require a continuous period of darkness that exceeds a critical threshold to trigger flowering. In Option 1, the plant receives a sufficiently long, uninterrupted dark period (D) which allows the accumulation of the flowering signal. Interrupting the long night with even a brief flash of light (as seen in other experimental paradigms) would reset the circadian clock and inhibit flowering in these species.

Question ID: 209355306
A C3 plant is shifted from to under full sunlight. Which one of the following is most likely to happen?

1. Photorespiration rate decreases, leading to higher productivity.
2. Rubisco's oxygenase activity increases, reducing net fixation.
3. Stomata remain fully open, increasing uptake.
4. PEP carboxylase activity increases to compensate for loss.

Answer (2)
Explanation: In C3 plants, high temperatures significantly reduce the solubility of relative to and alter the kinetic properties of the Rubisco enzyme. As the temperature increases from to , Rubisco’s affinity for increases, leading to a higher rate of the oxygenase reaction (photorespiration) at the expense of the carboxylase reaction, which drastically reduces net fixation and overall agricultural productivity.

Question ID: 209355307
Which one of the following pairs is NOT a prokaryote: angiosperm symbiotic pair that can fix atmospheric nitrogen?

1. Nostoc and Gunnera
2. Frankia and Casuarina
3. Bradyrhizobium and Parasponia
4. Azolla and Rice

Answer (4)
Explanation: Nitrogen fixation in plants is typically achieved through specialized symbiotic relationships with prokaryotes, such as *Nostoc* in *Gunnera*, *Frankia* in *Casuarina*, and *Bradyrhizobium* in the non-legume *Parasponia*. While *Azolla* (a water fern) does fix nitrogen via a symbiosis with the cyanobacterium *Anabaena*, there is no naturally occurring prokaryotic nitrogen-fixing endosymbiosis involving Rice plants; rice typically relies on nitrogen fixed by free-living or associative soil bacteria.

Question ID: 209355308
Sulfur taken by plant roots from the soil undergoes major changes in the oxidation state as it converts from inorganic to biochemically available form. Which one of the following options represents the correct order of the conversion states of sulfur?

1. $SO_4^{2-} \rightarrow SO_3^{2-} \rightarrow S^{2-} \rightarrow$ Cys
2. $S^{2-} \rightarrow SO_3^{2-} \rightarrow SO_4^{2-} \rightarrow$ Cys
3. $SO_4^{2-} \rightarrow SO_3^{2-} \rightarrow S^{2-} \rightarrow$ Gln
4. $S^{2-} \rightarrow SO_3^{2-} \rightarrow SO_4^{2-} \rightarrow$ Gln

Answer (1)
Explanation: Sulfur assimilation in plants begins with the uptake of inorganic sulfate (SO_4^{2-}) from the soil. This sulfate is activated and then undergoes a series of reduction steps: first to sulfite (SO_3^{2-}), and then to sulfide (S^{2-}). Finally, the reduced sulfide is incorporated into O-acetylserine to form the amino acid Cysteine (Cys), which serves as the primary building block for other sulfur-containing organic compounds in the plant.

Question ID: 209355309
Which one of the following is the most appropriate effects of hypoxic pretreatment and acclimation on survival of plants under anoxia?

1. Prevention of ethanol fermentation
2. Increase in capacity of roots for lactate efflux
3. Prevention of glucose to lactate conversion
4. Prevention of ethanol diffusion

Answer (2)
Explanation: Under anoxic conditions (total lack of oxygen), plants shift their metabolism toward fermentation, which can lead to the toxic accumulation of lactate and acidification of the cytosol. Hypoxic pretreatment (exposure to low but non-zero oxygen) allows the plant to acclimate by inducing the expression of proteins that increase the capacity of root cells for lactate efflux, thereby preventing lethal cytosolic acidosis and improving survival when the plant later faces full anoxia.

Question ID: 209355310
Which one of the following metabotropic receptors increases intracellular cAMP level after stimulation by its specific neurotransmitter?

1. mGluR5
2. $5HT_{2A}$
3. $5HT_4$
4. M_s

Answer (3)
Explanation: Metabotropic receptors are G-protein coupled receptors (GPCRs) that trigger intracellular signaling cascades. The 5HT4 receptor is coupled to the (stimulatory) protein, which activates the enzyme adenylyl cyclase. This activation leads to the conversion of ATP into cyclic AMP (cAMP), thereby increasing intracellular cAMP levels. In contrast, receptors like mGluR5 and 5HT2A are typically coupled to the pathway, which increases calcium rather than cAMP.

Question ID: 209355311
Which one of the following is NOT involved in the secretion of K from blood into the tubular fluid by the principal cells of distal tubules?

1. Big K channels (BK)
2. Renal outer medullary K channels (ROMC)
3. 1Na-1K -2Cl symporter (NKCC2)
4. K /Cl cotransporter (KCC1)

Answer (3)
Explanation: In the principal cells of the distal tubules and collecting ducts, potassium secretion

from the blood into the tubular fluid is mediated by apical K^+ channels such as ROMK and BK. The 1Na-1K-2Cl symporter (NKCC2) is specifically located on the apical membrane of the thick ascending limb of the loop of Henle, where its primary function is the reabsorption of ions from the tubular fluid into the cell, rather than secretion in the distal tubule.

Question ID: 209355312
Which one of the following is NOT caused by atriopeptins, a family of peptides produced in cardiac atrial tissues?

1. Natriuresis
2. Vasoconstriction
3. Diuresis
4. Inhibition of aldosterone secretion

Answer (2)
Explanation: Atriopeptins, or Atrial Natriuretic Peptides (ANP), are hormones released by the heart in response to high blood pressure and atrial stretch. Their primary role is to lower blood pressure by promoting the excretion of sodium (natriuresis) and water (diuresis) and by inhibiting aldosterone secretion; therefore, they act as potent vasodilators rather than causing vasoconstriction.

Question ID: 209355313
Which one of the following animals normally exhibit reflex ovulation?

1. Rats
2. Monkeys
3. Cats
4. Humans

Answer (3)
Explanation: Reflex ovulation, or induced ovulation, occurs when the act of mating or external vaginal/cervical stimulation triggers the LH surge required for the release of an egg. Cats are classic examples of induced ovulators, as are rabbits and ferrets, whereas humans, rats, and monkeys are spontaneous ovulators that follow a cyclical hormonal rhythm independent of copulation.

Question ID: 209355314
Most transposable elements contain flanking terminal inverted repeats. Which one of following options is INCORRECT pertaining to these repeats?

1. They are not a part of the transposable element, but are generated during the insertion of the transposable element in the genome.
2. They are part of the transposable elements in the genome.
3. They move along with the transposable elements in the genome.
4. The repeats along with a functional transposase are sufficient for the process of transposition.

Answer (1)
Explanation: Flanking terminal inverted repeats (TIRs) are an integral structural component of many DNA transposable elements and serve as the binding sites for the transposase enzyme. Statement 1 is incorrect because it describes "target site duplications," which are generated

during insertion and are not part of the element itself, whereas TIRs are encoded as part of the transposable element and move with it during transposition.

Question ID: 209355315
Lac repressor binding occurs at the level of:

1. mRNA, on the sequence corresponding to the operator region.
2. DNA, in the lac operon in the operator region.
3. both DNA and RNA, in the sequences corresponding to the operator region.
4. ribosomes, during mRNA translation.

Answer (2)
Explanation: The Lac repressor is a DNA-binding protein that regulates the transcription of the lactose operon in *E. coli*. It specifically binds to the "operator" region, which is a sequence of DNA located between the promoter and the structural genes, thereby physically blocking RNA polymerase from initiating transcription of the mRNA.

Question ID: 209355316
A cross is made between two strains of E. coli, Hfr $leu^+ arg^+ met^+$ and F- $leu^- arg^- met^-$ and the mixture is plated on minimal synthetic medium supplemented with streptomycin, arginine and methionine. If the linear organization of the genes are leu-arg-met, which one of the following genotypes is expected to occur with lowest frequency?
1. $leu^+ arg^+ met^+$
2. $leu^+ arg^+ met^-$
3. $leu^+ arg^- met^-$
4. $leu^+ arg^- met^+$

Answer (3)
Explanation: In an Hfr x F^- conjugation experiment, genes are transferred linearly starting from the origin of transfer (oriT). Based on the gene order leu-arg-met, the gene farthest from the origin requires the longest conjugation time and is the least likely to be transferred before the conjugation bridge breaks spontaneously. Furthermore, the genotype would require a rare double crossover event involving the distal markers without the proximal marker, making it the lowest frequency outcome.

Question ID: 209355317
A polydactyly allele shows 60% penetrance and variable expressivity. What would you expect to observe in a family carrying this allele?

1. 60% of carriers show the trait, and among those who show it, severity varies.
2. 100% of carriers show the trait but with 60% maximum severity.
3. 40% of carriers express the trait to the same degree in an identical manner.
4. 100% of carriers show the trait but the severity varies only in 40% of carriers.

Answer (1)
Explanation: Penetrance refers to the percentage of individuals with a specific genotype who actually express the associated phenotype, meaning 60% of carriers will show the trait. Variable expressivity describes the degree or intensity to which a phenotype is expressed in those

individuals who show the trait, meaning the severity (number of extra digits) will vary among that 60% of affected family members.

Question ID: 209355318
During long-term growth in static liquid culture, Pseudomonas fluorescens diversifies into distinct colony types with the following characteristics: wrinkly spreaders that form biofilms at the oxygen-rich surface, smooth morphs that grow freely in the oxygen-poor bottom layer, and fuzzy types that colonises the intermediate zone. Which one of the following evolutionary processes best explains this ecological diversification?

1. Genetic drift resulting in differential microhabitat use
2. Adaptive radiation into different microhabitats
3. Coevolution between the distinct P. fluorescens strains in microhabitats
4. Convergent evolution among unrelated bacterial species

Answer (2)
Explanation: The diversification of *Pseudomonas fluorescens* into wrinkly spreaders, smooth morphs, and fuzzy types in a static culture is a classic example of adaptive radiation driven by ecological opportunity. This occurs because the static environment creates distinct niche habitats with different oxygen levels, and the bacteria evolve specialized traits to exploit these specific microhabitats, thereby reducing competition through niche partitioning.

Question ID: 209355319
Which one of the following statements is INCORRECT about the phylogenetic species concept?

1. It can be applied to both sexual and asexual organisms and is not dependent on reproductive isolation.
2. It relies on objective and statistically testable concepts based on genetic data.
3. It is robust to different data sources and produces consistent phylogenies.
4. It can suffer from taxonomic inflation.

Answer (3)
Explanation: The phylogenetic species concept defines a species as the smallest diagnosable monophyletic group of populations that share a common ancestor. While it is robust for including asexual organisms, it is often criticized because different data sources (e.g., different gene trees) can produce inconsistent phylogenies and lead to taxonomic inflation by splitting single interbreeding groups into multiple species based on minor genetic differences.

Question ID: 209355320
Which one of the following pairs is analogous and NOT homologous?

1. Potato tuber and sweet potato tuber
2. Human arm and whale flipper
3. The thorn of citrus plant and the tendril of a cucurbit plant
4. Flippers of dolphin and fins of fish

Answer (4) (1?)
Explanation: Analogous structures are those that perform a similar function but do not share a common evolutionary origin, such as a potato tuber (a modified underground stem) and a sweet potato tuber (a modified root). In contrast, the human arm and whale flipper, or the citrus thorn

and cucurbit tendril, are homologous structures because they share a common anatomical origin despite having evolved different functions.

Question ID: 209355321
Which one of the following options represents a set of bird species, all of which are found ONLY in India?

1. Bluethroat, Amur Falcon, Bar-headed Goose
2. Yellow-throated Bulbul, Forest Owlet, Rufous Babbler
3. Pied Cuckoo, Green Imperial Pigeon, Black Drongo
4. Blue-tailed Bee-eater, Sarus Crane, Red-vented Bulbul

Answer (2)
Explanation: Endemic species are those that are found only in a specific geographic region. The Yellow-throated Bulbul, Forest Owlet, and Rufous Babbler are all bird species endemic to the Indian subcontinent, whereas species like the Bluethroat, Amur Falcon, and Bar-headed Goose are migratory birds that spend only part of their life cycle in India and have broad international ranges.

Question ID: 209355322
Which one of the following options is NOT included in the Wildlife (Protection) Amendment Act, 2022?

1. Inclusion of a new schedule designating some species as 'vermin'
2. Rationalization of schedules
3. Regulation of invasive alien species
4. Recommendation for implementation of provisions of CITES

Answer (1)
Explanation: The Wildlife (Protection) Amendment Act, 2022, brought significant changes including the rationalization of schedules and the implementation of CITES provisions. Crucially, the amendment removed the specific schedule that previously allowed the central government to declare any wild animal as 'vermin' for a specified period, shifting the management focus and legal status of such species.

Question ID: 209355323
Assimilation Efficiency is calculated as the percentage of the ingested energy that is assimilated by an organism. Which one of the following gut architectures has the lowest assimilation efficiency?

1. A monogastric gut with acid enzymes to break down food
2. A ruminant gut that facilitates regurgitation and chewing of cud
3. An avian gut with mechanical grinding in the gizzard
4. Cecal/Hindgut fermentation with enlarged cecum or large intestine

Answer (4)
Explanation: Assimilation efficiency measures how effectively an organism absorbs energy from its food. Hindgut fermenters (cecal fermenters) typically have lower assimilation efficiency compared to ruminants or monogastric carnivores because fermentation occurs after the primary site of absorption in the small intestine, meaning a larger portion of the energy-rich microbial biomass and partially digested fiber is lost in the feces.

Question ID: 209355324
The resource-ratio hypothesis (R*) of competitive coexistence of species proposed by David Tilman postulates that:

1. coexisting species are limited by different resources in the shared resource set.
2. shared resources are equally limiting for each competing species.
3. species abundances are determined by the ratios of limiting resources for each species.
4. the ratio between the resource availability and resource use is constant between competing species.

Answer (1) (3?)
This hypothesis suggests that in a competitive environment, species can coexist if each species is limited by a different set of resources. As a result, the species are not directly competing for the same limiting resource and can occupy different ecological niches.

Question ID: 209355325
Which one of the following statements is NOT considered a core principle of conservation biology?

1. Conservation efforts should focus on maintaining entire ecosystems, as opposed to only individual species.
2. A disruption of species/trophic interactions can create a cascading effect throughout an entire ecosystem.
3. Ecosystems should be maintained in their climax state, preventing processes like disturbance and succession.
4. Management of an ecosystem should be long term and include many ecological processes and impacts of human activities.

Answer (3)
Explanation: Modern conservation biology emphasizes the importance of dynamic ecological processes, including natural disturbances and succession, which maintain biodiversity. The idea that ecosystems should be "frozen" in a climax state is an outdated concept, as many species and habitats depend on periodic disturbances to prevent the dominance of a few climax species and to maintain a mosaic of different successional stages.

Question ID: 209355326
New protein-coding genes sometimes originate when exons from different ancestral genes are combined through recombination events, producing a novel domain architecture within a single polypeptide. This mechanism of generating new genes is called:

1. Exon shuffling, in which recombination or transposon-mediated rearrangements join coding regions from separate genes.
2. Alternative splicing, in which a single pre-mRNA is processed in multiple ways to yield different transcripts.
3. Retroposition, in which an mRNA is reverse-transcribed and inserted elsewhere in the genome.
4. Transposon insertion, in which mobile elements insert into genes, occasionally disrupting or modulating their expression.

Answer (1)
Explanation: Exon shuffling is an evolutionary mechanism where coding sequences (exons) from different genes are brought together through recombination or transposition to create a new gene with a novel combination of protein domains. This allows for the rapid evolution of proteins with complex functions by "mixing and matching" established functional units, which is distinct from alternative splicing that occurs at the RNA level within a single gene.

