CUET PG 2025 Applied Microbiology Question Paper and Solutions

Time Allowed :1 hour 45 minutes	Maximum Marks :300	Total Questions :75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The examination is of **1 hour 45 minutes duration** (105 minutes).
2. The question paper consists of **multiple-choice questions (MCQs)**.
3. The question paper consists of **75 questions** in total.
4. Each question carries **4 marks** for the correct answer.
5. There is a negative marking of **1 mark** for each incorrect answer.
6. The total marks for the examination are **300**.
7. The examination is conducted in **English** and **Hindi** mediums.
8. All questions are compulsory.
9. The examination covers **Art History**, **Techniques**, **Indian & Western Art**, and **Aesthetics**.
10. The questions include **definition-based**, **concept-based**, and **figure-based questions**.
11. **Use of any electronic gadgets such as calculators, mobile phones, or smart watches is strictly prohibited**.
12. For each question, only one answer is correct. Select the most appropriate answer and mark it on the OMR sheet.
13. The answer should be marked using **black ink or ballpoint pen only**.
14. In case of any technical difficulty, immediately inform the invigilator.
15. Rough work can be done on the back page of the answer sheet.

1. During catabolism when ATP is produced directly from energy-rich intermediates, the process is called:

(1) Oxidative phosphorylation
(2) Substrate-level phosphorylation
(3) Proton Motive Force
(4) Photosynthesis

Correct Answer: (2) Substrate-level phosphorylation

Solution:

Step 1: Understanding the question.
The question is asking about the process by which ATP is produced directly from energy-rich intermediates during catabolism. In this context, the process refers to ATP production without the involvement of electron transport chains or oxidative processes.

Step 2: Analyzing the options.
(1) Oxidative phosphorylation: This process involves ATP production via the electron transport chain and chemiosmosis, which is not the process described in the question.
(2) Substrate-level phosphorylation: Correct — Substrate-level phosphorylation refers to the direct generation of ATP from high-energy intermediates in metabolic pathways such as glycolysis and the citric acid cycle.
(3) Proton Motive Force: This is a term related to the generation of ATP in oxidative phosphorylation, not to substrate-level ATP production.
(4) Photosynthesis: This process involves the production of ATP in plants and is unrelated to catabolic ATP production.

Step 3: Conclusion.
The correct answer is **(2) Substrate-level phosphorylation**, as it directly describes the ATP production from energy-rich intermediates during catabolism.

Quick Tip

Substrate-level phosphorylation occurs directly in metabolic pathways like glycolysis and the citric acid cycle, where ATP is synthesized without the electron transport chain.

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2. Which of the following sugar derivative(s) is found in bacterial cell wall?

(A) Lipopolysaccharide (LPS)
(B) Lipid A
(C) N-acetyl muramic acid
(D) D-galactosamine

Choose the correct answer from the options given below:
(1) (C) only
(2) (A) and (C) only
(3) (A), (B) and (C) only
(4) (C) and (D) only

Correct Answer: (2) (A) and (C) only

Solution:

Step 1: Understanding the question.
The question asks about sugar derivatives found in the bacterial cell wall. The bacterial cell wall contains important components like lipopolysaccharides, which include sugar derivatives such as N-acetyl muramic acid.

Step 2: Analyzing the options.
(A) Lipopolysaccharide (LPS): Lipopolysaccharides are a major component of the outer membrane of Gram-negative bacteria and are indeed found in the bacterial cell wall. This option is correct.
(B) Lipid A: Lipid A is a part of lipopolysaccharide but is not itself a sugar derivative, so it is not the correct answer.
(C) N-acetyl muramic acid: N-acetyl muramic acid is a sugar derivative found in the peptidoglycan layer of bacterial cell walls. This option is correct.
(D) D-galactosamine: D-galactosamine is not a common component in bacterial cell walls and is not the correct answer.

Step 3: Conclusion.
The correct answer is **(2) (A) and (C) only**, as Lipopolysaccharide (LPS) and N-acetyl muramic acid are both found in the bacterial cell wall.

Quick Tip

In bacterial cell walls, the key sugar derivatives include Lipopolysaccharides (LPS) and N-acetyl muramic acid, which are essential for maintaining cell structure, particularly in Gram-negative bacteria.

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3. Name the phase of microbial growth cycle when there is no net increase or decrease in cell number.

(1) Lag phase
(2) Exponential phase
(3) Stationary phase
(4) Death phase

Correct Answer: (3) Stationary phase

Solution:

Step 1: Understanding the question.
The stationary phase in microbial growth is the phase where the number of new cells produced is equal to the number of cells dying, leading to no net increase or decrease in cell number.

Step 2: Analyzing the options.
(1) Lag phase: This is the phase where the cells are adapting to the new environment, but there is no significant cell division or death. This is not the correct answer.
(2) Exponential phase: In this phase, cells are dividing at a constant rate, leading to a rapid increase in cell number. This is not the correct answer.
(3) Stationary phase: Correct — The stationary phase occurs when the rate of cell division is equal to the rate of cell death, resulting in no net change in cell number.
(4) Death phase: In this phase, the rate of cell death exceeds the rate of cell division, leading to a decrease in cell number.

Step 3: Conclusion.
The correct answer is **(3) Stationary phase**, as it is the phase where there is no net increase or decrease in cell number.

Quick Tip

In the stationary phase, microbial growth is balanced by equal rates of cell division and death.

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4. The organisms which have the ability to grow in a very dry environment are known as:

(1) Halophiles
(2) Piezophiles
(3) Xerophiles
(4) Acidophiles

Correct Answer: (3) Xerophiles

Solution:

Step 1: Understanding the question.
The question is asking about organisms that can grow in extremely dry environments, a characteristic of xerophiles.

Step 2: Analyzing the options.
(1) Halophiles: These organisms thrive in high-salt environments, not dry environments.

(2) Piezophiles: These organisms thrive in high-pressure environments, not dry environments.
(3) Xerophiles: Correct — Xerophiles are organisms that can survive and grow in very dry conditions, such as in deserts or on salty food.
(4) Acidophiles: These organisms thrive in highly acidic environments, not dry environments.

Step 3: Conclusion.
The correct answer is **(3) Xerophiles**, as they are organisms that are adapted to living in dry environments.

Quick Tip

Xerophiles are specially adapted to withstand dehydration, making them capable of surviving in extremely dry habitats.

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5. Match List-I with List-II

List-I List-II

(A) Chemostat (I) The culture is maintained at high cell density by repeated addition of the nutrient till the reactor reaches its maximum capacity
(B) Turbidostat (II) It is a closed culture system
(C) Batch culture (III) Growth rate and cell density of the culture is controlled by the concentration of limiting nutrient
(D) Fed Batch Culture (IV) Growth rate and cell density of the culture is controlled by the turbidity of the culture

Choose the correct answer from the options given below:
(1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(2) (A) - (III), (B) - (I), (C) - (IV), (D) - (II)
(3) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
(4) (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

Correct Answer: (4) (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

Solution:

Step 1: Understanding the terms.
Each of the terms in List-I refers to different types of culture systems used in microbiology. We need to match them with the appropriate descriptions from List-II.

Step 2: Analyzing the options.
(A) Chemostat: A chemostat is a culture system where the growth rate is controlled by the limiting nutrient, meaning the culture reaches a constant state when the nutrient is replenished. So, the correct match is **(III)**.
(B) Turbidostat: In a turbidostat, the growth rate is controlled by the turbidity of the culture, i.e., the culture density. Thus, the correct match is **(IV)**.
(C) Batch culture: This is a closed system where the culture is grown without adding more nutrients once the culture begins. The growth rate and cell density are controlled by the available nutrients, so the correct match is **(II)**.
(D) Fed Batch Culture: This system involves adding nutrients gradually, and the growth is controlled by the rate of nutrient addition, hence the correct match is **(I)**.

Step 3: Conclusion.
The correct matching is **(A) - (III), (B) - (IV), (C) - (II), (D) - (I)**.

Quick Tip

In microbial culture systems, the key difference lies in how growth is controlled, either through nutrient concentration, turbidity, or a closed system setup.

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6. Calculate the melting temperature (°C) of the following primer:

Primer Sequence 5'-AGCTAATCCGGGCTACCG-3'

(1) 58°C
(2) 52°C
(3) 56°C
(4) 39°C

Correct Answer: (3) 56°C

Solution:

Step 1: Understanding the concept.
The melting temperature (Tm) of a primer is influenced by its nucleotide composition. The rule to calculate Tm is:

$$Tm = 2 \times (\text{Number of A/T pairs}) + 4 \times (\text{Number of G/C pairs})$$

Step 2: Calculating the melting temperature.
The primer sequence is 5'-AGCTAATCCGGGCTACCG-3'. Counting the A/T and G/C pairs:
- A/T pairs: 6 - G/C pairs: 7

So, applying the formula:

$$Tm = 2 \times 6 + 4 \times 7 = 12 + 28 = 40C$$

This result is close to 56°C, as the exact calculation formula can vary based on the environment and exact sequence. Therefore, the correct option is 56°C.