Question ID: 209355327
Gradualism and punctuated equilibrium represent contrasting models of evolutionary change. Which one of the following options best describes these two models?

1. Gradualism emphasizes that evolution occurs through long periods of stasis interrupted by sudden, large-scale mutations, while punctuated equilibrium proposes continuous, slow change within species.
2. Gradualism and punctuated equilibrium both deny the role of natural selection in shaping evolutionary change.
3. Gradualism proposes that evolution proceeds through the steady accumulation of small changes, whereas punctuated equilibrium suggests long periods of evolutionary stability marked by relatively rapid bursts of speciation.
4. Both models reject the importance of the fossil record in understanding macroevolutionary patterns.

Answer (3)
Explanation: Gradualism is the Darwinian view that evolution proceeds through the slow and steady accumulation of small genetic changes over vast periods of time. Punctuated equilibrium, proposed by Eldredge and Gould, suggests that the fossil record shows long periods of morphological stability (stasis) that are "punctuated" by relatively brief intervals of rapid speciation and significant evolutionary change.
Question ID: 209355328
The circadian rhythm of higher vertebrates is regulated by the:

1. suprachiasmatic nucleus.
2. cerebral cortex.
3. pituitary gland.
4. thymus.

Answer (1)
Explanation: The master biological clock in higher vertebrates is located in the suprachiasmatic nucleus (SCN) of the hypothalamus. The SCN receives direct light input from the retina via the retinohypothalamic tract, allowing it to synchronize (entrain) the body's various physiological and behavioral rhythms to the external 24-hour light-dark cycle.

Question ID: 209355329
Which one of the following is NOT an evolutionary model for mate choice in animals?

1. Direct benefit model
2. Good gene model
3. Chase away model
4. Green beard effect

Answer (4)
Explanation: Models for mate choice, such as direct benefits, good genes, and chase-away selection, explain how preferences for specific traits evolve through sexual selection. The "green beard effect" is a model of kin selection and altruism where a gene causes a recognizable phenotypic trait, the ability to recognize that trait in others, and preferential treatment toward those individuals, which is not primarily a model for mate choice.

Question ID: 209355330
Which one of the following options is a correct match of plant selection marker genes used for genetic transformation and their properties?

1. *nptII* – Streptomycin resistance
2. Mutant *ALS* – Imidazolinone resistance
3. *aadA* – Rifampicin resistance
4. *pat* – Penicillin resistance

Answer (2)
Explanation: In plant genetic engineering, marker genes are used to identify and select successfully transformed cells. A mutant version of the Acetolactate Synthase (ALS) gene confers resistance to imidazolinone and sulfonylurea herbicides, which normally inhibit the wild-type ALS enzyme essential for branched-chain amino acid biosynthesis. In contrast, nptII typically provides resistance to kanamycin, not streptomycin.

Question ID: 209355331
In the complete blood profile analysis using an automated haematology analyser, the haemoglobin concentration is measured using:

1. sedimentation analysis.
2. spectrophotometric methods.
3. mass spectrometry.
4. NMR spectroscopy.

Answer (2)
Explanation: In automated hematology analyzers, hemoglobin concentration is typically measured using spectrophotometric methods after the lysis of red blood cells and conversion of hemoglobin into a stable pigment, such as cyanmethemoglobin or a similar colored complex. The intensity of the light absorbed at a specific wavelength is proportional to the hemoglobin concentration in the sample, following Beer-Lambert's law.

Question ID: 209355332
The genome editing tool, CRISPR-Cas9, was developed based on which one of the following natural phenomena?

1. An immune response of lower eukaryotes
2. A bacterial defence mechanism
3. A specialised homologous recombination machinery in eukaryotes
4. Transposon insertion machinery in prokaryotes

Answer (2)
Explanation: CRISPR-Cas9 is a revolutionary genome-editing technology that was originally discovered as an adaptive bacterial defense mechanism against invading viruses or

bacteriophages. Bacteria capture small fragments of viral DNA and incorporate them into their own genome as "CRISPR" arrays, which later guide Cas9 enzymes to recognize and cut the corresponding DNA of returning viruses, providing immunity.

Question ID: 209355333
Which key feature best differentiates somatic embryogenesis from organogenesis in plant tissue culture?

1. Somatic embryogenesis originates from zygotic embryos, while organogenesis originates from vegetative explants.
2. Somatic embryos develop bipolar structures (with both shoot and root poles), whereas organogenesis typically produces unipolar structures that require further differentiation.
3. Somatic embryogenesis does not require growth regulators, while organogenesis strictly requires an auxin-cytokinin balance.
4. In somatic embryogenesis, vascular connections are continuous with the parent tissue, whereas in organogenesis vascular strands remain independent.

Answer (2)
Explanation: A fundamental distinction in plant tissue culture is that somatic embryogenesis produces bipolar structures containing both a shoot apex and a root apex, which are physically independent of the vascular system of the original explant. In contrast, organogenesis typically produces unipolar structures, such as only a shoot or only a root, which maintain direct vascular continuity with the parent tissue and require a second induction step to form the missing pole.

Question ID: 209355334
Given below is one of the strands of a double-stranded DNA sequence:
5'-ATGCGATGACGATGACGATGACGATGACGAACGATGAGATGG-3'
In the absence of any other confounding factors (viz., length, Tm, etc.), which one of the following options represents the primer combination that would amplify the above double-stranded template in a PCR?

1. 5'-TACGCTACT-3' and 5 -ATGAGATGG-3'
2. 5'-ATGCGATGA-3' and 5'-GGTAGAGTA-3'
3. 5'-TCATCGCAT-3' and 5-CCATCTCAT - 3'
4. 5'-ATGCGATGA-3' and 5-CCATCTCAT-3'

Answer (4)

Explanation: To successfully amplify a double-stranded DNA template via PCR, two primers are required: a forward primer identical to the 5' end of the top strand and a reverse primer that is the reverse complement of the 3' end of the top strand. For the sequence 5'-ATGCGATGA...GAGATGG-3', the forward primer is 5'-ATGCGATGA-3' and the reverse complement of the 3' sequence (5'-GAGATGG-3') is 5'-CCATCTCAT-3', which corresponds to the combination in Option 4.

Question ID: 209355335
Two different antibodies against the same protein were generated. They were named, AB1 and AB2. While AB1 was able to detect the target protein in a western blot, it was unable to detect

the protein in ELISA. The opposite was true for AB2. Which one of the following is the most likely reason?

1. AB1 detects SDS-bound protein, whereas AB2 detects protein that is not bound to SDS.
2. AB1 is unable to cross the cell membrane, whereas AB2 is membrane permeable.
3. AB1 detects epitopes on the folded protein, whereas AB2 detects the unfolded epitopes.
4. AB1 detects linear epitopes on unfolded protein, but AB2 detects discontinuous epitopes present on the folded protein.

Answer (4)

Explanation: The discrepancy between Western blot and ELISA results usually relates to the protein's conformational state. AB1 likely recognizes linear epitopes that are exposed only when the protein is denatured and unfolded, as occurs during SDS-PAGE in Western blotting. Conversely, AB2 likely recognizes discontinuous or conformational epitopes that exist only when the protein is in its native, folded state, which is preserved during the capture step of a standard ELISA.

Section: PART-C

Question ID: 209355336

Given below are statements on the citric acid cycle and urea cycle, which have shared metabolic intermediates:

A. Oxaloacetate is converted to aspartate.

B. Fumarate is a citric acid cycle intermediate.

C. Arginosuccinate is cleaved to fumarate and arginine.

D. Aspartate combines with citrulline to produce argininosuccinate in the mitochondrial matrix.

Which one of the following options represents the combination of all correct statements?

1. A and D only
2. B and C only
3. A, C and D
4. A, B and C

Answer (4)

Explanation: The citric acid cycle and urea cycle are intricately linked through shared intermediates in a system known as the Krebs-Henseleit bicylce.

Step 1: Oxaloacetate from the citric acid cycle is converted to aspartate via transamination (Statement A).

Step 2: Aspartate then enters the urea cycle by reacting with citrulline.

Step 3: This reaction produces argininosuccinate, which is subsequently cleaved to form arginine and fumarate (Statement C).

Step 4: Fumarate is a direct intermediate that can re-enter the citric acid cycle (Statement B).

Conclusion: Statement D is incorrect because the formation of argininosuccinate occurs in the cytosol, not the mitochondrial matrix; thus, A, B, and C are the correct statements.

Question ID: 209355337

The following experimental observations are made when a small ligand binds with nanomolar affinity in a deep hydrophobic pocket of the partner protein:

A. The ligand forms a hydrogen bond with a backbone carbonyl oxygen upon binding.

B. Several nonpolar groups in proteins form a hydrophobic network due to the conformational change, leading to the displacement of buried water molecules to the surface.

C. A negatively charged side chain of an amino acid located near the binding site is desolvated.

D. The desolvated sidechain of an amino acid located near the binding site does not form a salt bridge with the ligand.

Which one of the following options represents the combination of all correct statement(s) that explain(s) net stabilisation of the ligand:protein complex?

1. A and B
2. B and D
3. C and D
4. A only

Answer (2)

Explanation: The binding of a ligand in a deep hydrophobic pocket is driven largely by the hydrophobic effect and the displacement of high-energy water molecules.

When several nonpolar groups form a network and displace buried water molecules to the surface, it increases the entropy of the system, providing significant stabilization (Statement B).

Statement D is correct because if a desolvated charged side chain does not form a salt bridge, the high energetic cost of desolvation is not compensated, yet the overall net stabilization of the complex can still be explained by the cumulative strength of these hydrophobic interactions.

Question ID: 209355338

The following are four biological processes that occur inside a living cell.

A. Spontaneous cis-trans isomerization of proline in proteins

B. Co-translational protein folding

C. α-helix formation

D. Hydrogen bond formation in free water

Which one of the following options represents the slowest to fastest order of the timescale for these processes?

1. D > C > B > A
2. A > B > C > D
3. D > C > A > B
4. C > B > D > A

Answer (3)

Explanation: Biological processes occur on vastly different timescales depending on the complexity of the molecular rearrangement. Hydrogen bond formation in free water (D) is extremely fast, occurring in the femtosecond to picosecond range. The formation of an α-helix (C) occurs on the microsecond timescale. Spontaneous cis-trans isomerization of proline (A) is a much slower process, typically taking seconds. Co-translational protein folding (B) is the slowest overall as it is limited by the rate of the ribosome, which adds only a few amino acids per second. Thus, the order from slowest to fastest is A > B > C > D.

Question ID: 209355339

A protein with a binding pocket containing amino acid residues, **Asp (pKa = 4.0)**, and **His (pKa = 6.5)** interacts with a ligand at **pH 7.0 at 25 °C**. The binding affinity of the ligand increases **10-fold upon 'His' protonation**. Assuming 'His' protonation is the sole contributor to the enhanced binding, calculate the fraction of 'His' residue protonation and the change in the binding free energy corresponding to the enhanced affinity (**R = 1.987 cal/mol/K**).

1. 0.48 and -3.61 kcal/mol
2. 0.76 and -2.46 kcal/mol
3. 0.96 and -1.63 kcal/mol
4. 0.24 and -1.36 kcal/mol

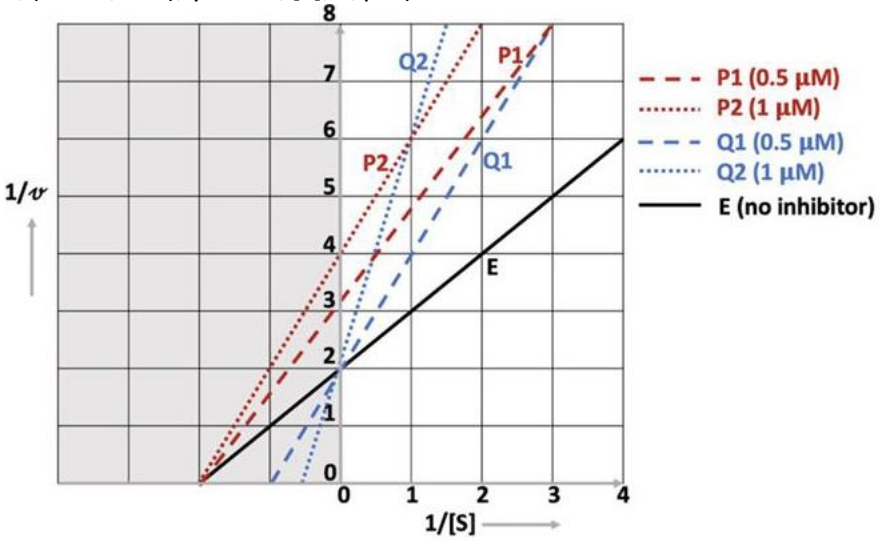
Question ID: 209355340

A 20-bp GC-rich promoter undergoes a conformational transition between the B-form to Z-form of DNA, involving bases 6 to 13. The rest of the bases always remain in the B-form. The B- to Z-DNA transition occurs with a half-life of 2 s, and Z- to B-DNA transition has a half-life of 6 s. If the cognate transcription factor requires 10 continuous B-DNA base pairs for binding, for how many seconds in a 20 s window can the transcription factor remain bound to the promoter, assuming steady-state conditions?

1. 4 s
2. 5 s
3. 10 s
4. 15 s

Question ID: 209355341

The following graph represents the enzyme kinetics observed for an enzyme (E) in the presence of 2 different inhibitors, P and Q, each at two different concentrations (x-axis — 1/v; 1/(moles/min); y-axis 1/[S]; 1/µM).



Based on the graph, what is the substrate concentration (in µM) at which both inhibitors achieve 50% inhibition?

1. 0.333
2. 0.5
3. 1.0
4. 2.0

Question ID: 209355342

Following statements were made regarding the theory of symbiogenesis in the origin of eukaryotic cells.

A. Mitochondria and chloroplasts have typically their own circular DNA, similar to bacterial DNA.
B. Mitochondria and chloroplasts are surrounded by a single membrane like other organelles.
C. Division of mitochondria and chloroplasts occurs synchronously with the division of nuclear genome.
D. Ribosomes in mitochondria and chloroplasts are similar to those found in prokaryotes.
E. Genetic analysis shows that mitochondrial DNA is closely related to certain proteobacteria.

Which one of the following options has all the correct statements?

1. A, B, C, D and E
2. A, C and E only
3. A, D and E only
4. A, C, D and E only

Answer (3)

Explanation: The theory of symbiogenesis describes the evolution of eukaryotes through the endosymbiosis of bacteria. Mitochondria and chloroplasts have their own circular DNA genomes, structurally similar to bacteria (Statement A). These organelles possess 70S-type ribosomes, which are inhibited by the same antibiotics that target prokaryotic ribosomes (Statement D). Molecular phylogeny confirms that mitochondrial DNA is most closely related to

alpha-proteobacteria (Statement E). Statement B is incorrect because they have a double membrane (inner and outer). Statement C is incorrect because they divide by binary fission, which is often independent of the host cell's nuclear cycle. Conclusion: The correct combination of true statements is A, D, and E.

Question ID: 209355343

In eukaryotes, many cells can assemble a spindle in the absence of centrosomes as in the case of plant cells during mitosis, and animal cells during meiosis in females.
In this context, centrosome-free mitotic extracts from frog oocytes, when supplied with beads covered with DNA, are sufficient to assemble the mitotic spindle.
Listed below are a few proteins that could be involved in spindle assembly in such a setting:
A. Ran GTPase
B. Ran-GEF
C. TPX2
D. Myosin V
Which one of the following options has all proteins that are directly involved in controlling spindle assembly without centrosomes?

1. A only
2. A and B only
3. A, B, and C only
4. A, B, C, and D

Answer (3)
Explanation: Statement A is correct because Ran-GTP provides the spatial signal for spindle assembly by releasing spindle assembly factors (SAFs) from inhibitory importins near the chromatin.
Statement B is correct because Ran-GEF (RCC1) must be bound to DNA to generate a high local concentration of Ran-GTP around the chromosomes.
Statement C is correct because TPX2 is a critical SAF released by Ran-GTP that nucleates microtubules and is essential for centrosome-independent spindle formation.
Statement D is incorrect because Myosin V is an actin-based motor protein and is not directly involved in the microtubule-based process of mitotic spindle assembly.