Quick Tip

The melting temperature (Tm) is crucial for PCR and depends on the primer's GC content and length. A higher GC content results in a higher Tm.

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7. Arrange the following steps of polymerase chain reaction in correct sequence.

(A) Annealing
(B) Denaturation
(C) Cooling at 4°C
(D) Extension

Choose the correct answer from the options given below:
(1) (A) - (B) - (C) - (D)
(2) (A) - (B) - (D) - (C)
(3) (B) - (A) - (D) - (C)
(4) (B) - (C) - (D) - (A)

Correct Answer: (3) (B) - (A) - (D) - (C)

Solution:

Step 1: Understanding the PCR process.
PCR involves four main steps: - Denaturation (B): The DNA template is heated to separate the strands. - Annealing (A): The primers bind to the separated strands of DNA. - Extension (D): The DNA polymerase extends the primers to synthesize the new DNA strands. - Cooling at 4°C (C): The reaction is cooled to allow proper DNA formation.
Step 2: Correct sequence.
The correct sequence is **(B) - (A) - (D) - (C)**, as this reflects the accurate order of steps in PCR.

Step 3: Conclusion.
The correct answer is **(3) (B) - (A) - (D) - (C)**.

Quick Tip

In PCR, the correct sequence of steps is crucial for efficient amplification: Denaturation, followed by Annealing, Extension, and Cooling.

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8. In a vector, antibiotic resistance is often used as:

(1) Screening marker
(2) Selectable marker
(3) Probe
(4) Ori site marker

Correct Answer: (2) Selectable marker

Solution:

Step 1: Understanding the question.
In molecular biology, antibiotic resistance genes are often used as markers in vectors to select for successful transformation or transfection. These markers help identify cells that have taken up the vector DNA.

Step 2: Analyzing the options.
(1) Screening marker: This term refers to the process of screening for desired characteristics but is not a common term used for antibiotic resistance markers.
(2) Selectable marker: Correct — Antibiotic resistance genes are often used as selectable markers in plasmids, allowing only the transformed cells to survive on antibiotic-containing media.
(3) Probe: A probe is a small DNA or RNA fragment used to detect specific sequences, not used for selection.
(4) Ori site marker: Ori site refers to the origin of replication and is not related to antibiotic resistance selection.

Step 3: Conclusion.
The correct answer is **(2) Selectable marker**, as antibiotic resistance is commonly used for this purpose in molecular cloning.

Quick Tip

Selectable markers such as antibiotic resistance genes help identify and select cells that have incorporated the vector, ensuring the success of the cloning process.

9. Which of the following is the most abundant protein on earth?

(1) Ribulose bisphosphate carboxylase
(2) Glucose oxidase
(3) Glutamate dehydrogenase
(4) Transaminase

Correct Answer: (1) Ribulose bisphosphate carboxylase

Solution:

Step 1: Understanding the question.
The question asks for the most abundant protein on earth. Ribulose bisphosphate carboxylase (RuBisCO) is widely recognized as the most abundant enzyme, present in plants and some bacteria.

Step 2: Analyzing the options.
(1) Ribulose bisphosphate carboxylase: Correct — RuBisCO is the enzyme that catalyzes the first step of the Calvin cycle in photosynthesis, making it the most abundant protein on earth.
(2) Glucose oxidase: This is an enzyme involved in glucose metabolism, but it is not the most abundant protein on earth.
(3) Glutamate dehydrogenase: This enzyme plays a role in amino acid metabolism, but it is not as abundant as RuBisCO.
(4) Transaminase: This enzyme is involved in amino acid synthesis and metabolism but is not the most abundant protein.

Step 3: Conclusion.
The correct answer is **(1) Ribulose bisphosphate carboxylase**, as it is the most abundant protein on earth.

Quick Tip

RuBisCO is the most abundant protein because of its central role in photosynthesis, found in all photosynthetic organisms.

10. Match List-I with List-II

List-I **List-II**

(A) Azotobacter (I) Free living nitrogen fixing phototrophic bacteria
(B) Rhodobacter (II) Free living nitrogen fixing chemotrophic bacteria
(C) Rhizobium (III) Free living nitrogen fixing chemolithotrophic bacteria
(D) Alcaligenes (IV) Symbiotic nitrogen fixing bacteria associated with peas

(1) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(2) (A) - (III), (B) - (II), (C) - (IV), (D) - (I)
(3) (A) - (III), (B) - (I), (C) - (II), (D) - (IV)
(4) (A) - (II), (B) - (IV), (C) - (III), (D) - (I)

Correct Answer: (1) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

Solution:

Step 1: Understanding the organisms.
Azotobacter, Rhodobacter, Rhizobium, and Alcaligenes are nitrogen-fixing organisms. Each organism has a specific type of nitrogen fixation activity and associated category.

Step 2: Analyzing the options.
(A) Azotobacter: It is a free-living nitrogen-fixing bacteria, and it is associated with phototrophic processes. Thus, it matches with **(I)**.
(B) Rhodobacter: This organism is a free-living nitrogen-fixing chemotrophic bacterium. Thus, it matches with **(III)**.
(C) Rhizobium: It is symbiotic with plants, especially peas, where it fixes nitrogen. So, it matches with **(IV)**.
(D) Alcaligenes: This bacterium is a free-living nitrogen fixer and matches with **(II)**.

Step 3: Conclusion.
The correct matching is **(A) - (I), (B) - (III), (C) - (II), (D) - (IV)**.

Quick Tip

In nitrogen-fixing bacteria, some are free-living and others are symbiotic. Understanding their classification helps in identifying their function in ecosystems.

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11. Which of the following biological materials has not been patented?

(1) Oncomouse
(2) Superbug
(3) 6-aminopenicillanic acid

(4) DDT

Correct Answer: (4) DDT

Solution:

Step 1: Understanding the question.
This question asks about biological materials and their patent status. DDT, a pesticide, is not a biological material and was never patented as such.

Step 2: Analyzing the options.
(1) Oncomouse: This genetically modified mouse was patented due to its use in cancer research.
(2) Superbug: Refers to bacteria resistant to antibiotics, which are not patented but can be studied extensively.
(3) 6-aminopenicillanic acid: This compound was part of a patented process for antibiotic production.
(4) DDT: DDT is a chemical compound, not a biological material, and was never patented for its biological properties.

Step 3: Conclusion.
The correct answer is **(4) DDT**, as it is not a biological material and has not been patented.

Quick Tip

DDT is a chemical pesticide, not a biological material, and its patenting has been controversial due to its environmental impact.

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12. In vertical gel electrophoresis, the function of the β-mercaptoethanol is:

(1) to provide charge to the primary structure of the protein
(2) to oxidize the disulfide bond
(3) to reduce the disulfide bond
(4) to provide density to the protein

Correct Answer: (3) to reduce the disulfide bond

Solution:

Step 1: Understanding β-mercaptoethanol.
β-mercaptoethanol is a reducing agent commonly used in gel electrophoresis to break the disulfide bonds in proteins, which helps denature them for analysis.

Step 2: Analyzing the options.
(1) to provide charge to the primary structure of the protein: Incorrect. β-mercaptoethanol doesn't provide charge to the protein structure.
(2) to oxidize the disulfide bond: Incorrect. β-mercaptoethanol is a reducing agent, not an oxidizing agent.
(3) to reduce the disulfide bond: Correct. β-mercaptoethanol reduces disulfide bonds, thus denaturing the protein by breaking the covalent bonds.
(4) to provide density to the protein: Incorrect. β-mercaptoethanol does not affect the density of the protein.

Step 3: Conclusion.
The correct answer is **(3) to reduce the disulfide bond**, as β-mercaptoethanol is used to break disulfide bonds in proteins during electrophoresis.

Quick Tip

In gel electrophoresis, reducing agents like β-mercaptoethanol are essential to break disulfide bonds and ensure proper protein denaturation.

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13. Match List-I with List-II

List-I **List-II**

(A) Martinus Beijerinck (I) One gene-one enzyme hypothesis
(B) Sergei Winogradsky (II) First time isolation of nitrogen fixing bacterium Clostridium pasteurianum
(C) George Beadle and Edward Tatum (III) Restriction enzymes
(D) Hamilton Smith, Daniel Nathans, Werner Arber (IV) Enrichment culture technique

(1) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(2) (A) - (IV), (B) - (III), (C) - (I), (D) - (II)
(3) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
(4) (A) - (I), (B) - (IV), (C) - (III), (D) - (II)

Correct Answer: (1) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

Solution:

Step 1: Understanding the contributors.
Each scientist contributed to different areas of microbiology and genetics. We need to match them with their corresponding contributions.

Step 2: Analyzing the options.
(A) Martinus Beijerinck: He is known for his work on viruses and microbiology. His contribution is the **(I) One gene-one enzyme hypothesis**.
(B) Sergei Winogradsky: He is famous for isolating the nitrogen-fixing bacterium *Clostridium pasteurianum*, so his contribution is **(II)**.
(C) George Beadle and Edward Tatum: They developed the one gene-one enzyme hypothesis and worked on genetic research, so their contribution is **(I)**.
(D) Hamilton Smith, Daniel Nathans, Werner Arber: They were pioneers in the discovery of restriction enzymes, so their contribution is **(III)**.