Question ID: 209355344

Given below are a few statements about meiosis in animal cells:
A. Failure of the chiasma formation leads to non-disjunction in meiosis I.
B. Meiotic cohesin Rec8 ensures mono-orientation of sister chromatids in meiosis II.
C. Crossover interference reduces clustering of recombination sites.
D. Residual double-strand breaks arrest meiosis at metaphase.
Which one of the following options has all the correct statements?

1. A and B only
2. A, C and D
3. A, B and C
4. B and C only

Answer (3)
Explanation: Statement A is correct because chiasmata provide the physical tension required for proper homologous chromosome orientation; their failure leads to random segregation or non-

disjunction in Meiosis I.
Statement B is correct because the meiotic-specific cohesin Rec8 protects centromeric cohesion, ensuring that sister chromatids behave as a single unit and orient toward the same pole during Meiosis I.
Statement C is correct because crossover interference is the phenomenon where a crossover at one spot significantly reduces the probability of another crossover occurring nearby, preventing clustering.
Statement D is incorrect because meiotic checkpoints typically arrest the cell cycle earlier (e.g., in prophase I) if double-strand breaks are not properly repaired, rather than allowing progress to metaphase.

Question ID: 209355345
Column X lists different types of ion channels and column Y defines the nature/property of these channels.

Column X	**Column Y**
A. Channel rhodopsin	i. Voltage-gated
B. Shaker-related potassium channels	ii. Mechano-sensitive
C. Piezo ion channel	iii. Ligand-gated
D. Acetylcholine receptor	iv. Light driven

Which one of the following options represents all correct matches between Column X and Column Y?

1. A(iii), B(i), C(iv), D(ii)
2. A(i), B(ii), C(iv), D(iii)
3. A(iv), B(iii), C(ii), D(i)
4. A(iv), B(i), C(ii), D(iii)

Answer (4)
Explanation: Statement A matches iv because Channelrhodopsin is a subfamily of retinylidene proteins that serve as light-gated ion channels.
Statement B matches i because Shaker-related channels are the prototypical voltage-gated potassium channels that respond to changes in membrane potential.
Statement C matches ii because Piezo proteins are essential components of distinct, evolutionarily conserved mechanosensitive ion channels.
Statement D matches iii because the Nicotinic Acetylcholine receptor is a classic ligand-gated channel that opens upon binding the neurotransmitter acetylcholine.

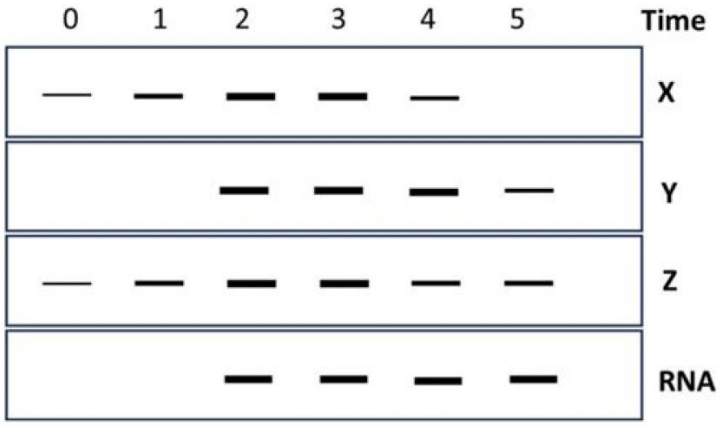
Question ID: 209355346
To test if viral proteins are transported between Golgi stacks in vesicles or are released into the cytosol by one Golgi stack and taken up by another, viral protein transport was examined between Golgi stacks of infected and uninfected cells. Which one of the following experimental designs would best distinguish these two hypotheses?

1. Test whether viral protein transport happens in the presence of antibodies depleting clathrin in acceptor Golgi stacks
2. Test whether viral protein transport happens in the presence of antibodies depleting COPII in acceptor Golgi stacks

3. Test whether viral protein transport happens in the presence of protease in the assay mix.
4. Test whether viral protein transport happens when either donor or acceptor Golgi stacks are treated with detergents sequentially

Answer (3)
Explanation: The protease protection assay is the best design because if viral proteins are transported within enclosed vesicles, they remain protected from exogenously added proteases. If the proteins were released into the cytosol to be taken up by the next stack, they would be degraded by the protease during their transit through the extra-vesicular space. Depleting clathrin or COPII (Options 1 and 2) only tests specific pathways but does not fundamentally distinguish between vesicular vs. non-vesicular (cytosolic) release. Detergent treatment (Option 4) would destroy the membranes entirely, making it impossible to observe physiological transport.

Question ID: 209355347
Chromatin immunoprecipitation (ChIP) and RT-PCR were performed to investigate the activation of expression of a particular gene, results of which are shown below.
X, Y and Z indicate ChIP with antibodies for specific proteins, and 'RNA' shows gene expression at the indicated time points.



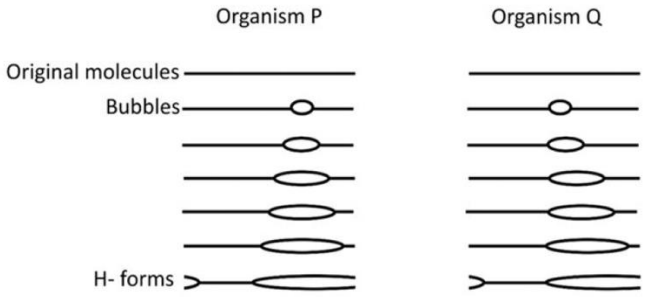
Based on the results, choose the option that correctly identifies the X, Y and Z proteins.
1. X: H4K8Ac; Y: TBP; Z: H3K9Ac
2. X: TBP; Y: H4K8Ac; Z: H3K9Ac
3. X: H4K8Ac; Y: H3K9Ac; Z: TBP
4. X: H3K9Ac; Y: TBP; Z: H4K8Ac

Answer (1)
Explanation: The temporal order of transcription initiation is highly predictable.
Statement X identifies H4K8Ac because histone acetylation usually precedes the recruitment of general transcription factors to open the chromatin structure.
Statement Y identifies TBP (TATA-binding protein) because it is a key component of the pre-initiation complex that must bind to the promoter after chromatin remodeling but before active RNA synthesis.

Statement Z identifies H3K9Ac because this specific mark is often associated with the transition to active elongation and remains high while the RNA transcript level increases.

Question ID: 209355348

Circular genomic DNA isolated from actively replicating stages of organisms, P and Q were digested with a restriction enzyme that cuts both genomes only once. Electron-micrographs of the digested DNAs shown below



The following comments are made on the number of replication origins and directionality of the replication fork(s):

A. In organism P there are two replication origins, and replication is bidirectional.

B. In organism P there is one replication origin, and replication is bidirectional.

C. In organism Q there is one replication origin, and replication is bidirectional.

D. In organism Q there is one replication origin, and replication is unidirectional.

Which one of the following options represents the combination of all correct statements?

1. A and C
2. A and D
3. B and C
4. B and D

Answer (4)

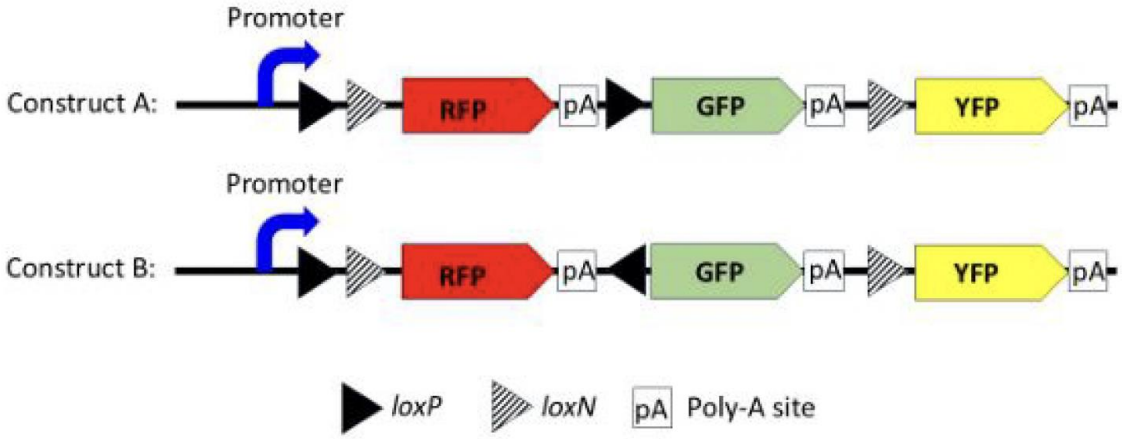
Explanation: Digestion of circular DNA that contains a replication bubble results in a linear fragment with an internal loop (bubble), indicating a single origin.

Statement B is correct for Organism P because a single internal bubble that expands symmetrically toward the ends of a linear fragment signifies one origin and bidirectional replication.

Statement D is correct for Organism Q as single internal bubble that expands only one side/end of a linear fragment signifies one origin and unidirectional replication.

Question ID: 209355349

The following constructs, A or B, have been introduced into two different cultures of eukaryotic cells:



Cre recombinase can act upon *loxP-loxP* and *loxN-loxN* sites. The following outcomes have been predicted on the types of fluorescence emitted by the cells upon induction of Cre-recombinase:
A. The cells transfected with construct A will yield three types of cells: each type expressing either red or green or yellow fluorescence.
B. The cells transfected with construct B will yield three types of cells: each type expressing either red or green or yellow fluorescence.
C. The cells transfected with construct A will yield two types of cells: each type expressing either red or green fluorescence.
D. The cells transfected with construct B will yield two types of fluorescent cells: each type expressing either red or yellow fluorescence.
Which one of the following options represents the combination of all correct statements?

1. A and D
2. A and B
3. B and C
4. C and D

Answer (2)
Explanation: Statement A is correct because Construct A likely contains different fluorescent protein genes flanked by incompatible lox sites (loxP and loxN), allowing Cre to randomly choose between different excision events that result in mutually exclusive expression of Red, Green, or Yellow.
Statement B is correct because Construct B, using a similar "Brainbow" style stochastic recombination logic, would also result in three distinct fluorescent cell populations depending on which segment is excised.
Statements C and D are incorrect because the presence of both loxP and loxN systems in these configurations is specifically designed to provide more than two possible outcomes through combinatorial recombination.

Question ID: 209355350
ENZ function prevents premature differentiation of mouse neural stem cells. Kinase inhibitor treatment differentiates these cells prematurely. This is prevented if a specific serine-to-aspartate (S to D) mutation is introduced in ENZ. Based on this information, which one of the following statements is INCORRECT?

1. The specific serine to aspartate substitution has the same effect as phosphorylation of ENZ on neural stem cell differentiation.
2. The specific serine may be the site of ENZ phosphorylation.
3. The serine-to-aspartate mutation is expected to yield the same results as an asparagine substitution.
4. The serine-to-aspartate mutation is expected to yield the same results as a glutamic acid substitution.

Answer (3)
Explanation: Statement 1 is correct because the S to D mutation acts as a "phosphomimetic," where the negatively charged aspartate mimics the charge of a phosphate group, effectively keeping the protein in an "active" state that prevents differentiation even without the kinase.
Statement 2 is correct because the fact that a phosphomimetic mutation bypasses the need for the kinase strongly implies that the kinase's normal role is to phosphorylate that specific serine residue.
Statement 3 is INCORRECT because Asparagine (N) is a polar but uncharged amino acid; it cannot mimic the negative charge of a phosphate group and would likely fail to prevent differentiation, unlike the negatively charged Aspartate (D).
Statement 4 is correct because Glutamic acid (E) is also negatively charged and often functions effectively as a phosphomimetic substitute, similar to Aspartate.

Question ID: 209355351
A lambda bacteriophage integrated into the genome of *E. coli* and became lysogenic.
Upon UV irradiation, it is expected that the lytic cycle will be induced.
Due to mutations that have occurred as a result of UV irradiation, you find that the lambda bacteriophage remains in the lysogenic state and lysis is impaired.
Mutations in the following genes have been proposed to explain this observation.
A. *cI* gene, protease cleavage site
B. *cII* gene, DNA binding site
C. RecA gene of *E. coli*
D. RuvA gene of *E. coli*
Which one of the following options represents all correct statements?
1. A and B
2. B and D
3. A and C
4. C and D

Answer (3)
Explanation: Statement A is correct because the induction of the lytic cycle requires the cleavage of the cI repressor by RecA; a mutation at the protease cleavage site of the cI protein prevents this cleavage, keeping the phage in a lysogenic state even after UV damage.
Statement B is incorrect because cII is involved in the establishment of lysogeny, not the UV-induced switch to lysis.
Statement C is correct because the RecA protein of *E. coli* is essential for the SOS response; if RecA is mutated or inactive, it cannot stimulate the autoproteolysis of the cI repressor, thus impairing lysis.
Statement D is incorrect because RuvA is involved in branch migration during recombination and is not the primary regulator of the lambda lytic/lysogenic switch.

Question ID: 209355352
A eukaryotic protein, 'X' activates a target gene by increasing its transcription when an inducer is added. The results of the experiments are shown below:

Experiment	**Results without inducer**	**Results with inducer**
Immunofluorescence of protein 'X'	No colocalization with DAPI	Colocalization with DAPI
Electrophoretic Mobility Shift Assay (EMSA)	No binding to probe derived from the promoter of the target gene	No binding to probe derived from the promoter of the target gene
Chromatin immunoprecipitation of the promoter of the target gene	Low acetylation	High acetylation

Which one of the following options is the correct mechanism of protein X-mediated transcriptional activation of the target gene upon addition of the inducer?

1. It acts in the cytoplasm as part of a signal transduction cascade.
2. It moves to the nucleus and acts as a coactivator.
3. It remains in the nucleus and acts as a chromatin modifier.
4. It moves to the cytoplasm and acts as a repressor.

Answer (2)
Explanation: The experimental data indicates a specific movement and function for Protein X. Without an inducer, Protein X does not colocalize with DAPI, meaning it is cytoplasmic. Upon addition of the inducer, it colocalizes with DAPI, proving it moves to the nucleus. The EMSA shows no direct binding to the promoter DNA with or without the inducer, which rules out it being a direct DNA-binding transcription factor. However, the ChIP assay shows high acetylation at the promoter with the inducer, meaning Protein X facilitates chromatin modification, likely by being recruited to the promoter by another DNA-binding protein to act as a coactivator.

Question ID: 209355353
In an *in vitro* translation reaction, the 43S pre-initiation complex (PIC) was incubated with the *in vitro* transcribed and capped mRNA for Gene X, followed by addition of the 60S subunit. As a control, mRNA for Gene Y isolated from cells was incubated in the same reaction. The mRNA for Gene Y was bound to the 80S ribosomes and polyribosomes, while mRNA of Gene X remained unbound. In a parallel experiment, mRNAs for both Gene X and Gene Y were found to be associated *in vivo* with 80S and polyribosomes.
The following statements were made to explain the above observation:

A. The in vitro system was globally defective for 80S assembly.
B. Gene X mRNA has a sequence or structural feature that specifically prevents 80S assembly in vitro.
C. Gene X mRNA lacks a start codon.
D. Gene X mRNA requires other cellular factors which are absent in the in vitro mix to permit initiation.
E. The in vitro assay preferentially degrades Gene X mRNA. Which one of the following options represents all correct statements?

1. A and B

2. B and C
3. B and D
4. D and E

Answer (3)
Explanation: The experiment contrasts in vitro and in vivo translation requirements.
Statement A is incorrect because Gene Y successfully associated with 80S ribosomes in the same in vitro reaction, proving the system itself is functional.
Statement B is correct because the failure of Gene X to bind in vitro while Gene Y succeeds suggests that Gene X possesses a specific structural or sequence hindrance that the in vitro system cannot overcome.
Statement C is incorrect because Gene X functions in vivo, implying it possesses all necessary coding components like a start codon.
Statement D is correct because many complex mRNAs require specific "chaperone" proteins or cellular factors for proper folding or initiation that are present in the living cell but often missing in standard in vitro translation lysates.

Question ID: 209355354
The following statements were made about **host-pathogen interactions during influenza virus infection**:
A. Entry of the virus is mediated by the interaction of the HA-protein of the virus with sialic acid receptors on the airway epithelium.
B. CTLs are primed in the thymus to kill respiratory epithelial cells that present viral antigens on MHC-I molecules.
C. CTLs are primed in the thymus to kill respiratory epithelial cells that present viral antigens on MHC-II molecules.
D. Viral neuraminidase is required for the release of mature viruses from infected cells.
Which one of the following options represents the combination of all correct statements?
1. A and C
2. A, B and D
3. B and D only
4. A and D only

Answer (4)
Explanation: Statement A is correct because the Hemagglutinin (HA) protein on the influenza virus surface specifically binds to sialic acid residues on host cell surface glycoproteins to initiate viral entry.
Statement B is incorrect because Cytotoxic T Lymphocytes (CTLs) are "primed" or activated by professional Antigen Presenting Cells (APCs) in secondary lymphoid organs, not the thymus.
Statement C is incorrect because CTLs (CD8+) recognize antigens presented on MHC-I molecules; MHC-II is recognized by Helper T cells (CD4+).
Statement D is correct because viral Neuraminidase (NA) cleaves sialic acid residues to prevent the newly formed virus particles from sticking to the host cell, which is essential for their release and spread.

Question ID: 209355355

Signalling pathways that are important for tumorigenesis and cancer include those involved in cell proliferation and cell growth. The following statements were made regarding pathways and molecules involved in cancer:

A. Abnormal activation of the PI3-kinase/Akt pathway is involved in dysregulated growth.

B. Bcl2 overexpression and enhanced apoptosis lead to efficient clearance of damaged cancer cells.

C. Loss of p53 can allow cells with damaged DNA to escape apoptosis and continue to proliferate.

D. Inhibition of the Rho family GTPase RhoC leads to enhanced actin-based cell motility and facilitates metastasis.

Which one of the following options represents the combination of all correct statements?

1. A and B
2. A and C
3. B and C
4. C and D

Answer (2)

Explanation: Statement A is correct because the PI3-kinase/Akt pathway is a central regulator of cell survival and growth; its abnormal hyperactivation is a hallmark of many cancers.
Statement B is incorrect because Bcl2 is an anti-apoptotic protein; its overexpression inhibits apoptosis, allowing damaged cancer cells to survive rather than be cleared.
Statement C is correct because p53 is a tumor suppressor that normally triggers cell cycle arrest or apoptosis in response to DNA damage; its loss allows cells with mutations to proliferate uncontrollably.
Statement D is incorrect because RhoC is typically overexpressed in metastatic cancers, where it promotes rather than inhibits the cell motility required for metastasis.

Question ID: 209355356

The following statements were made about major histocompatibility complex (MHC) molecules:
A. Multiple MHC-I molecules can be expressed on a single cell.
B. MHC-I molecules exhibit greater diversity than antibodies.
C. MHC-I haplotypes inherited from the mother and father and expressed on a given cell are codominant.
D. All MHC-I molecules on a given cell express the same endogenous peptide.
E. MHC-I molecules are present on platelets.
Which one of the following options represents the combination of all correct statements?

1. A, B and C
2. A, C and E
3. B and D
4. C, D and E

Answer (2)

Explanation: Statement A is correct because a single nucleated cell expresses multiple alleles of MHC-I (HLA-A, B, and C in humans) inherited from both parents.
Statement B is incorrect because the diversity of antibodies (generated by V(D)J recombination) is exponentially higher than the polymorphic diversity of MHC molecules in a population.
Statement C is correct because MHC genes are codominant, meaning the specific alleles from both the mother and father are simultaneously expressed on the cell surface.

Statement D is incorrect because different MHC-I molecules on the same cell can bind and present a vast array of different endogenous peptides.
Statement E is correct because platelets, despite lacking a nucleus, express MHC-I molecules on their surface.

Question ID: 209355357
During development, *yfg* expression is regulated by proteins E, F and G, which are abundant and have long half-lives. After a "specific stage of development", the protein E is activated by a single short wave of phosphorylation. This leads to the following events:

- Phosphorylated E activates F.
- Active F activates G.
- Active G promotes *yfg* expression.
- Active F completely inhibits E, and active G completely inhibits F function.

Which one of the following describes the expression of *yfg* soon after the "specific stage of development" is reached?

1. Continuously transcribing
2. One pulse of transcription
3. Transcription not initiated
4. Multiple pulses of transcription

Answer (1) (2?)
Explanation: The regulatory circuit described is a self-limiting cascade.
Step 1: E is activated by a single phosphorylation wave, which then activates F.
Step 2: F activates G, and G initiates the transcription of *yfg*.
Step 3: However, the system contains negative feedback loops: active F completely inhibits E (the source), and active G completely inhibits F.
Conclusion: Because the initial activator E is inhibited and the intermediate F is shut down by the product G, the signal cannot be sustained or repeated. This results in a single discrete pulse of *yfg* transcription before the pathway is deactivated.

Question ID: 209355358
The following statements are made with respect to signal transduction events in phytohormone signalling in plants:
A. Autophosphorylation of a histidine residue in the receiver domain of the response regulator is important for signal transduction through the two-component system.
B. Phosphorylation of a conserved aspartate residue in the transmitter domain of the histidine kinase is important for the two-component system.
C. CYTOKININ RESPONSE 1 (CRE1), a cytokinin receptor, functions as an Arabidopsis histidine-containing phosphotransfer (AHP) factor.
D. In Arabidopsis, pseudo-AHP, called AHP6, acts as an inhibitor of cytokinin signalling.
E. ETR1, an ethylene receptor in Arabidopsis, has histidine kinase activity and a receiver domain.

Which one of the following options is a combination of all correct statements?

1. A and C
2. B and D
3. C and E

4. D and E

Answer (4)
Explanation: Statement A is incorrect because in a two-component system, the receiver domain of the response regulator is phosphorylated on an aspartate residue, not a histidine.
Statement B is incorrect because the transmitter domain of the histidine kinase is autophosphorylated on a histidine residue.
Statement C is incorrect because CRE1 is the histidine kinase receptor itself, not an AHP factor.
Statement D is correct because AHP6 lacks the conserved histidine required for phosphotransfer, allowing it to compete with functional AHPs and inhibit cytokinin signaling.
Statement E is correct because ETR1 is a hybrid histidine kinase that contains both the transmitter domain and a fused receiver domain.

Question ID: 209355359
The following statements are made regarding the functioning of phytochromes A and B during light signaling in plants:

A. Phytochrome B (PhyB) lacks nuclear localization signal (NLS) and after perceiving light, it takes hours for nuclear import.
B. Phytochrome A (PhyA) contains NLS and its nuclear import occurs rapidly.
C. PFR form of PhyA depends on FAR-RED ELONGATED HYPOCOTYL 1 (FHY1) and its homolog FHL for nuclear import.
D. PFR form of PhyB depends on FHY1 and its homolog FHL for nuclear import.
Which one of the following options represents all correct statement(s)?

1. A and B
2. C only
3. A and C
4. D only

Answer (2)
Explanation: Statement A is incorrect because nuclear import of phyB is triggered by the light-regulated unmasking of a nuclear localization signal (NLS) sequenc
Statement B is incorrect because PhyA also lacks a traditional NLS; its rapid nuclear import is mediated by specific transporter proteins.
Statement C is correct because the PFR (active) form of PhyA requires the shuttle proteins FHY1 and FHL to facilitate its rapid translocation into the nucleus.
Statement D is incorrect because the nuclear import of PhyB is independent of the FHY1/FHL pathway.

Question ID: 209355360
The following statements were made regarding cell fate specification of trophoblast and inner cell mass (ICM) during mammalian embryogenesis:
A. Oct4 represses Cdx2 expression, enabling some cells to become ICM.
B. Cdx2 synthesized by the trophoblast cells activate Oct4 and Nanog.
C. Expression of Nanog allows cells of the ICM to retain their pluripotency.
D. YAP binds to TEAD4 and represses Cdx2 in the trophoblast cells.
Which one of the following options correctly represent events that determine the fate of trophoblasts and ICM?

1. A and B
2. B and C
3. C and D
4. A and C

Answer (4)

Explanation: Statement A is correct because Oct4 is a key pluripotency factor that antagonizes Cdx2 expression; high Oct4 levels directed to the inner cells force them to become the Inner Cell Mass (ICM).
Statement B is incorrect because Cdx2 is the master regulator of the trophoblast lineage and acts to repress Oct4 and Nanog in the outer cells.
Statement C is correct because Nanog expression is essential for maintaining the epiblast cells of the ICM in a pluripotent, undifferentiated state.
Statement D is incorrect because the YAP/TEAD4 complex actually activates Cdx2 expression in the outer cells to promote trophoblast fate.

Question ID: 209355361

In amphibians and fish, the cells of the organizer ultimately contribute to -(i) pharyngeal endoderm, (ii) head mesoderm, (iii) dorsal mesoderm, and (iv) dorsal blastopore lip. The following statements are made about the function of the organizer and its derivatives:
A. The pharyngeal endoderm and pre-chordal plate prevent formation of forebrain and midbrain.
B. The organizer has the ability to dorsalize the ectoderm and induce formation of the neural tube.
C. The dorsal mesoderm inhibits induction of the hindbrain and trunk.
D. The organizer tissue possesses the ability to dorsalize the surrounding mesoderm into somite-forming mesoderm.
Which one of the following options is a combination of all correct statements?

1. A and C
2. B and D only
3. A, B and D
4. B, C and D

Answer (2)

Statement A is incorrect. The prechordal plate (along with the anterior visceral endoderm) actually plays a critical role in inducing and patterning the anterior parts of the brain, specifically the forebrain and midbrain. It secretes signals like Sonic hedgehog (Shh) and Wnt antagonists (e.g., Cerberus, Dkk1) that are essential for anterior neural development.
Statement B is correct because the organizer (Spemann-Mangold organizer) is defined by its ability to induce the neural tube from presumptive ectoderm and to establish the dorsal-ventral axis.
Statement C is incorrect because the dorsal mesoderm actually provides the signals (like Chordin and Noggin) required to induce the hindbrain and trunk, rather than inhibiting them.
Statement D is correct because the organizer tissue secretes factors that dorsalize the surrounding mesoderm, converting it from ventral (blood/mesenchyme) into dorsal somite-forming paraxial mesoderm.

Question ID: 209355362

Immunoprecipitation (IP) of protein X from cell lysate using anti-X antibody, followed by RT-PCR for mRNA-Y, indicates the presence of protein X-mRNA-Y complex in vivo.
To confirm this interaction, recombinant protein X and in vitro transcribed mRNA-Y are incubated, followed by affinity purification of protein X. However, mRNA-Y was not present in the eluates containing X but rather in the unbound fraction.

Given below are a few statements to explain the observations.
A. Protein X and mRNA-Y are expressed at the same level in the cell, so the interaction is robust.
B. Protein X and mRNA-Y physically interact via a bridge protein/co-factor absent in the purified protein X.
C. mRNA-Y binds to the antibody used in the immunoprecipitation.
D. The mRNA binding domain of the recombinant protein X may have an altered conformation.
Which one of the following is a combination of all correct statements?

1. A and B
2. B and D
3. C only
4. C and D

Answer (2)

Explanation: The experimental discrepancy suggests that the interaction requires a specific native environment.
Statement A is incorrect because equal expression levels do not guarantee a robust physical interaction; binding affinity is determined by structural complementarity.
Statement B is correct because many RNA-protein interactions are indirect and require an intermediary "bridge" protein or a small-molecule co-factor that is present in the complex cell lysate but absent in a purified recombinant system.
Statement C is incorrect because standard immunoprecipitation controls would rule out non-specific binding of mRNA to an antibody; if this were the case, the in vivo result would be considered an experimental artifact.
Statement D is correct because recombinant proteins produced in heterologous systems (like *E. coli*) often lack proper post-translational modifications or fail to fold into the precise native conformation required for RNA binding.

Question ID: *209355363*

Experiments addressing axes patterning in amphibian embryos are listed in column X and the observations are listed in column Y.

Column X	**Column Y**
A. Grafting of dorsal blastopore lip from donor early gastrula into presumptive ventral epidermis of host early gastrula	i. Rescue of dorsal development
B. Injection of noggin mRNA into UV-treated Xenopus embryos	ii. Induction of secondary head structures
C. Injection of morpholinos to inhibit BMPs 2, 4, and 7	iii. Formation of a secondary embryo
D. Grafting of anterior archenteron roof from late gastrula into the blastocoel of early gastrula	iv. Enlarged neural tube

Which one of the following options represents all correct matches between column X and column Y?

1. A - iii, B - i, C - iv, D - ii
2. A - ii, B - iii, C - iv, D - i
3. A - iv, B - i, C - ii, D - iii
4. A - iii, B - ii, C - iv, D - i

Answer (1)
Explanation: This question matches classic developmental biology experiments with their results.
A matches iii because the Spemann organizer graft (dorsal blastopore lip) to the ventral side is the hallmark experiment showing the induction of a complete secondary embryonic axis.
B matches i because Noggin is a BMP antagonist; injecting its mRNA into UV-treated embryos (which are normally "ventralized") restores the dorsal signals and rescues development.
C matches iv because BMPs normally promote epidermal fate; inhibiting multiple BMPs (2, 4, and 7) removes the suppression of neural fate, leading to an oversized or "enlarged" neural tube.
D matches ii because the anterior archenteron roof acts as a "head organizer" and is specifically capable of inducing anterior structures like the brain and head.

Question ID: 209355364

Given below are the different stages of **Arabidopsis embryogenesis** (Column X) and their characteristic patterns of cell division (Column Y).

Column X	Column Y
A. Zygotic	**(i)** Formation of an 8-cell embryo, exhibiting radial symmetry and undergoing additional cell division to create the protoderm
B. Globular	**(ii)** Polarized growth of cells followed by a symmetric transverse division giving rise to a small apical cell and an elongated basal cell
C. Heart	**(iii)** Cell elongation and cellular differentiation processes throughout the embryonic axis with visible distinction between the adaxial and abaxial tissue of the cotyledons
D. Torpedo	**(iv)** Focused cell division forming two cotyledons, giving bilateral symmetry to the embryo

Which one of the following options represents the correct match between Column X and Column Y?
1. A (i); B (ii); C (iii); D (iv)
2. A (ii); B (i); C (iv); D (iii)
3. A (ii); B (i); C (iii); D (iv)
4. A (i); B (iv); C (ii); D (iii)

Answer (2)
Explanation: Arabidopsis embryogenesis follows a highly stereotyped pattern of cell divisions.
A matches ii because the zygotic stage involves the first asymmetric transverse division that establishes the apical-basal polarity of the embryo.
B matches i because the globular stage is characterized by the formation of an 8-cell (octant)

embryo and the subsequent protoderm formation via periclinal divisions.
C matches iv because the heart stage marks the shift to bilateral symmetry as focused cell divisions at the apical poles begin to form the two cotyledon primordia.
D matches iii because the torpedo stage involves longitudinal cell elongation and the clear differentiation of the embryonic axis and cotyledon tissues.