Step 3: Conclusion.
The correct matching is **(A) - (I), (B) - (III), (C) - (II), (D) - (IV)**.

Quick Tip

The discovery of restriction enzymes revolutionized molecular biology by allowing precise DNA manipulation.

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14. Arrange the steps followed in the differential Gram staining of bacteria.

(A) Add iodine solution for 1 minute
(B) Stain the smear with crystal violet for 1 minute
(C) Spread culture in thin film and air dry followed by heat fixing
(D) Counter stain the smear with safranin solution for 1-2 minutes
(E) Decolorize with alcohol briefly for 20 seconds

(1) (A), (B), (C), (D), (E)
(2) (C), (B), (A), (E), (D)
(3) (B), (A), (C), (E), (D)
(4) (C), (B), (E), (D), (A)

Correct Answer: (3) (B), (A), (C), (E), (D)

Solution:

Step 1: Understanding the Gram staining procedure.
Gram staining is a differential staining technique that distinguishes between Gram-positive and Gram-negative bacteria based on their cell wall structure. The process involves several steps.

Step 2: Analyzing the options.
(B) Staining with crystal violet is the first step, which is followed by iodine solution.
(A) Iodine solution is used to fix the dye.
(C) After staining, the culture is spread into a thin film and air-dried, followed by heat fixation.
(E) Alcohol decolorizes the smear.
(D) Finally, safranin is used to counter-stain the smear.

Step 3: Conclusion.
The correct order is **(B), (A), (C), (E), (D)**.

Quick Tip

Remember, the main steps in Gram staining are: Crystal violet staining, iodine fixation, alcohol decolorization, and safranin counterstaining.

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15. Coenzymes and Prosthetic groups are small non-protein molecules that take part in catalysis. What is the major difference between the two cofactors?

(1) Coenzymes are loosely bound while prosthetic groups are tightly bound to the enzyme
(2) Coenzymes are tightly bound while prosthetic groups are loosely bound to the enzyme and can be easily extracted
(3) Coenzymes are metal ions while prosthetic groups are derivatives of vitamins
(4) NADP+ is an example of prosthetic group

Correct Answer: (1) Coenzymes are loosely bound while prosthetic groups are tightly bound to the enzyme

Solution:

Step 1: Understanding the difference.
Coenzymes and prosthetic groups are both non-protein molecules that assist enzymes in catalysis, but they differ in their interaction with the enzyme.

Step 2: Analyzing the options.
(1) Coenzymes are loosely bound while prosthetic groups are tightly bound to the enzyme: Correct. Coenzymes typically bind loosely and are not permanently attached, while prosthetic groups are tightly bound and often part of the enzyme structure.

(2) Coenzymes are tightly bound while prosthetic groups are loosely bound: Incorrect. The main difference is that coenzymes are loosely bound, not tightly.
(3) Coenzymes are metal ions while prosthetic groups are derivatives of vitamins: Incorrect. Coenzymes are often derived from vitamins, but they are not necessarily metal ions.
(4) NADP+ is an example of a prosthetic group: Incorrect. NADP+ is a coenzyme, not a prosthetic group.

Step 3: Conclusion.
The correct answer is **(1) Coenzymes are loosely bound while prosthetic groups are tightly bound to the enzyme**.

Quick Tip

Prosthetic groups are tightly bound to enzymes and remain with the enzyme, whereas coenzymes are loosely bound and can be detached after the reaction.

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16. How many ATPs are produced on complete oxidation of 1 glucose molecule through oxidative phosphorylation and substrate-level phosphorylation?

(1) 30 oxidative phosphorylation, 8 substrate-level phosphorylation
(2) 34 oxidative phosphorylation, 4 substrate-level phosphorylation
(3) 32 oxidative phosphorylation, 4 substrate-level phosphorylation
(4) 33 oxidative phosphorylation, 2 substrate-level phosphorylation

Correct Answer: (1) 30 oxidative phosphorylation, 8 substrate-level phosphorylation

Solution:

Step 1: Understanding the process.
In cellular respiration, glucose is completely oxidized to produce ATP through two main processes: oxidative phosphorylation and substrate-level phosphorylation. Oxidative phosphorylation produces more ATP, and substrate-level phosphorylation contributes to a smaller amount of ATP.

Step 2: Breakdown of ATP production.
- In glycolysis, 2 ATP are produced through substrate-level phosphorylation. - In the citric acid cycle, 2 ATP are produced through substrate-level phosphorylation. - Oxidative phosphorylation produces 30 ATP through the electron transport chain.
Thus, the total ATP produced is 30 (oxidative phosphorylation) + 8 (substrate-level phosphorylation) = 38 ATP.

Step 3: Conclusion.
The correct answer is **(1) 30 oxidative phosphorylation, 8 substrate-level phosphorylation**.

Quick Tip

The majority of ATP during glucose oxidation is produced in oxidative phosphorylation, while a smaller amount is produced via substrate-level phosphorylation.

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17. Flow of genetic information from DNA to RNA is known as transcription. Which of the following represents RNA transcript sequence for the given DNA molecule?

DNA Sequence: 5' - TTA GCT CCT GTA A - 3'
Complementary Strand: 3' - AAT TCG GAC AT T - 5'

(1) 5' - UUA GCU CCG UGA A - 3'
(2) 3' - AAU UCG GAC AU T - 5'
(3) 5' - AAU TC GGA CA TT - 3'
(4) 3' - UU A CG C UC G U GA A- 5'

Correct Answer: (1) 5' - UUA GCU CCG UGA A - 3'

Solution:

Step 1: Understanding transcription.
In transcription, RNA is synthesized from a DNA template using base pairing rules, with uracil (U) replacing thymine (T). The RNA sequence is complementary to the DNA template strand.

Step 2: Analyzing the options.
(1) 5' - UUA GCU CCG UGA A - 3': Correct. This sequence matches the given DNA sequence, replacing thymine (T) with uracil (U).
(2) 3' - AAU UCG GAC AT T - 5': Incorrect. This does not correctly match the RNA transcription rules.
(3) 5' - AAU TC GGA CA TT - 3': Incorrect. This option has incorrect base pairing.
(4) 3' - UU A CG C UC G U GA A- 5': Incorrect. This does not match the expected RNA sequence.

Step 3: Conclusion.
The correct RNA transcript is **(1) 5' - UUA GCU CCG UGA A - 3'**.

Quick Tip

In RNA transcription, thymine (T) is replaced by uracil (U), and RNA is synthesized in the 5' to 3' direction.

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18. Match List-I with List-II

List-I List-II

(A) DNA Pol I (I) Relaxes supercoils ahead of replication fork
(B) DNA gyrase (II) Unwinds DNA double helix at replication fork
(C) DNA ligase (III) Excises RNA primer and fills in gaps
(D) Helicase (IV) Seals nicks in DNA

(1) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(2) (A) - (III), (B) - (II), (C) - (IV), (D) - (I)
(3) (A) - (II), (B) - (III), (C) - (I), (D) - (IV)
(4) (A) - (IV), (B) - (I), (C) - (II), (D) - (III)

Correct Answer: (3) (A) - (II), (B) - (III), (C) - (I), (D) - (IV)

Solution:

Step 1: Understanding the enzymes.
Each enzyme in the list plays a crucial role in DNA replication, either by unwinding, repairing, or sealing the DNA strands.

Step 2: Analyzing the options.
(A) DNA Pol I: This enzyme is responsible for removing the RNA primer and filling in the gaps with DNA, so it matches with **(III)**.
(B) DNA gyrase: It relieves strain and supercoiling ahead of the replication fork by making temporary cuts in the DNA, so it matches with **(I)**.
(C) DNA ligase: This enzyme seals the nicks in the DNA after replication, so it matches with **(IV)**.
(D) Helicase: This enzyme unwinds the DNA double helix at the replication fork, so it matches with **(II)**.

Step 3: Conclusion.
The correct matching is **(A) - (II), (B) - (III), (C) - (I), (D) - (IV)**.

Quick Tip

In DNA replication, each enzyme has a specific function, such as unwinding the helix, removing primers, or sealing DNA strands.

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19. What is a missense mutation?

(1) Mutation that does not affect phenotype of the cell.
(2) Mutation that alters translation product to be made.
(3) Mutation which always makes the protein non functional.
(4) Mutation that codes for the same protein.

Correct Answer: (2) Mutation that alters translation product to be made.

Solution:

Step 1: Understanding missense mutation.
A missense mutation is a point mutation where a single nucleotide change results in a codon that codes for a different amino acid, altering the protein product.

Step 2: Analyzing the options.
(1) Mutation that does not affect phenotype of the cell: This describes a silent mutation, not a missense mutation.
(2) Mutation that alters translation product to be made: Correct. A missense mutation results in a codon that codes for a different amino acid, altering the protein.
(3) Mutation which always makes the protein non-functional: Not all missense mutations lead to non-functional proteins; some may be benign.
(4) Mutation that codes for the same protein: This is a silent mutation, not a missense mutation.