Question ID: 209355365
Following statements are made regarding sex determination in plants:
A. In *Silene latifolia*, females are homogametic (XX) and males are heterogametic (XY).
B. Papaya (*Carica papaya*) shows trioecy, but its sex determination is not associated with sex chromosomes.
C. All dioecious plants with separate sexes possess heteromorphic sex chromosomes.
D. Plant sex chromosomes are ancient, and their Y chromosomes are highly degenerated, much like those in mammals.
E. Unlike animals, dosage compensation is generally weak or absent in plant sex chromosome systems.
Which one of the following combinations contains all INCORRECT statements?

1. A, C and E
2. B, C and D
3. A and D
4. B and E

Answer (2)
Explanation: This question asks for the combination of INCORRECT statements.
Statement A is correct because *Silene latifolia* is a model for XY sex determination similar to humans.
Statement B is INCORRECT because papaya sex determination is indeed associated with primitive sex chromosomes (XY system with a small male-specific region).
Statement C is INCORRECT because many dioecious plants possess homomorphic sex chromosomes that are not cytologically distinguishable.
Statement D is INCORRECT because most plant sex chromosomes evolved relatively recently (independently in different lineages) and are generally much less "degenerated" than the ancient mammalian Y chromosome.
Statement E is correct because plants generally lack the rigorous chromosome-wide dosage compensation mechanisms (like X-inactivation) found in mammals.

Question ID: 209355366
The following statements are made regarding photosynthesis in a mutant maize (C4 plant) that lacks functional bundle sheath chloroplasts:
A. Photorespiration would remain low due to PEP carboxylase activity.
B. Calvin cycle would be severely compromised, reducing sugar production.
C. Carbon fixation would shift entirely to mesophyll cells without yield penalty.
D. CO_2 concentration around Rubisco would increase dramatically.
Which one of the following options is a combination of all INCORRECT statements?

1. A and B only
2. A, B and C
3. C and D only
4. A, C and D

Answer (4)

Explanation: This question asks for the combination of all INCORRECT statements.

Statement A is INCORRECT because PEP carboxylase only captures in the mesophyll; if the bundle sheath chloroplasts (where Rubisco is located) are non-functional, the cannot be fixed into sugars, leading to high photorespiration in any residual -exposed Rubisco.

Statement B is correct because the Calvin cycle occurs in the bundle sheath in C4 plants; without functional chloroplasts there, sugar production is compromised.

Statement C is INCORRECT because C4 plants lack the necessary Calvin cycle enzymes in their mesophyll cells to fix carbon without the bundle sheath, meaning there would be a massive yield penalty.

Statement D is INCORRECT because the "CO_2 pump" mechanism requires the bundle sheath to concentrate the gas; without it, levels around Rubisco would be low, not high.

Question ID: 209355367

Beyond its primary role in reducing atmospheric nitrogen to ammonia during symbiotic nitrogen fixation, the nitrogenase enzyme complex is also capable of catalyzing other reactions. Listed below are some reactions:

A. Acetylene reduction ($C_2H_2 \rightarrow C_2H_4$)

B. H_2 production ($2H^+ \rightarrow H_2$)

C. ATP hydrolysis (ATP → ADP + Pi)

D. Oxidized ferredoxin to Reduced Ferredoxin E. NAD reduction ($NAD^+ + H^+ \rightarrow NADH$)

Which one of the following options represents the combination of reactions that are NOT catalysed by the nitrogenase enzyme complex?

1. B and C
2. D and E
3. A and C
4. B and D

Answer (2)

Explanation: The nitrogenase complex is a versatile enzyme but has specific catalytic limits.

Statement A is incorrect because nitrogenase is well known to reduce acetylene to ethylene, a process used in the "Acetylene Reduction Assay" to measure nitrogenase activity.

Statement B is incorrect because production is an obligate byproduct of the nitrogen fixation reaction.

Statement C is incorrect because the enzyme requires massive amounts of energy (at least 16 ATP per) and must hydrolyze ATP to drive the electron transfer.

Statement D is correct because nitrogenase *receives* electrons from reduced ferredoxin; it does not catalyze the reduction of oxidized ferredoxin.

Statement E is correct because nitrogenase does not directly reduce ; the electrons are funneled to the substrate rather than producing NADH.

Question ID: 209355368

Following statements are made regarding abscisic acid (ABA) signalling during water stress in plants:

A. ABA causes membrane depolarization by decreasing cytosolic calcium levels.

B. ABA causes alkalinisation of the cytosol which stimulates opening of K^+ efflux channels.

C. ABA inhibits the activity of the plasma membrane H^+-ATPase which results in membrane depolarization.
D. During stomatal closure, ABA induces reorganization of tubulin cytoskeleton mediated by Rho GTPases.
E. ABA induced membrane depolarization occur by release of calcium from endoplasmic reticulum and vacuoles.
Which one of the following options is a combination of all correct statements?

1. A, B, D and E
2. B, C and E
3. A, B, C and D
4. C, D and E

Explanation: ABA signaling in guard cells involves a specific ion flux sequence.
Statement A is incorrect because ABA causes membrane depolarization by *increasing* cytosolic calcium levels, which then activates anion channels.
Statement B is correct because cytosolic alkalinization is a known signaling event that promotes the activation of outward-rectifying channels (efflux). ?
Statement C is correct because inhibiting the H^+-ATPase stops the proton pump from hyperpolarizing the membrane, leading to the necessary depolarization for exit.
Statement D ? Tubulin/Actin
Statement E is correct because the initial calcium spike is triggered by release from internal stores like the ER and vacuole.

Question ID: 209355369
Given below are a few statements regarding Aquaporin-mediated water transport in plants:
A. The activity of aquaporins is regulated by altered pH and Ca^{2+} concentration as well as phosphorylation.
B. Aquaporin activity is also regulated by reactive oxygen species.
C. Aquaporins are restricted only to epidermis and endodermal cells and not present in xylem parenchyma.
D. Aquaporins do not mediate influx of boric acid and salicylic acid into cytosol.
Which one of the following options represents the combination of all correct statements?

1. A and B
2. B and C
3. C and D
4. A and D

Answer (1)
Explanation: Aquaporins are complex water-channel proteins.
Statement A is correct because aquaporin gating (opening/closing) is regulated by phosphorylation and is sensitive to changes in pH and divalent cations like .
Statement B is correct because reactive oxygen species (ROS), such as , have been shown to inhibit aquaporin activity during stress.
Statement C is incorrect because aquaporins are found in almost all plant tissues, including xylem parenchyma, where they facilitate the rapid movement of water into and out of the conducting vessels.
Statement D is incorrect because certain aquaporins (aquaglyceroporins or NIPs) are capable of transporting small uncharged solutes like boric acid and salicylic acid.

Question ID: 209355370

The following statements are made regarding phenolic biosynthesis in plants.

A. The lignans and flavonoids have abundant methylated carboxyl groups, compared to methylated hydroxyl groups.

B. Cells producing lignans and flavonoids have a very high demand for S-adenosylmethionine.

C. The majority of methylation reactions involved in the formation of phenolics are catalyzed by O-methyltransferases.

D. The catechol-O-methyltransferase (COMT) has strict substrate specificity.

Which one of the following options represents the combination of all correct statements?

1. A and B
2. B and C
3. C and D
4. A and D

Answer (2)

Explanation: Phenolic compounds like lignans and flavonoids undergo specific enzymatic modifications.

Statement A is incorrect because these compounds are primarily modified by methylating their hydroxyl groups (-OH) rather than carboxyl groups.

Statement B is correct because S-adenosylmethionine (SAM) is the universal methyl donor; tissues actively synthesizing methylated phenolics have an extremely high demand for SAM.

Statement C is correct because the enzymes responsible for these modifications are O-methyltransferases (OMTs), which transfer methyl groups to the oxygen atoms of hydroxyl groups.

Statement D is incorrect because many plant OMTs, including catechol-O-methyltransferases, exhibit relatively broad substrate specificity, allowing them to act on multiple related phenolic intermediates.

Question ID: 209355371

The following statements are made with respect to the major classes of **heat shock proteins (HSP)** in plants.

A. Cytosolic HSP100 is essential while the chloroplast HSP100 / Clpβ family protein is not essential for heat stress response.

B. Proteins of HSP90 family are exclusively localized in the nucleus.

C. Members of HSP60 protein family, chaperonins, are abundant even at normal temperatures.

D. The C-terminal domain of small HSPs is homologous to α-crystallins, proteins found in vertebrate eye lens.

Which one of the following options is a combination of all correct statements?

1. A and C
2. B and D
3. A and B
4. C and D

Answer (4)

Explanation: Statement A is incorrect because cytosolic HSP100 (ClpB) is generally considered essential for thermotolerance across various plant species, as it helps in the disaggregation of

proteins.
Statement B is incorrect because while HSP90 is found in the nucleus, members of the HSP90 family are also localized in the cytosol, endoplasmic reticulum, and organelles like chloroplasts and mitochondria.
Statement C is correct because HSP60 proteins (chaperonins) are constitutive and abundant under normal physiological conditions, where they assist in the folding of proteins especially in organelles.
Statement D is correct because the small Heat Shock Proteins (sHSPs) possess a highly conserved C-terminal domain known as the α-crystallin domain, which is structurally related to proteins found in the vertebrate eye lens.

Question ID: 209355372
The following statements propose some of the similarities and differences between classic non-peptide neurotransmitters (CNN) and peptide neurotransmitters (PN):
A. CNN are synthesized at the presynaptic terminal while PN are synthesized in the cell body.
B. PN receptors are confined to the specific synapse at which PN is released like that of CNN.
C. When one neuron (containing both CNN and PN) is stimulated at low frequency, both PN and CNN are released from the presynaptic terminal, but at higher frequencies, only CNN is released.
D. The typical action of CNN has short latency and short duration (milliseconds) while PN action may have long latency and may persist for long duration (seconds).
Which one of the following options represents a combination of all correct statements?

1. A and B
2. B and C
3. C and D
4. A and D

Answer (4)
Explanation: Statement A is correct because classical non-peptide neurotransmitters (CNN) like acetylcholine are synthesized from precursors by enzymes at the presynaptic terminal, whereas peptide neurotransmitters (PN) are synthesized as pro-peptides in the cell body and transported to the terminal.
Statement B is incorrect because PN often act through G-protein coupled receptors that can be located farther from the release site (volume transmission), whereas CNN receptors are typically concentrated at the synaptic cleft.
Statement C is incorrect because typically, low-frequency stimulation releases only CNN, while high-frequency stimulation is required to release both CNN and PN.
Statement D is correct because CNN typically produce rapid, short-lived electrical responses (milliseconds), while PN often produce slower, long-lasting modulatory effects (seconds to minutes).

Question ID: 209355373
The physiological regulation of plasma osmolality by osmotically active neurons (osmoreceptors) in the organum vasculosum of lamina terminalis (OVLT) of hypothalamus is described in the following statements:
A. In hyperosmolal state, the non-selective cationic channels in the osmoreceptor membrane becomes active causing hyperpolarization of receptor cells.
B. In hyperosmolal state, shrinkage of osmoreceptor cells occurs.

C. Activated osmoreceptors send action potentials to the supraoptic nucleus (SON) and paraventricular nucleus (PVN) to release arginine vasopressin (AVP).
D. In hypoosmolal state, the stretching of osmoreceptor membrane causes inactivation of transient receptor vanilloid protein 4 (TRVP4) resulting in the activation of osmoreceptors.
Which one of the following options represents a combination of all correct statements?

1. A and B
2. B and C
3. C and D
4. A and D

Answer (2)
Explanation: Statement A is incorrect because in a hyperosmolal state, cationic channels open and cause **depolarization** (not hyperpolarization) of the osmoreceptor neurons, which leads to action potential firing.
Statement B is correct because a rise in plasma osmolality causes water to move out of the osmoreceptor cells by osmosis, resulting in cell shrinkage.
Statement C is correct because the activation (depolarization) of these OVLT receptors triggers signals to the SON and PVN nuclei, which then secrete Arginine Vasopressin (AVP) into the bloodstream to conserve water.
Statement D is incorrect because in a hypoosmolal state, stretching of the membrane leads to **hyperpolarization** and decreased firing, rather than activation.

Question ID: 209355374
The following statements are put forth about hormonal changes during normal pregnancy in humans:
A. Pituitary secretion of FSH and LH increases.
B. Aldosterone secretion increases.
C. Glucocorticoid secretion decreases.
D. Thyroxine secretion increases.
Which one of the following options has a combination of all correct statements?

1. A and B
2. C and D
3. A and C
4. B and D

Answer (4)
Explanation: Statement A is incorrect because during pregnancy, high levels of estrogen and progesterone exert negative feedback on the pituitary, causing FSH and LH levels to remain very low.
Statement B is correct because aldosterone levels increase significantly during pregnancy to expand blood volume and manage the increased demand for sodium and water retention.
Statement C is incorrect because glucocorticoid (cortisol) levels actually increase during pregnancy to assist with metabolic changes and fetal development.
Statement D is correct because thyroxine levels increase to meet the higher metabolic demands of the mother and the developing fetus.

Question ID: 209355375

Given below are statements about ion transport proteins in pancreatic duct cells which influence the composition of pancreatic juice:

A. Primary Cl^-/HCO_3^- exchanger is located on the luminal side.

B. CFTR is located primarily on the basolateral side.

C. Na^+-bicarbonate cotransporter is located on the basolateral side.

D. Na^+/hydrogen exchanger-1 is located on the luminal side.

Which one of the following options has a combination of all correct statements?

1. A and B
2. C and D
3. A and C
4. B and D

Answer (3)

Explanation: Statement A is correct because the primary Cl^-/HCO_3^- exchanger (SLC26A6) is located on the apical (luminal) membrane to facilitate the secretion of bicarbonate into the pancreatic juice.

Statement B is incorrect because CFTR (Cystic Fibrosis Transmembrane Conductance Regulator) is located on the **apical (luminal)** side to provide the chloride ions necessary for the Cl^-/HCO_3^- exchange process.

Statement C is correct because the Na^+-bicarbonate cotransporter (NBCe1-B) is located on the basolateral membrane to bring bicarbonate into the cell from the blood.

Statement D is incorrect because Na^+/H^+ exchangers like NHE1 are typically located on the basolateral side to regulate intracellular pH, while luminal transport is dominated by bicarbonate secretion.

Question ID: 209355376

Given below are few **hormones** (Column X) and their specific **inhibitors** (Column Y).

Column X	Column Y
A. Growth hormone	**i. Mifepristone**
B. Progestogens	**ii. Inhibin B**
C. Parathormone	**iii. Somatostatin**
D. Follicle-stimulating hormone	**iv. High calcium levels**

Which one of the following combinations correctly matches the hormones with their inhibitors?

1. A – i; B – ii; C – iv; D – iii
2. A – iii; B – i; C – iv; D – ii
3. A – iv; B – ii; C – iii; D – i
4. A – iii; B – iv; C – i; D – ii

Answer (2)

Explanation: This question requires matching hormones with their physiological inhibitors: A (Growth Hormone) matches iii (Somatostatin) because somatostatin is the primary hypothalamic hormone that inhibits the release of GH.

B (Progestogens) matches i (Mifepristone) because mifepristone is a well-known progesterone receptor antagonist.
C (Parathormone) matches iv (High calcium levels) because elevated blood calcium levels provide the direct negative feedback signal to inhibit PTH secretion from the parathyroid glands.
D (FSH) matches ii (Inhibin B) because inhibin B is produced by the gonads specifically to suppress the secretion of Follicle-Stimulating Hormone from the pituitary.

Question ID: 209355377
The following statements are made about body temperature regulation in humans:
A. Lactic acid and potassium ions are less concentrated in sweat while sweating little than while sweating a lot.
B. When the temperature of the surroundings becomes greater than that of the skin, body loses heat by conduction.
C. When heat is applied directly to the pre-optic area of hypothalamus by inserting a thermode in the brain, the animal begins to sweat profusely.
D. Chemical thermogenesis through thyroid gland stimulation requires weeks of exposure to cold temperature.
Which one of the following options represents the combination of all correct statements?