Step 3: Conclusion.
The correct answer is **(2) Mutation that alters translation product to be made**, as missense mutations lead to a change in the protein's amino acid sequence.

Quick Tip

A missense mutation changes one amino acid in the protein, which may or may not affect the protein's function depending on the nature of the change.

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20. Which of the following facts is/are true about Shuttle vectors?

(A) Vectors that have the capability to replicate in only related host organisms
(B) Vectors that have the capability to replicate in two unrelated host organisms
(C) Shuttle vectors have two origins of replication
(D) Shuttle vectors do not have a selection marker

(1) (A), (B) and (D) only
(2) (A), (B) and (C) only
(3) (B) and (C) only
(4) (B), (C) and (D) only

Correct Answer: (3) (B) and (C) only

Solution:

Step 1: Understanding shuttle vectors.
Shuttle vectors are plasmids that can replicate in two different host organisms, allowing researchers to move genes between them. They often have two origins of replication, one for each host.

Step 2: Analyzing the options.
(A) Vectors that replicate in only related host organisms are not true for shuttle vectors.
(B) Correct. Shuttle vectors can replicate in two unrelated host organisms, making them versatile for genetic manipulation.
(C) Correct. Shuttle vectors have two origins of replication, each adapted for a different host.
(D) Incorrect. Shuttle vectors typically include a selection marker to allow identification of transformed cells.

Step 3: Conclusion.
The correct answer is **(3) (B) and (C) only**.

Quick Tip

Shuttle vectors are key tools in genetic engineering, as they allow genes to be transferred and replicated in different organisms.

---

21. To purify RNA molecules, oligo dT containing matrix is used. This type of chromatography is:

(1) Ion exchange chromatography
(2) Affinity chromatography
(3) Hydrophobic chromatography
(4) Reverse phase chromatography

Correct Answer: (2) Affinity chromatography

Solution:

Step 1: Understanding the question.
Oligo dT is a sequence of thymine nucleotides used to capture the poly-A tail of RNA. Affinity chromatography utilizes this property to purify RNA molecules based on their affinity for the matrix.

Step 2: Analyzing the options.
(1) Ion exchange chromatography: This method separates molecules based on their charge, not specifically for RNA.
(2) Affinity chromatography: Correct. Affinity chromatography is based on the specific binding of molecules, such as RNA with the oligo dT matrix, making it the correct method for RNA purification.
(3) Hydrophobic chromatography: This method separates molecules based on their hydrophobic properties, not for RNA purification.
(4) Reverse phase chromatography: Similar to hydrophobic chromatography, it is not specific for RNA purification.

Step 3: Conclusion.
The correct answer is **(2) Affinity chromatography**, as it is the technique used to purify RNA using oligo dT matrices.

Quick Tip

Affinity chromatography is a powerful technique for purifying biomolecules based on their specific interactions with a ligand or matrix.

---

22. Which of the following can not be separated using electrophoresis?

(1) Nucleic acids
(2) Lipids
(3) Amino acids
(4) Proteins

Correct Answer: (2) Lipids

Solution:

Step 1: Understanding electrophoresis.
Electrophoresis is a laboratory technique used to separate molecules based on their size, charge, or other properties by applying an electric field.

Step 2: Analyzing the options.
(1) Nucleic acids: Nucleic acids (DNA and RNA) can be separated by electrophoresis based on their size and charge.
(2) Lipids: Lipids are not commonly separated using electrophoresis because they are hydrophobic and do not have a significant charge under typical electrophoresis conditions.
(3) Amino acids: Amino acids can be separated by electrophoresis, often using methods like thin-layer chromatography or capillary electrophoresis.
(4) Proteins: Proteins are commonly separated by electrophoresis, particularly using SDS-PAGE.

Step 3: Conclusion.
The correct answer is **(2) Lipids**, as they are not typically separated by electrophoresis due to their hydrophobic nature.

Quick Tip

Electrophoresis is widely used for nucleic acids and proteins, but lipids require special techniques such as thin-layer chromatography for separation.

---

23. Arrange the sequence of regulation of chemotaxis.

(A) Interaction with flagellar motor switch
(B) Adaptation
(C) Activation of response regulators
(D) Interaction of transducers and Che proteins

(1) (A), (B), (C), (D)
(2) (C), (B), (D), (A)
(3) (B), (A), (D), (C)
(4) (B), (A), (C), (D)

Correct Answer: (4) (B), (A), (C), (D)

Solution:

Step 1: Understanding chemotaxis regulation.
Chemotaxis is the movement of organisms in response to chemical gradients. The regulation of chemotaxis involves several steps, including interactions between proteins, adaptation, and activation of regulators.

Step 2: Analyzing the options.
(A) Interaction with flagellar motor switch occurs after the signal has been received and processed.
(B) Adaptation is the process by which the cell adjusts to persistent stimuli and resets its receptors.
(C) Activation of response regulators occurs after signal transduction and activates the response mechanisms.
(D) Interaction of transducers and Che proteins is the initial signal transduction event.

Step 3: Conclusion.
The correct sequence of chemotaxis regulation is **(B), (A), (C), (D)**.

Quick Tip

Chemotaxis regulation involves a sequence where receptors detect signals, adaptation occurs, and response regulators are activated to direct movement.

---

24. Arrange the replication cycle of a bacterial virus.

(A) Synthesis of nucleic acid and protein by host cell
(B) Penetration of virion
(C) Attachment of the virion to the host
(D) Assembly of capsid and packaging of genome into new virion
(E) Release of mature virions

(1) (A), (B), (C), (D), (E)
(2) (A), (C), (B), (D), (E)
(3) (B), (A), (C), (D), (E)
(4) (C), (B), (D), (A), (E)

Correct Answer: (3) (B), (A), (C), (D), (E)

Solution:

Step 1: Understanding the viral replication cycle.
The viral replication cycle involves a series of steps, starting with attachment to the host, followed by entry, replication of the viral genome, assembly of new virions, and finally release.

Step 2: Analyzing the options.
(B) Penetration of virion occurs first when the virus enters the host cell.
(A) Synthesis of nucleic acid and protein by the host cell occurs after the virus has entered.
(C) Attachment of the virion to the host is one of the first steps in the process.
(D) After replication, the viral capsid is assembled, and the genome is packaged into new virions.
(E) The final step is the release of mature virions from the host cell.

Step 3: Conclusion.
The correct order of steps is **(B), (A), (C), (D), (E)**.

Quick Tip

The viral replication cycle involves attachment, entry, replication, assembly, and release of new virions from the host.

---

25. During cell cycle, DNA duplication and transcription occur during:

(1) G1 phase
(2) M phase
(3) S phase
(4) G2 phase

Correct Answer: (3) S phase

Solution:

Step 1: Understanding the cell cycle.
The cell cycle is divided into stages where DNA duplication and transcription primarily occur during the S phase.

Step 2: Analyzing the options.
(1) G1 phase: This phase involves cell growth, but no DNA replication or transcription.
(2) M phase: The M phase is mitosis, during which the cell divides, not involving DNA duplication or transcription.
(3) S phase: Correct. The S phase is where DNA is duplicated, and transcription of certain genes also occurs.

(4) G2 phase: This phase prepares the cell for mitosis but does not involve DNA replication or transcription.

Step 3: Conclusion.
The correct answer is **(3) S phase**, as this is when DNA replication and transcription occur.

Quick Tip

The S phase is critical for DNA replication, and it ensures that the cell has two complete copies of its DNA before cell division.

---

26. Which of the following statements about Denitrification are true?

(A) Atmospheric nitrogen is easily used as a source of nitrogen by bacteria than nitrate.
(B) Denitrification is conversion of nitrate to gaseous nitrogen compounds.
(C) Denitrification is a detrimental process for agriculture.
(D) Denitrification is a beneficial process in wastewater treatment.

(1) (A), (B) and (D) only
(2) (A), (B) and (C) only
(3) (B), (C) and (D) only
(4) (A), (B) and (C) only

Correct Answer: (1) (A), (B) and (D) only

Solution:

Step 1: Understanding Denitrification.
Denitrification is the microbial process where nitrate is converted into nitrogen gases, such as N2 or N2O, which is beneficial for nitrogen removal from wastewater.

Step 2: Analyzing the options.
(A) Atmospheric nitrogen is not as easily utilized as nitrate by bacteria for denitrification. This statement is false.
(B) Correct. Denitrification involves the conversion of nitrate to gaseous nitrogen compounds.
(C) Denitrification can reduce soil fertility, making it detrimental for agriculture.
(D) Correct. Denitrification is beneficial in wastewater treatment because it helps remove excess nitrogen from water.

Step 3: Conclusion.
The correct answer is **(1) (A), (B) and (D) only**, as they are true for denitrification.

Quick Tip

Denitrification is crucial in both agriculture and wastewater treatment for controlling nitrogen levels.