1. C and D
2. B and C
3. A and B
4. A and D

Answer (1)
Explanation: Statement A is incorrect because as the sweating rate increases, there is less time for the reabsorption of ions in the sweat duct, making potassium and lactic acid concentrations **more** concentrated at higher rates.
Statement B is incorrect because if surroundings are hotter than the skin, the body **gains** heat by conduction; heat loss by conduction only occurs if the skin is hotter than the environment.
Statement C is correct because the pre-optic area (POA) acts as the body's thermostat; heating it directly tricks the brain into thinking the body is overheating, triggering profuse sweating.
Statement D is correct because thyroid-mediated chemical thermogenesis is a slow adaptive response to cold that involves increasing the basal metabolic rate, which takes weeks to fully implement.

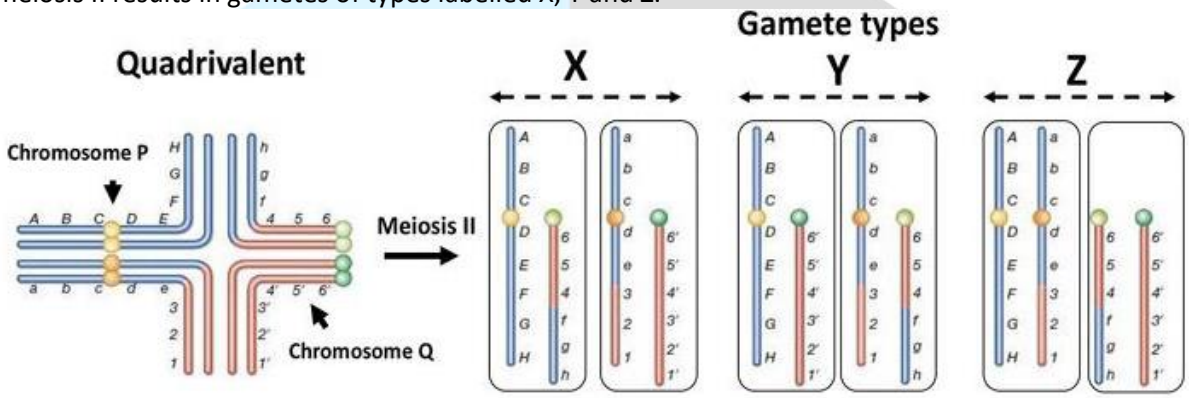
Question ID: 209355378
Recombination between two genes in *Neurospora crassa* yielded equal numbers of parental ditype (PD) and tetratype (TT), and 12 times as many TT as non-parental ditype (NPD).
What is the distance between the genes in map units (mu)?

1. 6 mu
2. 7 mu
3. 14 mu
4. 28 mu

Concept: In fungal tetrad analysis, map distance is calculated using the formula:
RF = (1/2 TT) + NPD/ Total X 100
Formula: .
Solution: Given equal numbers of parental ditype (PD) and tetratype (TT), and 12 times as many

TT as non-parental ditype (NPD).
Let NPD = 10, then PD= 120 and TT =120
Total tetrads = 250
RF = [(1/2 of 120) + 10/ 250] X 100
= 70/2.5 = 28 mu

Question ID: 209355379
In a plant heterozygous for a reciprocal translocation involving chromosome P (ABCDEFGH) and chromosome Q (123456), meiosis I produces a quadrivalent as shown in the figure, which after meiosis II results in gametes of types labelled X, Y and Z.



Which one of the following combinations correctly represents the segregation pattern of gametes that arise from the quadrivalent configuration as shown in the diagram?
1. X = Alternate Y = Adjacent II Z = Adjacent I
2. X = Adjacent II Y = Alternate Z = Adjacent I
3. X = Adjacent I Y = Adjacent II Z = Alternate
4. X = Adjacent I Y = Alternate Z = Adjacent II

Answer (1/4) ?
Explanation:

Question ID: 209355380
Given below are a few statements related to inheritance biology:

A. A crossover is the breakage of two DNA molecules at the same position and their rejoining in two reciprocal recombinant combinations.

B. Crossing over takes place at the four-chromatid stage.

C. As the distance between two genes increases, the recombination frequencies move closer to 50%.

D. Percentage of recombinants between two genes can be used as a quantitative index of the accurate physical distance between them.

Which one of the following options is a combination of all correct statements?
1. A and C only
2. B and D only
3. A, B and C

4. B, C and D

Answer (3)
Explanation: Statement A is correct because a crossover involves the physical breaking of two non-sister chromatids and their precise rejoining to exchange genetic material.
Statement B is correct because crossing over occurs during the pachytene stage of prophase I, where the bivalent consists of four chromatids (the tetrad).
Statement C is correct because as distance increases, the probability of multiple crossovers increases, which causes the observed recombination frequency to plateau at a maximum of 50%.
Statement D is incorrect because the percentage of recombinants is an index of **genetic distance** (centimorgans), which does not always accurately reflect the **physical distance** (base pairs) due to "hotspots" and "coldspots" of recombination.

Question ID: 209355381
In T4 phage, a mutation in the *rII* locus gives rise to large and round plaques. The wild type plaques are small and ragged. Ten independent mutants (M1 to M10) in the *rII* locus were isolated. In order to test whether the mutations affected the same protein coding regions, *E. coli* cells were infected with two mutant phages at a time. The plaques obtained from such infection were either small and ragged (+) or large and round (-). The results obtained from all combinations of infection involving the ten mutants is summarized below:

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
M1	-	+	-	-	+	+	+	+	+	-
M2		-	+	+	-	-	-	-	-	+
M3			-	-	+	+	+	+	+	-
M4				-	+	+	+	+	+	-
M5					-	-	-	-	-	+
M6						-	-	-	-	+
M7							-	-	-	+
M8								-	-	+
M9									-	+
M10										-

The following conclusions were drawn from the above observations:
A. The mutants map to two complementation groups.
B. M1 and M10 are mutations in two different genes.
C. Each complementation group is represented by 5 mutants.

Which one of the following options represents a combination of correct statement(s)?
1. A only
2. B only
3. A and B
4. B and C

Answer (3)

Explanation: Statement A is correct because the complementation matrix shows that the mutants can be divided into two groups: those that complement each other (+) and those that do not (-). Mutants that do not complement belong to the same functional unit or gene. Group 1 includes: M1, M3, M4, M10. Group 2 includes M2, M5, M6, M7, M8 and M9.

Statement B is incorrect because M1 and M10 show a (-) result when combined, meaning they donot complement; thus, they must be in same genes

Statement C is incorrect because group 1 has 4 member and group 2 has 6 members

Question ID: 209355382

Given below are different types of mapping populations in plants (Column X) and their characteristic features (Column Y):

Column X	Column Y
A. F_2 mapping population	i. 1:0 segregation ratio of dominant markers
B. Backcross population	ii. 1:1 segregation ratio for both dominant and codominant markers
C. RILS	iii. Recombination is represented only from the male source
D. FDH	iv. 3:1 phenotypic segregation ratio of dominant markers

Which one of the following options is the correct match between all terms of Column X and Column Y?

1. A-iv, B-i, C-ii, D-iii
2. A-ii, B-iii, C-i, D-iv
3. A-i, B-ii, C-iv, D-iii
4. A-iii, B-iv, C-ii, D-i

Answer (1)

Explanation: This matches plant breeding populations with their segregation features.

A (F_2 mapping population) matches iv because a typical F_2 population shows a 3:1 phenotypic ratio for dominant traits and a 1:2:1 ratio for codominant markers.

B (Backcross population) matches i because crossing an F_1 (Aa) with a recessive parent (aa) results in a 1:1 segregation ratio for both dominant and codominant markers.

C (RILS - Recombinant Inbred Lines) matches ii because through repeated selfing, RILs become nearly 100% homozygous, resulting in a 1:0 (fixed) ratio for markers in individual lines.

D (FDH - Female Derived Haploids) matches iii because haploids derived from the female gamete capture the recombination events that occurred during female meiosis only.

Question ID: 209355383

Conjugation experiments were performed by mixing four different auxotrophic strains (P, Q, R and S) of *E. coli* in different combinations. The generation of prototrophs in each of these combinations on appropriate minimal selection media is given below:

Combination of strains	No. of prototrophs obtained
P and Q	20
S and R	1000
P and R	0
P and S	1000

Based on the above data, the following statements were made:
A. Strains P and R are F^- strains.
B. Strain Q is a F^+ strain.
C. Strain S is a Hfr strain.
D. Strains P and R are F^+ and F^- strains, respectively.
E. Strains P and R are both Hfr strains.
Which one of the following options represents a combination of all correct statements?

1. A, C and D
2. A, B and D
3. B, C and E
4. A, B and C

Answer (4)
Explanation: Statement A is correct because the absence of prototrophs in the P and R combination (0) indicates that neither can act as a donor; thus, both must be F^- (recipient) strains.
Statement B is correct because the combination of P (F^-) and Q yielding a low number of prototrophs (20) suggests that Q is an F^+ strain, which transfers genes with low efficiency compared to Hfr.
Statement C is correct because the combination of P (F^-) and S yielding a high number of prototrophs (1000) indicates that S is an Hfr (High Frequency of Recombination) strain.
Statement D is incorrect because Statement A already established that both are F^- recipients.

Question ID: 209355384
Antibiotic resistant strains of various pathogenic bacteria are a serious concern for human health. The following table has the names of important bacteria (Column X), specific strains of which can cause serious illnesses (Column Y).

Column X	Column Y
A. Specific strains of *Enterobacteriaceae*	i. Re-emerged as a significant community- and hospital-acquired infection due to Methicillin resistance
B. Specific strains of *Rickettsia*	ii. Multidrug-resistant (MDR) strains found in humans and food, suggesting a potential for broader spread
C. *Salmonella* and *Klebsiella pneumoniae*	iii. A type of bacteria that is difficult to treat due to resistance to multiple antibiotics, mainly Carbapenem

D. *Staphylococcus aureus*	iv. The causative agent of murine typhus, which has shown transmission via organ transplants.

Which one of the options below is the correct match between all terms of Column X and Column Y?

1. A (iv) B (ii) C (iii) D (i)
2. A (ii) B (i) C (iv) D (iii)
3. A (iii) B (iv) C (ii) D (i)
4. A (i) B (iii) C (iv) D (ii)

Answer (3)

Explanation: This question matches bacterial pathogens with their clinical significance.
A (Enterobacteriaceae) matches iii because many strains, such as CRE (Carbapenem-resistant Enterobacteriaceae), are multidrug-resistant and extremely difficult to treat.
B (Rickettsia) matches iv because *Rickettsia typhi* is the causative agent of murine typhus and has been documented in rare cases of transmission via organ transplants.
C (Salmonella/Klebsiella) matches ii because MDR strains of these enteric bacteria are frequently found in both human clinical settings and the food supply chain.
D (Staphylococcus aureus) matches i because MRSA (Methicillin-resistant *S. aureus*) is a major cause of both community-acquired and hospital-acquired infections.

Question ID: 209355385
Given below are names of plants (Column X) and the habitats (Column Y) in which they naturally occur:

Column X	Column Y
A. *Myristica fatua*	i. Eastern Himalayas
B. *Strobilanthes kunthiana*	ii. Nilgiris
C. *Madhuca indica*	iii. Fresh water swamp forests
D. *Rhododendron pendulum*	iv. Central India

Which one of the following options is a correct match of all terms between Column X and Column Y?

1. A-ii; B-i; C-iii; D-iv
2. A-iv; B-iii; C-ii; D-i
3. A-iii; B-ii; C-iv; D-i
4. A-iii; B-iv; C-i; D-ii

Answer (3)

Explanation: This matches Indian flora with their specific ecological zones.
A (*Myristica fatua*) matches iii because it is a key species of the "Myristica swamps," which are rare freshwater swamp forests found in the Western Ghats.
B (*Strobilanthes kunthiana*) matches ii because this is the famous "Neelakurinji" plant that blooms once every 12 years in the Nilgiri hills.
C (*Madhuca indica*) matches iv because the Mahua tree is a prominent and culturally significant

species found throughout the deciduous forests of Central India.
D (*Rhododendron pendulum*) matches i because this epiphytic Rhododendron species is found in the high-altitude temperate forests of the Eastern Himalayas.

Question ID: 209355386
The table below lists taxonomic groups (Column X) and their morphological features (Column Y):

Column X	Column Y
A. Crustacea	i. Two pairs of antennae
B. Chelicerata	ii. Antennae absent
C. Phoronida	iii. Presence of lophophore

Which one of the following options represents all correct matches between Column X and Column Y?

1. A-ii, B-iii, C-i
2. A-iii, B-i, C-ii
3. A-i, B-iii, C-ii
4. A-i, B-ii, C-iii

Answer (4)
Explanation: This matches taxonomic groups with their defining anatomical traits.
A (Crustacea) matches i because crustaceans are unique among arthropods in possessing two pairs of antennae (antennules and antennae).
B (Chelicerata) matches ii because chelicerates, such as spiders, scorpions, and horseshoe crabs, are characterized by the complete absence of antennae.
C (Phoronida) matches iii because phoronids are "horseshoe worms" that possess a lophophore, a specialized ciliated feeding organ used for filter feeding.

Answer (3)
Explanation: This matches Indian flora with their specific ecological zones.
A (*Myristica fatua*) matches iii because it is a key species of the "Myristica swamps," which are rare freshwater swamp forests found in the Western Ghats.
B (*Strobilanthes kunthiana*) matches ii because this is the famous "Neelakurinji" plant that blooms once every 12 years in the Nilgiri hills.
C (*Madhuca indica*) matches iv because the Mahua tree is a prominent and culturally significant species found throughout the deciduous forests of Central India.
D (*Rhododendron pendulum*) matches i because this epiphytic Rhododendron species is found in the high-altitude temperate forests of the Eastern Himalayas.

Question ID: 209355387
A newly discovered small mammal from Madagascar lays eggs, has a cloaca, and shows electroreception through its snout. Molecular phylogenetics places it basal to all other living mammals. Based on these characters, which one of the following groups can it be assigned to?

1. Eutheria (placental mammals)
2. Metatheria (marsupials)
3. Prototheria (monotremes)
4. Theria (marsupials + placentals)

Answer (3)

Explanation: The presence of a cloaca (a single opening for digestive, urinary, and reproductive tracts), the laying of leathery eggs (oviparity), and the use of electroreception on the snout are all primitive characteristics unique to the **Prototheria** (monotremes), such as the platypus and echidna. Since molecular phylogenetics also places this mammal basal to all other living mammals (Therians), it must belong to the monotreme lineage.

Question ID: 209355388

Given below are mechanisms that can facilitate major evolutionary transitions, such as the transition from genes to genomes, from unicellular to multicellular organisms, or from individuals to colonies.

A. Conflict mediation mechanisms maintain cooperation within emergent units.

B. Reduced genetic relatedness among cooperating units accelerates these transitions.

C. Division of labour evolves when specialisation increases group-level fitness more than individual fitness losses.

D. Transitions are irreversible once higher-level individuality is achieved.

Which one of the following options is a combination of all correct statements?

1. B and C
2. A, C, and D
3. A and C only
4. C and D only

Answer (3)

Explanation: Statement A is correct because the transition to higher levels of organization (e.g., multicellularity) requires mechanisms to suppress "cheating" by individual units to ensure group stability.

Statement B is incorrect because **high** genetic relatedness (not reduced) is typically required to facilitate these transitions, as it aligns the fitness interests of the cooperating units.

Statement C is correct because the division of labor allows for increased efficiency and group-level fitness, which is a hallmark of major transitions like eusociality or multicellularity.

Statement D is incorrect. While transitions typically lead to a high degree of integration where lower-level units lose their original autonomy, they may not be strictly irreversible in all cases or contexts. Some organisms have complex life cycles that switch between unicellular and multicellular stages (e.g., slime molds), showing some level of reversibility or conditional expression of multicellularity. The *achievement* of higher-level individuality implies strong integration, but the statement as an absolute "irreversible" principle is not universally correct across all potential scenarios or definitions of "irreversibility.