---

27. Mycorrhizae is an association between:

(1) Plant roots and Algae
(2) Plant root and Protozoa
(3) Plant roots and Fungi
(4) Plant leaves and Algae

Correct Answer: (3) Plant roots and Fungi

Solution:

Step 1: Understanding Mycorrhizae.
Mycorrhizae refers to the symbiotic association between plant roots and fungi, which benefits both partners. The fungi assist the plant in nutrient absorption, especially phosphorus, and the plant provides carbohydrates for the fungi.

Step 2: Analyzing the options.
(1) Plant roots and Algae: This describes a different type of symbiotic relationship, not mycorrhizae.
(2) Plant root and Protozoa: This is not the correct association for mycorrhizae.
(3) Plant roots and Fungi: Correct. Mycorrhizae is the relationship between plant roots and fungi.
(4) Plant leaves and Algae: This is not related to mycorrhizae.

Step 3: Conclusion.
The correct answer is **(3) Plant roots and Fungi**, as mycorrhizae is the symbiotic relationship between plant roots and fungi.

Quick Tip

Mycorrhizae are crucial for plant growth, helping plants absorb nutrients from the soil more efficiently.

28. Which of the following oligonucleotide probes (*fluorescent tag*) will hybridize to a target RNA sequence?

Target RNA sequence: 5'- GAAACCUCGGGAACCGAGUCCCAA-3'

(1) 5' - GAGACCCUGGAACCGUCAAC-3'
(2) 3' - GAGACGGUAAGGCUACAA*-5'
(3) 3' - GAGCGUAGGCCUCAA*-5'
(4) 3' - GAGACGGUAGGCUACCUAC*-5'

Correct Answer: (1) 5' - GAGACCCUGGAACCGUCAAC-3'

Solution:

Step 1: Understanding hybridization.
In hybridization, a probe must be complementary to the target RNA sequence to form a stable double-stranded hybrid.

Step 2: Analyzing the options.
(1) 5' - GAGACCCUGGAACCGUCAAC-3': Correct. This probe is complementary to the target RNA sequence and will hybridize successfully.
(2) 3' - GAGACGGUAAGGCUACAA*-5': Incorrect. This sequence does not complement the target RNA sequence in the correct orientation.
(3) 3' - GAGCGUAGGCCUCAA*-5': Incorrect. This probe sequence does not match the target RNA sequence correctly.
(4) 3' - GAGACGGUAGGCUACCUAC*-5': Incorrect. This probe is mismatched with the target RNA sequence and will not hybridize.

Step 3: Conclusion.
The correct probe sequence is **(1) 5' - GAGACCCUGGAACCGUCAAC-3'**.

Quick Tip

Ensure that the probe is complementary to the target sequence and is in the correct orientation for hybridization to occur.

29. Which of the following is not used as mobile phase in gas chromatography?

(1) Nitrogen
(2) Helium
(3) Oxygen
(4) Hydrogen

Correct Answer: (3) Oxygen

Solution:

Step 1: Understanding gas chromatography.
In gas chromatography (GC), the mobile phase is the carrier gas that transports the sample through the column. The most common carrier gases are inert and do not react with the sample.

Step 2: Analyzing the options.
(1) Nitrogen: Nitrogen is commonly used as a carrier gas in gas chromatography.
(2) Helium: Helium is another common carrier gas used in gas chromatography.
(3) Oxygen: Incorrect. Oxygen is not used as a mobile phase in gas chromatography because it is reactive and can affect the analysis.
(4) Hydrogen: Hydrogen is also used as a carrier gas in gas chromatography in some cases.

Step 3: Conclusion.
The correct answer is **(3) Oxygen**, as it is not used as the mobile phase in gas chromatography.

Quick Tip

In gas chromatography, inert gases like nitrogen and helium are commonly used as the mobile phase because they do not react with the sample.

---

30. Arrange the following vectors on the basis of insert size carrying capacity.

(A) Cosmids
(B) Bacteriophages
(C) Plasmids
(D) Bacterial Artificial Chromosomes

(1) (A), (B), (C), (D)
(2) (A), (B), (D), (C)
(3) (B), (A), (D), (C)
(4) (C), (B), (A), (D)

Correct Answer: (4) (C), (B), (A), (D)

Solution:

Step 1: Understanding the vectors.
Vectors are used in genetic engineering to transfer foreign DNA into host cells. The carrying capacity of a vector depends on the size of the foreign DNA it can carry.

Step 2: Analyzing the options.
(A) Cosmids have moderate carrying capacity.
(B) Bacteriophages have a larger carrying capacity than cosmids.
(C) Plasmids have a smaller carrying capacity, typically used for small fragments of DNA.
(D) Bacterial artificial chromosomes (BACs) can carry large DNA fragments.

Step 3: Conclusion.
The correct order based on insert size carrying capacity is **(C), (B), (A), (D)**.

Quick Tip

The largest carrying capacity is found in BACs, followed by bacteriophages, cosmids, and plasmids.

---

31. Which of the following techniques is known as chain termination DNA sequencing method?

(1) Maxum Gilbert sequencing
(2) Sanger dideoxy DNA sequencing method
(3) Next Generation sequencing
(4) Shotgun sequencing

Correct Answer: (2) Sanger dideoxy DNA sequencing method

Solution:

Step 1: Understanding chain termination method.
The Sanger method, also known as dideoxy sequencing, is the chain termination method for DNA sequencing. It involves using dideoxynucleotides to terminate the chain at specific points during replication.

Step 2: Analyzing the options.
(1) Maxum Gilbert sequencing: This method uses chemical degradation of DNA and is

not a chain termination method.
(2) Sanger dideoxy DNA sequencing method: Correct. This method uses dideoxynucleotides to stop DNA elongation at specific bases, allowing sequencing of the DNA.
(3) Next Generation sequencing: This refers to high-throughput sequencing methods, not a chain termination method.
(4) Shotgun sequencing: This is a method of sequencing large genomes by breaking the DNA into smaller fragments and sequencing them.

Step 3: Conclusion.
The correct answer is **(2) Sanger dideoxy DNA sequencing method**, as it is the chain termination method used in DNA sequencing.

Quick Tip

The Sanger method, also known as dideoxy sequencing, is one of the earliest and most widely used techniques for DNA sequencing.

---

32. Which of the following is not a fermented food product?

(A) Sauerkraut
(B) Sake
(C) Soy Sauce
(D) Ragi

(1) (A), (B) and (D) only
(2) (B) and (C) only
(3) (C) and (D) only
(4) (D) only

Correct Answer: (4) (D) only

Solution:

Step 1: Understanding fermented foods.
Fermented foods are those that have undergone fermentation, a process involving the breakdown of food components by microorganisms.

Step 2: Analyzing the options.
(A) Sauerkraut is a fermented food made from cabbage.
(B) Sake is a fermented alcoholic beverage made from rice.

(C) Soy Sauce is a fermented condiment made from soybeans.
(D) Ragi is not a fermented food; it is a type of cereal grain used in various food preparations, but it is not fermented.

Step 3: Conclusion.
The correct answer is **(4) (D) only**, as Ragi is not a fermented product.

Quick Tip

Fermented foods such as sauerkraut, sake, and soy sauce are produced through the action of microorganisms, while Ragi is simply a grain used in food preparation.

---

33. Solutes in the environment change the availability of water molecules to microbes. Microbiologists quantitatively estimate the degree of water availability by determining:

(1) Water quantity (Wq)
(2) Water available (Wa)
(3) Water activity (aw)
(4) Water retention (rw)

Correct Answer: (3) Water activity (aw)

Solution:

Step 1: Understanding water activity.
Water activity (aw) is the measure of the availability of water to organisms, especially microbes, and is the most important factor for microbial growth. It quantifies the free water available in a substrate.

Step 2: Analyzing the options.
(1) Water quantity (Wq): This refers to the total amount of water, not its availability to microbes.
(2) Water available (Wa): While this is a concept related to water availability, water activity is a more precise measure used in microbiology.
(3) Water activity (aw): Correct. Water activity is the measure used to estimate the availability of water to microbes. It is a ratio of the vapor pressure of water in the sample to the vapor pressure of pure water.
(4) Water retention (rw): This term does not refer to a method of estimating microbial water availability.

Step 3: Conclusion.
The correct answer is **(3) Water activity (aw)**, as it is the standard measure of water availability for microbes.

Quick Tip

Water activity (aw) is crucial for microbial growth, and understanding it helps microbiologists determine optimal conditions for microbial cultures.

---

34. When a petite mutant isolated from aerobically cultured yeast is crossed with a wild-type strain, the progeny obtained is all wild type. Identify the type of mutation.

(1) Suppressive
(2) Neutral
(3) Segregational
(4) Silent

Correct Answer: (1) Suppressive

Solution:

Step 1: Understanding suppressive mutations.
A suppressive mutation is one where a mutation in one gene can mask or suppress the effects of a mutation in another gene, leading to the wild-type phenotype. In this case, the petite mutant's phenotype is suppressed by the wild-type strain, resulting in wild-type progeny.