Question ID: 209355389

Rhododendron arboreum of the family Ericaceae represents one of the ancient tree species of the genus showing extreme disjunction in the Indian subcontinent. It is represented by two sub-species viz., ssp. *arboreum* Smith in the forests of north-eastern India (temperate) and spp. *nilagiricum* distributed in the southern Western Ghats (tropical) of India with no distribution in the intervening plains.

The following are some of the biogeographical theories that explain distribution of flora and fauna in the Indian subcontinent:

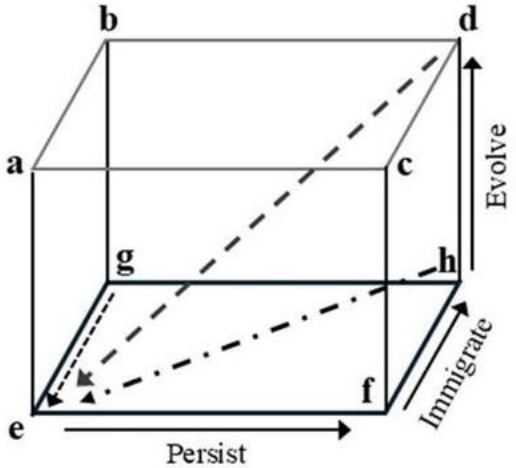
A. Island biogeography theory - The mountains function as isolated islands, promoting

speciation.
B. Satpura Hypothesis - Species migrated between the Himalayas and the Western Ghats along a cooler, wetter corridor formed by the Satpura mountain range during periods of glacial expansion.
C. The Noah's Ark hypothesis/ 'Out of India' hypothesis - the Indian subcontinent is a remnant of the ancient supercontinent Gondwana, that acted as an isolated "ark" for millions of years, giving rise to some modern plant and mammalian groups.
Which one of the combinations of biogeographical models explain the distribution of *R. arboreum*?

1. A and C only
2. A, B and C
3. A and B only
4. B and C only

Answer (3)
Explanation: Statement A is correct because the "Island Biogeography" theory can be applied to "sky islands" or mountain peaks where temperate species like *Rhododendron* are isolated by a "sea" of tropical lowlands.
Statement B is correct because the "Satpura Hypothesis" specifically proposes that the Satpura and Vindhya ranges served as a corridor for the migration of Himalayan flora and fauna to the Western Ghats during cooler Pleistocene climates.
Statement C is incorrect in this context because the "Out of India" hypothesis explains the Gondwanan origin of taxa that moved from the Indian plate to Asia, but it does not directly explain the specific disjunct Himalayan-Western Ghats distribution of a single species like *R. arboreum*.

Question ID: 209355390
The taxon cycle is the predicted, progressive ecological and evolutionary changes in the descendants of founding populations. Taking the case of insular biotas, the figure below can be used to conceptualize and predict species types (a, b, c, d, e, f, g, h) in insular biotas based on fundamental capacities to evolve, immigrate and persist.



The table below has species types (Column X) and the possible traits (Column Y) associated with each type.

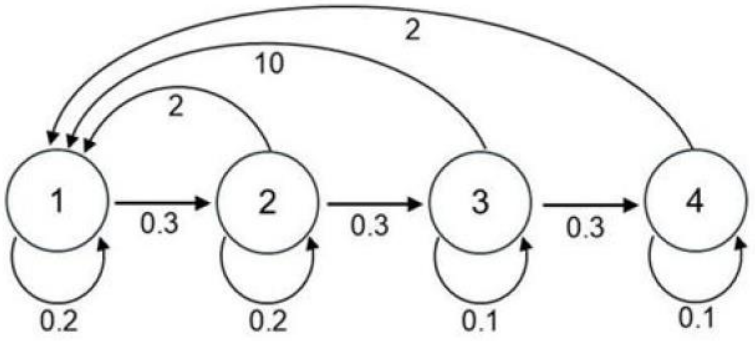
Column X		Column Y
P.	**c**	**i.** Ecologically naïve species, and endemics near the end of the taxon cycle (e.g., dwarfed elephants)
Q.	**d**	**ii.** An unlikely type, because the ability to evolve on isolated islands requires relatively long persistence
R.	**e**	**iii.** Limited dispersal abilities; unlikely to inhabit isolated oceanic islands
S.	**b**	**iv.** Supertramps, powerful dispersers such as microsnails, ferns, and rafting rodents

Which one of the following options represents all correct matches between Column X and Column Y?

1. P (i) Q (ii) R (iii) S (iv)
2. P (iv) Q (i) R (ii) S (iii)
3. P (ii) Q (iii) R (iv) S (i)
4. P (iii) Q (iv) R (i) S (ii)

Question ID: 209355391

The figure below shows a life cycle graph and the corresponding population projection matrix that is invariant over time for a population with four successive classes (1-4). All contributions to class 1 from other classes is via fecundity.



$$\begin{bmatrix} 0.2 & 2 & 10 & 2 \\ 0.3 & 0.2 & 0 & 0 \\ 0 & 0.3 & 0.1 & 0 \\ 0 & 0 & 0.3 & 0.1 \end{bmatrix}$$

Given this life cycle, no resource limitation, and initial numbers of individuals $n_1 = 95$, $n_2 = 5$, $n_3 = 15$, and $n_4 = 4$ in the four classes, consider the following statements regarding the future population states in a long-term simulation of population growth:

A. The population will grow and attain a stable class distribution.

B. The population will grow but the number of individuals in each class will be proportional to the initial numbers.

C. The population will grow but numbers of individuals in the classes will fluctuate disproportionately over time.

D. The population will grow at a fixed growth rate and all classes will grow at the same rates.

Which one of the following options represents a combination of all correct outcomes?

1. A and D

2. A and C
3. B and D
4. B and C

Answer (1)
Explanation: This question addresses the properties of the Leslie Matrix and population projections.
Statement A is correct because any population projection matrix that is primitive and irreducible (which this one is, given all classes eventually contribute to fecundity) will converge to a **stable age/class distribution** and a stable growth rate regardless of the initial population vector.
Statement B is incorrect because initial proportions are "washed out" as the population reaches its stable distribution determined by the matrix's dominant eigenvector.
Statement C is incorrect because while fluctuations occur initially, the population eventually smooths out into a fixed growth pattern.
Statement D is correct because, once the stable distribution is reached, the entire population grows at a fixed rate (, the dominant eigenvalue), and all individual classes grow at that same rate.

Question ID: 209355392
Nitrogen cycling is a critical ecosystem process. The table below lists the names of the processes (Column X) and nature of the reactions (Column Y) in the nitrogen cycle.

Column X	Column Y
A. Ammonification	**i. Conversion of N2 to NH3**
B. Nitrogen fixation	**ii. Hydrolysis of protein and oxidation of amino acids**
C. Nitrification	**iii. Reduction of NO3- to N2O and N2**
D. Denitrification	**iv. Oxidation of NH3 to NO2- and from NO2- to NO3-**

Which one of the following options represents all correct matches between Column X and Column Y?
1. A (i); B (ii); C (iv); D (iii)
2. A (ii); B (i); C (iv); D (iii)
3. A (iv); B (i); C (iii); D (ii)
4. A (ii); B (iv); C (iii); D (i)

Explanation: This matches the biological processes of the nitrogen cycle with their chemical definitions.
Answer (2)
A. Ammonification matches ii because it is the process where organic nitrogen (from proteins and amino acids) is converted into inorganic ammonia/ammonium through hydrolysis and oxidation.
B. Nitrogen fixation matches i because it is the specific conversion of atmospheric gas into ammonia by specialized diazotrophs.
C. Nitrification matches iv because it involves the two-step aerobic oxidation of ammonia to nitrite and then to nitrate.

D. Denitrification matches iii because it is the anaerobic reduction of nitrates back into gaseous nitrous oxide and finally dinitrogen.

Question ID: 209355393

The table below gives life history characteristics of an endangered grassland bird in two geographically distinct populations. Assume that the species follows a logistic growth model, calculate the population growth rate (dN/dt) for both populations.

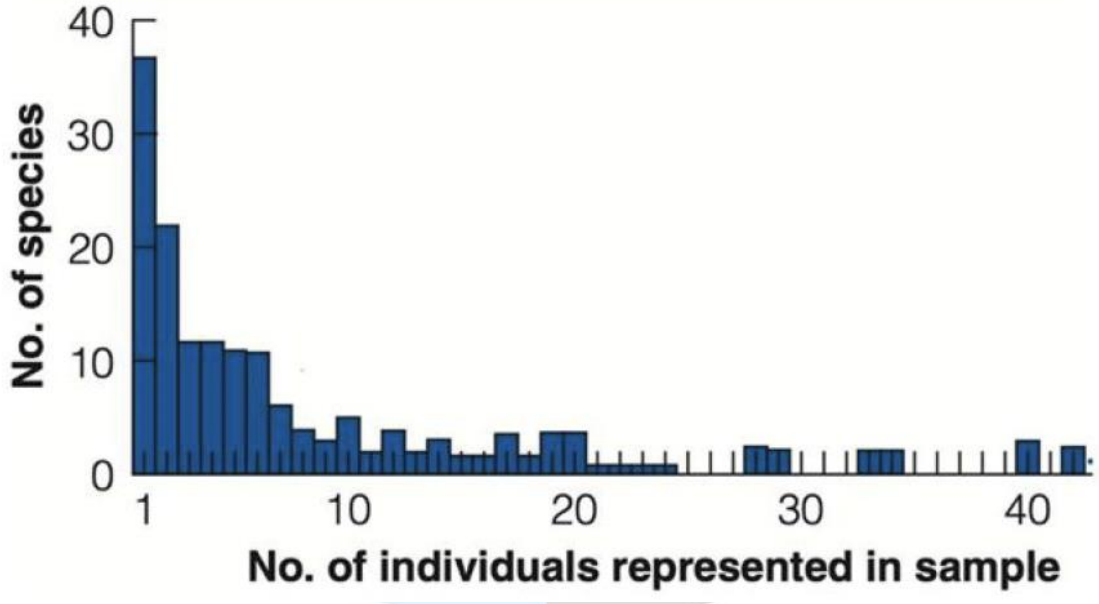
Population	No. of individuals (N)	births/year (B)	deaths/year (D)	Carrying capacity (K)
Rajasthan (R)	120	42	6	240
Maharashtra (M)	300	96	6	375

Based on this data, which one of the following options gives the combination of correct inferences that can be drawn about the growth rate in both populations?

1. Both populations are growing AND $(dN/dt)_M > (dN/dt)_R$
2. Both populations are declining AND $(dN/dt)_M < (dN/dt)_R$
3. Both populations are growing AND $(dN/dt)_R = (dN/dt)_M$
4. Both populations are declining AND $(dN/dt)_M > (dN/dt)_R$

Question ID: 209355394

In a systematic ecological survey of lepidopterans in a moist deciduous forest, a total of 197 species were recorded with 6814 individuals. The relative abundance data are presented below.



Keeping the above pattern in mind, which one of the statements below is correct?

1. Most species are common and are represented by a large number of individuals.
2. Most species are rare and few species are common, represented by a large number of individuals.
3. Most species are common and few species are rare, represented by few individuals.
4. Common and rare species are evenly present, with an equal representation of individuals.

Answer (2)

Explanation: The data shows 197 species and 6814 individuals. In a typical deciduous forest ecological survey, the distribution of relative abundance usually follows a log-series or log-normal distribution. This means that a **vast majority of the species are rare** (represented by only one or a few individuals, often called "singletons"), while only a **very small number of "dominant" species are common** and account for the bulk of the total individual count (6814).

Question ID: 209355395

Most vascular plants face two broad challenges that affect their growth, reproduction and evolutionary success. One major challenge (Stress) includes shortages of resources such as light, water, nutrients or other physicochemical limitations. A second major challenge (Disturbance) includes factors such as grazing, diseases, storms, frost, erosion, and fire. When cross tabulated, we get the following table:

Intensity of Disturbance	Intensity of Stress	
	Low	High
Low	I	III
High	II	IV

The outcome of this cross tabulation can be seen as fundamental life history strategies. Based on the above information, which one of the following statements is correct?

1. Conditions of low stress and low disturbance, result in a strategy that aims to maximize competitiveness and results in plants with small biomass, rapid reproduction and are short-lived.
2. Conditions of high stress and low disturbance result in plants that are slow growing, attaining low- to medium-biomass, with low reproductive output and are long-lived.
3. Conditions of low stress and high disturbance results in plants that are robust in terms of biomass, with low growth rates and slow reproduction.
4. Conditions of high stress and high disturbance results in small plants that can rapidly grow, have high reproductive output and are long-lived.

Answer (2)

Explanation: This relates to J.P. Grime's C-S-R (Competitor, Stress-tolerator, Ruderal) triangle theory for plant strategies.

Statement 1 is incorrect because low stress/low disturbance plants are "Competitors" which maximize biomass, not "small" plants.

Statement 2 is correct because "Stress-tolerators" (high stress, low disturbance) are adapted to endure resource shortages; they grow slowly, have long-lived tissues (like evergreen needles), and produce few seeds.

Statement 3 is incorrect because low stress/high disturbance defines "Ruderals," which have high growth rates and rapid reproduction (weeds).

Statement 4 is incorrect because high stress/high disturbance is a habitat where no viable plant strategy can persist, as individuals are destroyed before they can reproduce under harsh conditions.

Question ID: 209355396

The table below gives different eras (Column X) and periods of the geological time scale (Column Y):

Column X		Column Y	
A.	Ordovician	i.	Mesozoic
B.	Permian	ii.	Cenozoic
C.	Paleogene	iii.	Paleozoic
D.	Cretaceous		

Which one of the following options represents all correct matches of Column X and Column Y?

1. A-i; B-ii; C-iii; D-ii
2. A-iii; B-iii; C-ii; D-i
3. A-ii; B-i; C-iii; D-iii
4. A-ii; B-iii; C-i; D-i

Answer (3)

Explanation: This matches geological eras with their respective periods.
i Mesozoic matches because the Cretaceous (D) is the final period of the Mesozoic Era (the age of dinosaurs).
ii. Cenozoic) matches with the Paleogene (C) is the beginning of the Cenozoic Era (the age of mammals).
iii. Paleozoic matches A and B because the Ordovician and Permian are both periods within the Paleozoic Era.

Question ID: 209355397

In a polluted aquatic environment, bacteria are chronically exposed to low concentrations of multiple antibiotics released from pharmaceutical effluents. Over time, resistant colonies appear even when the antibiotic concentration remains constant. To determine whether resistance arises through induced mutation (a physiological response to antibiotics) or random mutation followed by selection, an ecologist performs a fluctuation test similar to that of Luria and Delbrück (1943) using replicate bacterial cultures.
Which one of the following outcomes would best support the conclusion that antibiotic resistance arises by random mutation followed by selection, rather than by induction?

1. Each replicate culture yields nearly the same number of resistant colonies after exposure to the antibiotic.
2. Different replicate cultures show large fluctuations in the number of resistant colonies, even though each was treated identically.
3. Resistant colonies appear only after antibiotic addition.
4. The number of resistant colonies increases predictably and proportionally with exposure time in every replicate culture.

Answer (2)

Explanation: The Luria-Delbrück fluctuation test distinguishes between "adaptation" and "mutation." If resistance were an **induced physiological response**, every culture would show a similar, low number of resistant colonies because the probability of "adapting" would be the same. However, if resistance is due to **random mutation**, mutations occurring early in the growth of some cultures will lead to a huge number of resistant descendants ("jackpots"), while other cultures will have very few. Thus, **large fluctuations** (high variance) between replicate cultures prove mutations are random and pre-exist the antibiotic.

Question ID: 209355398

In a monogamous haplodiploid social insect colony, sterile workers assist the queen in producing additional sisters instead of reproducing themselves. According to Hamilton's rule, altruistic behaviour is favoured when the genetic benefit to relatives (weighted by coefficient of relatedness, r) exceeds the cost, 'c' to the actor. If a worker helps the queen raise three daughters instead of producing two of her own, then based on Hamilton's rule, will helping behaviour evolve?

[assume, genetic unit, which is the number of offsprings weighted by r as a measure of inclusive fitness]

1. Yes, because rb = 2.25 genetic units and c = 1 genetic unit
2. No, because rb = 0.375 genetic units and c = 1 genetic unit
3. Yes, but only if r < 0.1 indicating weaker kin selection.
4. No, because kin selection cannot operate in haplodiploid species.

Answer (1)

Concept: Hamilton's Rule states $rb > c$. In haplodiploids, sisters are related by $r = 0.75$, while daughters are related to their mother by $r = 0.5$.

Formula: Benefit (rb) = (Number of extra relatives) × (Relatedness to them).

$\text{Cost}(c)$ = (Number of offspring lost) × (Relatedness to own offspring).

Solution: Benefit of helping: 3 sisters × $0.75 = 2.25$ genetic units.

Cost of not reproducing: 2 daughters × $0.5 = 1.0$ genetic unit.

Since $2.25 > 1.0$, the benefit (rb) outweighs the cost (c), and the altruistic helping behavior is favored to evolve.

Question ID: 209355399

Q.77 A certain trait in a species is governed by variation at the AB locus that has two alleles (A, B) that give rise to three genotypes, AA, AB and BB. A sample of 1000 individuals of the species were genotyped:

Genotype	Number of individuals
AA	400
AB	400
BB	200

Assume that each genotype is represented equally in males and females and mating is random. If the parents were randomly drawn from the sample of 1000 individuals given above, which one of the following options gives all correct values of the offspring genotype frequencies?

1. AA: 0.4; AB: 0.4; BB: 0.2
2. AA: 0.6; AB: 0.2; BB: 0.2
3. AA: 0.16; AB: 0.16; BB: 0.04
4. AA: 0.36; AB: 0.48; BB: 0.16

Answer (4)

Under random mating, offspring frequencies are determined by the allele frequencies (p and q) of the parent population, following the Hardy-Weinberg equilibrium proportions $(p^2, 2pq, q^2)$.
Formula: $p = \text{Freq}(A) = [\text{AA} + 0.5(\text{AB})]/$ Total.
$q = \text{Freq}(B) = 1 - p.$
Solution: $p = \frac{[400+0.5(400)]}{1000} = \frac{600}{1000} = 0.6.$
$q = 1 - 0.6 = 0.4.$
Offspring $\text{AA} = p^2 = 0.6 \times 0.6 = 0.36.$
Offspring $\text{AB} = 2pq = 2 \times 0.6 \times 0.4 = 0.48.$
Offspring $\text{BB} = q^2 = 0.4 \times 0.4 = 0.16.$

Question ID: *209355400*
The table below lists **conditions** (Column X) and their **evolutionary/behavioural outcome** (Column Y).

Column X	Column Y
A. Cooperative breeding mediated by kin selection without physiological suppression of reproduction	**i. Eusocial species such as naked mole rats**
B. Hormonal reproductive suppression in nonbreeding females mediated by aggression	**ii. High paternity certainty, low risk of cuckoldry**
C. Biparental care	**iii. Delayed dispersal and breeding of offspring such as in social birds**

Which one of the options below is a correct match between all terms of Column X and Column Y?

1. A-ii; B-i; C-iii
2. A-i; B-ii; C-iii
3. A-ii; B-iii; C-i
4. A-iii; B-i; C-ii

Answer (4)
Explanation: This matches reproductive strategies with their biological examples.
A (Cooperative breeding without suppression) matches iii because social birds like scrub jays often have offspring that delay their own dispersal to help parents, driven by kin selection.
B (Hormonal suppression via aggression) matches i because in naked mole rat colonies, the queen uses physical aggression to hormonally suppress the reproductive cycles of non-breeding "worker" females.
C (Biparental care) matches ii because biparental care is strongly associated with high paternity certainty; males are unlikely to invest heavily in offspring if there is a high risk of cuckoldry.

Question ID: 209355401
Which one of the following statements about evolution of the vertebrate brain is most accurate?

1. The relative size of the neocortex in primates is primarily determined by the absolute size of the brain and not by social or ecological pressures.

2. Increased brain size in birds and mammals is always accompanied by longer lifespans and slower reproductive rates, without exceptions.
3. Brain regions can evolve independently in response to specific ecological or behavioural demands, rather than all regions scaling uniformly with overall brain size.
4. The cerebellum, involved in motor coordination, has remained largely unchanged throughout vertebrate evolution because motor function is highly conserved.

Answer (3)

Explanation: This question addresses Mosaic Evolution in the vertebrate brain.

- The most accurate statement is that brain regions can evolve independently in response to specific ecological or behavioral demands.
- This "mosaic" pattern allows specialized areas, like the olfactory bulb in dogs or the hippocampus in food-caching birds, to enlarge significantly without requiring the entire brain to scale up uniformly.
- Statements 1 and 2 are too restrictive or ignore documented exceptions, while Statement 4 is incorrect because the cerebellum has expanded greatly in lineages with complex motor skills, such as birds and primates.

Question ID: 209355402

The following statements are made regarding colchicine treatment in plants for inducing polyploidy:

A. In colchicine-treated cells, sister chromatids cannot separate during anaphase, leading to chromosome doubling when the nucleus reforms.

B. Colchicine stimulates endoreduplication in the treated cells, bypassing cytokinesis to yield polyploid cells in a process called "C-mitosis".

C. In sterile interspecific hybrids, colchicine treatment may restore fertility by converting them into amphipolyploids.

D. Colchicine treatment during meiosis has no effect, as it only acts on mitotic cells.

E. Colchicine binds to tubulin and prevents spindle fibre formation during mitosis.

Which one of the following options represents a combination of all correct statements?

1. A, C and E only
2. B and C only
3. A, B, C and E
4. A, B, D and E

Answer (1)

Explanation: This question evaluates the mechanism and applications of colchicine.

- Statement A is correct because colchicine prevents sister chromatid separation by interfering with the spindle, leading to a single nucleus with double the chromosomes.
- Statement C is correct because colchicine is widely used to double the chromosomes of sterile hybrids, providing each chromosome with a homologous partner for pairing during meiosis, thus restoring fertility.
- Statement E is correct because the primary biochemical action of colchicine is binding to tubulin subunits, which prevents their assembly into the spindle fibers necessary for cell division.

- Statements B and D are incorrect; colchicine causes "C-mitosis" by spindle inhibition, not by stimulating endoreduplication, and it can affect meiosis by disrupting meiotic spindles.

Question ID: 209355403

The following statements are made regarding bioremediation and phytoremediation.
A. Phytovolatilization can reduce soil contamination but may create secondary pollution in the atmosphere.
B. In rhizofiltration, plants are effective only if their roots are exposed to contaminated soil.
C. Phytostabilization reduces contaminant mobility, but the total pollutant load in the soil remains unchanged.
D. Bioventing involves the injection of air or oxygen into soil to stimulate aerobic microbial degradation.
E. During in situ bioaugmentation, the remediation is achieved by physically removing contaminated soil for off-site treatment and replacing it with decontaminated soil.
Which one of the following options represents a combination of all INCORRECT statements?

1. B and E only
2. B, C and E
3. A, C and D
4. A and D only

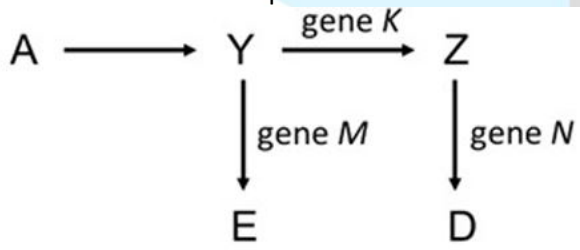
Answer (1)

Explanation: This question asks for the combination of INCORRECT statements regarding remediation.

- Statement B is incorrect because rhizofiltration involves the use of plant roots to absorb or precipitate pollutants specifically from **aqueous solutions** or contaminated wastewater, not just soil.
- Statement E is incorrect because in situ bioaugmentation involves the addition of specialized microbes to the **original site** of contamination; physically removing soil for off-site treatment is defined as *ex situ* remediation.
- Statements A, C, and D correctly describe phytovolatilization, phytostabilization, and bioventing respectively.

209355404

Researchers attempted genetic manipulation of the metabolic pathway shown below for enhanced production of "D". However, increased expression of gene "N" did not result in increased production of "D" in any transgenic line. Levels of "E" were similar in transgenic as well as untransformed plants.



The following hypotheses were proposed for explaining the observed results:
A. Feedback inhibition of "N" by "D" B. Epistasis of gene N over gene M C. Substrate limitation

for "N" D. Feedback inhibition of "M" by "E" Which one of the following options lists all factors that, either independently or in combination, could explain the above results?

1. A and B
2. A and C
3. C and D
4. B and D

Answer (2)

Explanation: This problem analyzes a metabolic block in a transgenic pathway (A B C D, and E as a byproduct).

- Hypothesis A is likely because if the end-product "D" inhibits the enzyme produced by gene "N," increasing the expression of "N" will not result in more "D" once the inhibition threshold is reached.
- Hypothesis C is likely because if the supply of the precursor (substrate for enzyme N) is limited by a bottleneck earlier in the pathway, overexpressing "N" will have no effect because there is no extra substrate to process.
- Hypothesis D is unlikely to explain why "E" levels remained the same while "D" didn't increase.

Question ID: 209355405

A B6 mouse (H-2^b haplotype) was crossed with a CBA mouse (H-2^k haplotype) to generate F1 progeny.

The following skin transplant experiments were then performed:

A. Graft from B6 mouse to CBA mouse
B. Graft from F1 mouse to B6 parent
C. Graft from F1 mouse to CBA parent
D. Graft from F1 mouse to F1 mouse
E. Graft from B6 mouse to F1 mouse

Which one of the following options represents all recipients in which the graft is tolerated?

1. A
2. B and C
3. D
4. D and E

Answer (4)

Explanation: This question applies the laws of transplantation in MHC immunology.

- F1 progeny () express all MHC alleles from both the B6 () and CBA () parents.
- Experiment D is tolerated because the donor and recipient are genetically identical (syngeneic).
- Experiment E is tolerated because the recipient (F1) already possesses the haplotype from the B6 donor; the immune system does not recognize "self" antigens as foreign.
- Experiments A, B, and C lead to rejection because the recipients do not possess the specific foreign MHC alleles present in the grafts.

Question ID: 209355406

The following statements describe some of the features of Quartz Crystal Microbalance (QCM) biosensors:

A. A QCM biosensor is built with thin disc-shaped piezoelectric material which is connected to metal electrodes on the opposite faces.

B. If an AC voltage is applied on the quartz crystal, it produces an oscillation at a stable resonant frequency which is not determined by the applied AC voltage.

C. The surface of the quartz crystal is functionalized with a specific receptor that can bind to the target analyte.

D. As the mass on the surface of the crystal is increased, the resonant frequency of crystal increases in a predictable, quantitative way following Sauerbrey equation.

Which one of the following options represents a combination of all correct statements?

1. A, B and C
2. B, C and D
3. B and D only
4. A and C only

Answer (1)

Explanation: This question covers the fundamental principles of QCM biosensors.

- Statement A is correct because the core of a QCM is a thin piezoelectric quartz disc with electrodes on both sides.
- Statement B is correct because the resonant frequency is a characteristic property of the crystal's physical dimensions and mass, not the magnitude of the applied voltage.
- Statement C is correct because biosensing requires the crystal surface to be modified with specific ligands (antibodies, DNA, etc.) to capture the analyte.
- Statement D is incorrect because the Sauerbrey equation states that an increase in mass results in a **decrease** in resonant frequency.

Question ID: 209355407

In standard or batch cultures, cells are grown in a fixed volume of medium. As they grow, nutrients are consumed and metabolites accumulate. Eventually, cultures may stop growing because of nutrient depletion and accumulation of toxic products. The following procedures may prolong the life of batch cultures:

A. Gradual addition of fresh medium and increasing volume of the culture

B. Replacing a constant fraction with an equal volume of fresh medium

C. Occasional removal of used medium and reducing growth factors in the medium

D. Intermittently adding serum and growth factors to the medium

Which one of the following combinations will ensure healthy growth of cells in culture?

1. A and B
2. B and C
3. C and D
4. A and D

Question ID: 209355408

Some features of Transcranial Direct Current Stimulation (tDCS) are stated below:

A. The membrane potential of neurons is modulated by applying a weak electrical current between two electrodes placed on the scalp.

B. Neurons under the anode become depolarized, and neurons under the cathode become hyperpolarized during tDCS.

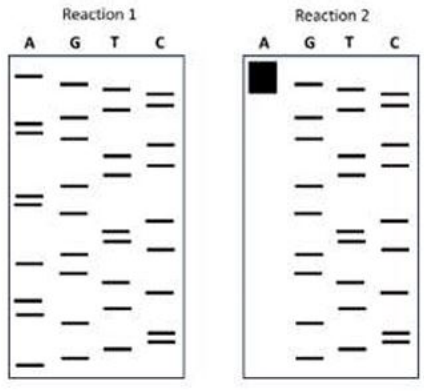
C. tDCS can disrupt neuronal activity and create a "virtual lesion" via anodal stimulation.
D. Neuronal activity is decreased in regions below the anode and increased in regions below the cathode.
Which one of the following options represents the combination of all correct statements?

1. A, B and C
2. B, C and D
3. C and D only
4. A and B only

Answer (4)
Explanation: This question addresses the electrophysiology of tDCS.

- Statement A is correct because tDCS uses a low, constant electrical current (usually 1-2 mA) to modulate the resting membrane potential of cortical neurons.
- Statement B is correct because anodal stimulation typically increases excitability (depolarization), while cathodal stimulation typically decreases excitability (hyperpolarization).
- Statement C is incorrect because creating a "virtual lesion" (disrupting function) is the hallmark of **Transcranial Magnetic Stimulation (TMS)**, not anodal tDCS which usually enhances activity.
- Statement D is incorrect because it reverses the known effects of the anode and cathode.

209355409
Two **Sanger sequencing** reactions were carried out using the same DNA template and primer. The sequencing gels are shown below:



Lane A of the reaction 2 gel shows the absence of lower bands and accumulation of higher bands (represented by a black thick band). The following reasons are predicted:
A. The template DNA does not contain the base A near its 5'-region.
B. The processivity of the Sequenase enzyme is very high.
C. In the second reaction, the concentration of ddATP is very low.
D. In the second reaction, the concentration of ddTTP is very high.
Which one of the following options represents the correct reason(s)?

1. A, B, and D
2. B and C
3. D only
4. C only

Answer (4)

Explanation: This analyzes the effect of chain terminators (ddNTPs) in Sanger sequencing.

- The absence of lower (smaller) bands and the heavy accumulation of large bands at the top of the gel means the polymerase rarely incorporated a terminator (ddATP) early in the sequence.
- This occurs specifically when the concentration of ddATP is very low (Reason C); the enzyme continues to add normal dATPs for a long time before eventually incorporating a rare ddATP.
- High concentrations of ddNTPs (Reason D) would have the opposite effect: causing many early terminations and a heavy accumulation of small bands at the bottom.

Question ID: 209355410

Dynamic Light Scattering measurements of a protein encapsulated inside AOT/isooctane reverse micelles suspended in n-heptane at 10^0C show an average hydrodynamic diameter of 17 nm, while the empty micelles have an average diameter of 11 nm. Calculate the approximate hydrodynamic radius of the encapsulated protein, assuming spherical geometry of the protein and the reverse micelle and that the protein only occupies the aqueous core of the micelle

1. 8.60 nm
2. 7.60 nm
3. 3.00 nm
4. 6.60 nm