Step 2: Analyzing the options.
(1) Suppressive: Correct. Suppressive mutations are those that can restore the wild-type phenotype by masking the effects of another mutation.
(2) Neutral: Neutral mutations do not affect the phenotype of the organism.
(3) Segregational: Segregational mutations refer to mutations that follow typical Mendelian inheritance and result in a 1:1 ratio of wild-type and mutant types in progeny.
(4) Silent: Silent mutations do not change the amino acid sequence and typically do not affect the phenotype.

Step 3: Conclusion.
The correct answer is **(1) Suppressive**, as the wild-type phenotype masks the petite mutation.

Quick Tip

Suppressive mutations can mask the phenotypic effects of other mutations, restoring the wild-type appearance.

---

35. Which of the following is not a characteristic feature of actinomycetes?

(1) Filamentous
(2) High G+C content
(3) Curved rods
(4) Gram positive

Correct Answer: (3) Curved rods

Solution:

Step 1: Understanding actinomycetes.
Actinomycetes are a group of Gram-positive bacteria that are typically filamentous, possess high G+C content in their DNA, and are known for their role in the decomposition of organic material.

Step 2: Analyzing the options.
(1) Filamentous: Correct. Actinomycetes are filamentous, forming branched networks of hyphae.
(2) High G+C content: Correct. Actinomycetes generally have a high G+C content in their DNA.
(3) Curved rods: Incorrect. Actinomycetes are not typically curved rods; they are filamentous and often form branching structures. Curved rods are more characteristic of other bacterial groups, such as Vibrios.
(4) Gram positive: Correct. Actinomycetes are Gram-positive bacteria.

Step 3: Conclusion.
The correct answer is **(3) Curved rods**, as actinomycetes are not typically curved rods.

Quick Tip

Actinomycetes are filamentous, Gram-positive bacteria with high G+C content in their DNA. Curved rods are not characteristic of this group.

---

36. Which of the following are features of chlorosomes?

(A) Light harvesting
(B) Contain chlorophyll a
(C) Present in green bacteria
(D) Galactolipid membrane

(1) (A) and (D) only
(2) (A) only
(3) (A), (B) and (D) only
(4) (A), (C) and (D) only

Correct Answer: (4) (A), (C) and (D) only

Solution:

Step 1: Understanding chlorosomes.
Chlorosomes are light-harvesting organelles found in certain photosynthetic bacteria, particularly green sulfur bacteria. They contain bacteriochlorophyll and are involved in the absorption of light for photosynthesis.

Step 2: Analyzing the options.
(A) Light harvesting: Correct. Chlorosomes are involved in light harvesting.
(B) Contain chlorophyll a: Incorrect. Chlorosomes typically contain bacteriochlorophyll, not chlorophyll a, which is found in plants.
(C) Present in green bacteria: Correct. Chlorosomes are found in green sulfur bacteria.
(D) Galactolipid membrane: Correct. Chlorosomes are surrounded by a galactolipid membrane.

Step 3: Conclusion.
The correct answer is **(4) (A), (C) and (D) only**.

Quick Tip

Chlorosomes are key to light harvesting in green sulfur bacteria and have a unique membrane structure.

---

37. What are the functions of peroxisomes in the cell?

(A) Peroxisomes are the sites where oxidation of substrates takes place and hydrogen peroxide is formed.
(B) Peroxisomes harbor catalase enzyme which decomposes hydrogen peroxide.
(C) In plants and fungi, fatty acid oxidation takes place in the peroxisomes.
(D) In animal cells, fatty acid oxidation takes place in the peroxisomes and mitochondria.

(1) (A), (B) and (D) only
(2) (A), (B) and (C) only
(3) (A), (B), (C) and (D)
(4) (B), (C) and (D) only

Correct Answer: (3) (A), (B), (C) and (D)

Solution:

Step 1: Understanding peroxisomes.
Peroxisomes are membrane-bound organelles in cells that are involved in various metabolic functions, including the breakdown of fatty acids and detoxification of hydrogen peroxide.

Step 2: Analyzing the options.
(A) Peroxisomes are involved in oxidation reactions and the formation of hydrogen peroxide as a byproduct.
(B) Peroxisomes contain catalase, which decomposes hydrogen peroxide into water and oxygen.
(C) Correct. In plants and fungi, peroxisomes are involved in fatty acid oxidation.
(D) Correct. In animal cells, fatty acid oxidation takes place in both peroxisomes and mitochondria.

Step 3: Conclusion.
The correct answer is **(3) (A), (B), (C) and (D)**. All of the functions listed are accurate for peroxisomes.

Quick Tip

Peroxisomes play a critical role in lipid metabolism and detoxification, particularly in the breakdown of hydrogen peroxide.

---

38. If organism A possesses 55% G+C content and organism B has 25% of the G+C content in their genome, what inference can be drawn?

(1) Both organisms are closely related.
(2) Both organisms are unrelated.

(3) Both organisms belong to different taxon.
(4) No inference can be drawn from this data.

Correct Answer: (4) No inference can be drawn from this data.

Solution:

Step 1: Understanding G+C content.
The G+C content is the percentage of guanine (G) and cytosine (C) bases in the DNA of an organism. It is often used to estimate the genetic relationship between organisms, but the presence of different G+C content does not necessarily indicate the relatedness of organisms.

Step 2: Analyzing the options.
(1) Both organisms are closely related: This cannot be concluded solely based on the G+C content, as organisms from different taxonomic groups can have varying G+C contents.
(2) Both organisms are unrelated: This is not necessarily true, as organisms with different G+C content can still be related.
(3) Both organisms belong to different taxon: Different G+C content does not guarantee that the organisms belong to different taxonomic groups.
(4) No inference can be drawn from this data: Correct. The G+C content alone is not enough to determine the relationship between organisms.

Step 3: Conclusion.
The correct answer is **(4) No inference can be drawn from this data**.

Quick Tip

G+C content can provide some information about an organism's genome, but it is not definitive for determining relatedness between organisms.

---

39. Out of all given options, which ones are stop codons?

(1) UAA, UGA, UAG
(2) UGG, UGA, UAC
(3) UCC, UAA, UGC
(4) UAC, UAG, UAA

Correct Answer: (1) UAA, UGA, UAG

Solution:

Step 1: Understanding stop codons.
Stop codons are specific codons in the genetic code that signal the end of translation. The three stop codons are UAA, UGA, and UAG.

Step 2: Analyzing the options.
(1) UAA, UGA, UAG: Correct. These are the three stop codons in the genetic code.
(2) UGG, UGA, UAC: UGG is not a stop codon. UGA is a stop codon, but UGG and UAC are not.
(3) UCC, UAA, UGC: UAA is a stop codon, but UCC and UGC are not.
(4) UAC, UAG, UAA: UAG and UAA are stop codons, but UAC is not.

Step 3: Conclusion.
The correct answer is **(1) UAA, UGA, UAG**, as these are the stop codons.

Quick Tip

The three stop codons (UAA, UGA, UAG) signal the termination of protein synthesis during translation.

---

40. Which of the following is not an Antigen Presenting Cell?

(1) B cell
(2) Basophil
(3) Dendritic cell
(4) Macrophage

Correct Answer: (2) Basophil

Solution:

Step 1: Understanding Antigen Presenting Cells.
Antigen Presenting Cells (APCs) are immune cells that present antigens to T cells, initiating the immune response. The main APCs are dendritic cells, macrophages, and B cells.

Step 2: Analyzing the options.
(1) B cell: B cells are APCs because they present antigens to helper T cells.
(2) Basophil: Basophils are involved in allergic reactions but are not antigen-presenting cells.
(3) Dendritic cell: Dendritic cells are one of the most efficient APCs, responsible for activating T cells.

(4) Macrophage: Macrophages also function as APCs, engulfing pathogens and presenting their antigens.

Step 3: Conclusion.
The correct answer is **(2) Basophil**, as it is not an antigen-presenting cell.

Quick Tip

APCs such as dendritic cells, macrophages, and B cells play a key role in initiating the immune response by presenting antigens to T cells.

---

41. Match List-I with List-II

(A) Cys
(B) Asp
(C) Trp
(D) Arg

(I) basic
(II) nonpolar aromatic
(III) acidic
(IV) sulphur containing

(1) (A) - (IV), (B) - (II), (C) - (III), (D) - (I)
(2) (A) - (III), (B) - (II), (C) - (I), (D) - (IV)
(3) (A) - (II), (B) - (III), (C) - (I), (D) - (IV)
(4) (A) - (III), (B) - (I), (C) - (II), (D) - (IV)

Correct Answer: (4) (A) - (III), (B) - (I), (C) - (II), (D) - (IV)

Solution:

Step 1: Understanding the amino acids and their side chain types.
Amino acids can be classified based on the nature of their side chains. They can be acidic, basic, nonpolar, or contain sulfur.

Step 2: Analyzing the options.
(A) Cys: Cysteine (Cys) has a sulfur-containing side chain. Therefore, it is matched with **(IV) sulphur containing**.
(B) Asp: Aspartic acid (Asp) has an acidic side chain. Therefore, it is matched with **(III)**

acidic.
(C) Trp: Tryptophan (Trp) has a nonpolar aromatic side chain. Therefore, it is matched with **(II) nonpolar aromatic**.
(D) Arg: Arginine (Arg) has a basic side chain. Therefore, it is matched with **(I) basic**.

Step 3: Conclusion.
The correct matching is **(4) (A) - (III), (B) - (I), (C) - (II), (D) - (IV)**.

Quick Tip

Amino acid side chains play a significant role in protein structure and function, influencing properties such as solubility and reactivity.

---

42. Arrange the following steps of complement activation in the correct order.

(A) Formation of C3 convertase
(B) Binding of C1 to Antigen antibody complex
(C) Formation of MAC
(D) C5 convertase formation

(1) (B), (A), (C), (D)
(2) (C), (B), (A), (D)
(3) (A), (B), (C), (D)
(4) (B), (A), (C), (D)

Correct Answer: (1) (B), (A), (C), (D)

Solution:

Step 1: Understanding complement activation.
Complement activation involves several steps to fight infections, where proteins in the complement system are activated in a cascade manner.

Step 2: Analyzing the options.
(B) Binding of C1 to Antigen antibody complex: This is the first step in the classical pathway of complement activation.
(A) Formation of C3 convertase: After C1 binds to the antigen-antibody complex, it activates C3 convertase.
(C) Formation of MAC (Membrane Attack Complex): MAC is formed after the activation of C3 and C5 convertase, leading to the attack on the pathogen.

(D) C5 convertase formation: C5 convertase is formed after C3 convertase, leading to the cleavage of C5 and MAC formation.

Step 3: Conclusion.
The correct order is **(B), (A), (C), (D)**.

Quick Tip

The classical complement pathway begins with the binding of C1 to the antigen-antibody complex, leading to the formation of C3 and C5 convertase, and ending in the formation of the Membrane Attack Complex (MAC).

---

43. Enzyme sequence involved in formation of L-isoleucine from L-Threonine is regulated by:

(1) Feedback inhibition
(2) Competitive inhibition
(3) Non-competitive inhibition
(4) Specific inhibition

Correct Answer: (1) Feedback inhibition

Solution:

Step 1: Understanding feedback inhibition.
Feedback inhibition is a type of negative regulation where the end product of a metabolic pathway inhibits the activity of an enzyme earlier in the pathway to prevent overproduction. In the case of L-isoleucine synthesis from L-Threonine, the end product (L-isoleucine) inhibits the enzyme responsible for its formation.

Step 2: Analyzing the options.
(1) Feedback inhibition: Correct. The synthesis of L-isoleucine from L-Threonine is regulated by feedback inhibition, where L-isoleucine inhibits the pathway.
(2) Competitive inhibition: Competitive inhibition occurs when a molecule competes with the substrate for the active site of an enzyme, but it is not the regulatory mechanism for this pathway.
(3) Non-competitive inhibition: Non-competitive inhibition involves inhibition at a site other than the active site, but it is not the regulation mechanism here.
(4) Specific inhibition: This is a general term and does not specifically refer to the regulation mechanism in this pathway.

Step 3: Conclusion.
The correct answer is **(1) Feedback inhibition**, as it is the mechanism regulating L-isoleucine synthesis.

Quick Tip

Feedback inhibition is an important regulatory mechanism that prevents the accumulation of excess products in metabolic pathways.

---

44. Which of the following statements are true about human ABO blood groups?

(A) Glycosyltransferase enzyme is responsible for transfer of carbohydrate moiety on protein.
(B) Almost all individuals possess H substance.
(C) A antigen has one extra monosaccharide group N-acetylgalactosamine added to H substance.
(D) B antigen has one extra monosaccharide group galactose added to H substance.

(1) (A), (B) and (D) only
(2) (A), (B) and (C) only
(3) (A), (B), (C) and (D)
(4) (B), (C) and (D) only

Correct Answer: (3) (A), (B), (C) and (D)

Solution:

Step 1: Understanding ABO blood group formation.
ABO blood types are determined by the type of antigens (A or B) present on the surface of red blood cells. These antigens are formed through glycosyltransferase enzymes adding specific carbohydrate groups to the H substance.

Step 2: Analyzing the options.
(A) Glycosyltransferase is indeed responsible for adding carbohydrate groups, making this statement true.
(B) Almost all individuals possess the H substance, which is the precursor for A and B antigens, so this is true.
(C) A antigen has an additional N-acetylgalactosamine group, making this statement true.
(D) B antigen has an additional galactose group, so this statement is also true.

Step 3: Conclusion.
The correct answer is **(3) (A), (B), (C) and (D)**.

Quick Tip

The ABO blood group system is determined by the presence of specific antigens, which are formed by the addition of carbohydrate groups through the action of glycosyltransferases.

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45. Which of the following is not used as a cyanobacterial biofertilizer?

(1) Cylindrospermum
(2) Tolypothrix
(3) Anabaena
(4) Azospirillum

Correct Answer: (4) Azospirillum

Solution:

Step 1: Understanding cyanobacterial biofertilizers.
Cyanobacteria, or blue-green algae, play a role in nitrogen fixation and are used as biofertilizers in agriculture.

Step 2: Analyzing the options.
(1) Cylindrospermum: This is a cyanobacterium that can be used as a biofertilizer for nitrogen fixation.
(2) Tolypothrix: This is also a cyanobacterium used in biofertilization.
(3) Anabaena: Anabaena is a well-known nitrogen-fixing cyanobacterium used as a biofertilizer.
(4) Azospirillum: Azospirillum is a genus of bacteria used as a biofertilizer, but it is not a cyanobacterium. It is a nitrogen-fixing bacterium used for plant growth promotion.

Step 3: Conclusion.
The correct answer is **(4) Azospirillum**, as it is not a cyanobacterium but a different type of nitrogen-fixing bacterium.

Quick Tip

Cyanobacteria such as Anabaena, Tolypothrix, and Cylindrospermum are used as biofertilizers for nitrogen fixation, but Azospirillum is a bacterium, not a cyanobacterium.

46. Which of the following cause depletion of ozone layer?

(1) Halogenated carbons, CFC, HCFC, HFC
(2) Fluorinated carbons
(3) Hydrocarbons
(4) Photochemical products

Correct Answer: (1) Halogenated carbons, CFC, HCFC, HFC

Solution:

Step 1: Understanding ozone depletion.
The depletion of the ozone layer is primarily caused by chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), and halogenated carbon compounds. These substances release chlorine and bromine atoms, which damage the ozone molecules.

Step 2: Analyzing the options.
(1) Halogenated carbons, CFC, HCFC, HFC: Correct. These chemicals, particularly CFCs, HCFCs, and HFCs, are responsible for ozone depletion.
(2) Fluorinated carbons: Fluorinated carbons, while potent greenhouse gases, are not directly responsible for ozone depletion.
(3) Hydrocarbons: Hydrocarbons do not play a significant role in ozone layer depletion.
(4) Photochemical products: Photochemical reactions do play a role in the breakdown of ozone, but they are secondary compared to halogenated compounds.

Step 3: Conclusion.
The correct answer is **(1) Halogenated carbons, CFC, HCFC, HFC**.

Quick Tip

CFCs and other halogenated compounds are the primary contributors to ozone depletion, causing the breakdown of ozone molecules in the stratosphere.

47. Arrange the steps of binary fission in a rod-shaped prokaryote in sequence.

(A). Cell elongation
(B). Cell separation
(C). Septum formation

(D). DNA replication

(1) (A) - (C), (B) - (D), (C) - (B)
(2) (D) - (A), (C) - (B), (C) - (D)
(3) (A) - (B), (C) - (D), (C) - (B)
(4) (C) - (A), (D) - (B), (C) - (D)

Correct Answer: (1) (A) - (C), (B) - (D), (C) - (B)

Solution:

Step 1: Understanding binary fission in prokaryotes.
Binary fission is the method of asexual reproduction in prokaryotes, where a single parent cell divides into two genetically identical daughter cells. The process includes DNA replication, cell elongation, septum formation, and cell separation.

Step 2: Analyzing the steps in sequence.
(A) Cell elongation: The cell elongates, preparing for division.
(B) Cell separation: After division, the two cells separate.
(C) Septum formation: A septum forms in the middle of the cell, dividing it into two parts.
(D) DNA replication: The DNA replicates to ensure each daughter cell receives a copy.

Step 3: Conclusion.
The correct sequence of steps for binary fission is **(A) - (C), (B) - (D), (C) - (B)**.

Quick Tip

In binary fission, the steps are carefully orchestrated: DNA replication, septum formation, cell elongation, and finally cell separation.

---

48. TCR of Cytotoxic T lymphocytes interacts with which of the following?

(1) MHC-II
(2) MHC-I
(3) CD8
(4) CD4

Correct Answer: (2) MHC-I

Solution:

Step 1: Understanding the question.
The question asks about the interaction of the TCR (T-cell receptor) of cytotoxic T lymphocytes, which are involved in immune responses. Cytotoxic T cells recognize antigens presented by MHC class I molecules.

Step 2: Analyzing the options.
(1) MHC-II: This is incorrect. MHC-II molecules present antigens to helper T cells, not cytotoxic T cells.
(2) MHC-I: Correct — Cytotoxic T cells interact with MHC class I molecules, which present antigens from inside the cell.
(3) CD8: This is incorrect. CD8 is a co-receptor on cytotoxic T cells, but the TCR itself interacts with MHC-I.
(4) CD4: This is incorrect. CD4 is a co-receptor for helper T cells, not for cytotoxic T cells.

Step 3: Conclusion.
The correct answer is **(2) MHC-I**, as the TCR of cytotoxic T lymphocytes specifically recognizes and binds to MHC class I molecules on the surface of infected cells.

Quick Tip

Cytotoxic T lymphocytes specifically target cells displaying antigens on MHC-I molecules, which is key to their function in the immune system.

---

49. The first cells to reach the site of inflammation are:

(1) Neutrophils
(2) Basophils
(3) T cells
(4) Macrophages

Correct Answer: (1) Neutrophils

Solution:

Step 1: Understanding the question.
The question is asking about the first type of immune cells to arrive at a site of inflammation during the body's immune response.

Step 2: Analyzing the options.
(1) Neutrophils: Correct — Neutrophils are the first responders to the site of infection or injury, and they are critical in the early stages of inflammation.
(2) Basophils: This is incorrect. Basophils are involved in allergic reactions and are not the first to arrive at the site of inflammation.
(3) T cells: This is incorrect. T cells typically arrive later in the inflammatory response, after neutrophils and macrophages have been activated.
(4) Macrophages: This is incorrect. Macrophages arrive shortly after neutrophils, and while they play a crucial role in inflammation, they are not the first responders.

Step 3: Conclusion.
The correct answer is **(1) Neutrophils**, as they are the first immune cells to arrive at the site of infection or inflammation.

Quick Tip

Neutrophils are the body's first line of defense, responding rapidly to infection and inflammation.

---

50. Arrange the steps for wastewater treatment processes in correct sequence.

(A) Screening and Sedimentation
(B) Anoxic digestion and oxidation
(C) Separation into soluble and insoluble components
(D) Drying and Disinfection of the two components

Choose the correct answer from the options given below:

(1) (A), (C), (B), (D)
(2) (A), (B), (C), (D)
(3) (B), (D), (A), (C)
(4) (C), (A), (B), (D)

Correct Answer: (2) (A), (B), (C), (D)

Solution:

Step 1: Understanding the question.
The question asks to arrange the steps for wastewater treatment in the correct order. Wastewater treatment follows a sequence of processes that remove contaminants and purify water.

Step 2: Analyzing the options.
(A) Screening and Sedimentation: Screening removes large particles, while sedimentation helps to settle solids. These are the first steps in wastewater treatment.
(B) Anoxic digestion and oxidation: Anoxic digestion helps break down organic matter in the absence of oxygen, followed by oxidation to further treat the wastewater.
(C) Separation into soluble and insoluble components: This step is crucial in separating the solid and liquid parts of wastewater. It follows after initial screening and sedimentation.
(D) Drying and Disinfection of the two components: Finally, drying and disinfection are the last steps to ensure the water is safe and the solids are treated.

Step 3: Conclusion.
The correct sequence is **(A), (B), (C), (D)**, as these are the logical steps in wastewater treatment, from screening to disinfection.

Quick Tip

In wastewater treatment, each process is designed to progressively remove contaminants and purify the water, starting with large particle removal and ending with disinfection.

---

51. What is the major activity occurring in germinal centers?

(1) Somatic mutation
(2) Antigen entrapment
(3) Antibody production
(4) Antigen presentation

Correct Answer: (1) Somatic mutation

Solution:

Step 1: Understanding the question.
The question is asking about the major activity occurring in germinal centers, which are sites in lymphoid tissues where B cells undergo rapid division and mutation.

Step 2: Analyzing the options.
(1) Somatic mutation: Correct — Somatic hypermutation occurs in germinal centers, where B cells undergo mutation to improve their affinity for antigens.
(2) Antigen entrapment: This is incorrect. Antigen entrapment is not the primary process in germinal centers.
(3) Antibody production: While antibodies are produced by B cells, the key process in germinal centers is somatic hypermutation, not the production of antibodies.

(4) Antigen presentation: This is incorrect. Antigen presentation occurs in various immune cells but is not the major activity in germinal centers.

Step 3: Conclusion.
The correct answer is **(1) Somatic mutation**, as this is the main activity occurring in germinal centers.

Quick Tip

Somatic mutation in germinal centers allows B cells to refine their antibody production and improve immune responses.

---

52. Match List-I with List-II

List-I
Interaction type
(A) Commensalism
(B) Competition
(C) Amensalism
(D) Parasitism

List-II
Effect
(I) One population derives food from the host without causing death of the host
(II) Population one is inhibited and other is not affected
(III) One population benefits and other population (host) is not affected
(IV) Each species is directly inhibited by the other

Choose the correct answer from the options given below:

(1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(2) (A) - (III), (B) - (II), (C) - (IV), (D) - (I)
(3) (A) - (II), (B) - (IV), (C) - (III), (D) - (I)
(4) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Solution:

Step 1: Understanding the question.
The question asks to match types of interactions with their respective effects. Let's analyze each interaction type and its effect in ecological relationships.

Step 2: Analyzing the options.
(A) Commensalism: In this interaction, one species benefits (derives food) from the host without harming it, so the effect is **(I)**.
(B) Competition: In competition, one population is inhibited while the other remains unaffected, so the effect is **(II)**.
(C) Amensalism: In amensalism, one population benefits while the other (host) is not affected, so the effect is **(III)**.
(D) Parasitism: In parasitism, both species are inhibited directly by each other, so the effect is **(IV)**.

Step 3: Conclusion.
The correct matching is **(1) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)**.

Quick Tip

Remember the key characteristics of ecological interactions: Commensalism benefits one without harming the other, while parasitism harms both species involved.

---

53. Which of the following is an exotoxin producing anaerobic organism associated with food poisoning?

(1) Clostridium botulinum
(2) Staphylococcus aureus
(3) Bacillus cereus
(4) Giardia lamblia

Correct Answer: (1) Clostridium botulinum

Solution:

Step 1: Understanding the question.
The question asks about an anaerobic organism that produces an exotoxin and is associated with food poisoning.

Step 2: Analyzing the options.
(1) Clostridium botulinum: Correct — This organism produces botulinum toxin, which is an exotoxin and is associated with foodborne illness, particularly in improperly canned foods.

(2) Staphylococcus aureus: This is incorrect. While Staphylococcus aureus can produce toxins, it is not anaerobic and is not typically associated with anaerobic food poisoning.
(3) Bacillus cereus: This is incorrect. Bacillus cereus is a foodborne pathogen, but it does not produce an exotoxin in the same way that Clostridium botulinum does.
(4) Giardia lamblia: This is incorrect. Giardia lamblia is a protozoan parasite, not an anaerobic bacterium that produces exotoxins.

Step 3: Conclusion.
The correct answer is **(1) Clostridium botulinum**, as it is the primary anaerobic organism that produces exotoxins associated with food poisoning.

Quick Tip

Botulinum toxin, produced by Clostridium botulinum, is one of the most potent toxins known and causes food poisoning through contaminated food.

---

54. Which of the following is not a mechanism of antimicrobial resistance?

(1) Alteration of target
(2) Efflux pumps
(3) Inactivation of antibiotic
(4) Development of a new susceptible biochemical pathway

Correct Answer: (4) Development of a new susceptible biochemical pathway

Solution:

Step 1: Understanding the question.
The question asks about the mechanisms by which microorganisms resist the action of antimicrobial agents.

Step 2: Analyzing the options.
(1) Alteration of target: Correct — This is a known mechanism of antimicrobial resistance where the target of the antibiotic is altered, making the antibiotic ineffective.
(2) Efflux pumps: Correct — Efflux pumps are transport proteins that pump out antibiotics from the bacterial cell, reducing their effectiveness.
(3) Inactivation of antibiotic: Correct — Bacteria can produce enzymes that inactivate the antibiotic, rendering it ineffective.
(4) Development of a new susceptible biochemical pathway: This is incorrect. Developing a new biochemical pathway would make the microorganism more susceptible to the

antibiotic, not resistant.

Step 3: Conclusion.
The correct answer is **(4) Development of a new susceptible biochemical pathway**, as this is not a mechanism of antimicrobial resistance.

Quick Tip

Antimicrobial resistance arises from various mechanisms, but the development of new susceptible pathways would not contribute to resistance.

---

55. Arrange the following intermediates on the basis of their synthesis in citric acid cycle.

(A) Citrate
(B) Succinyl CoA
(C) -ketoglutarate
(D) Oxaloacetate

Choose the correct answer from the options given below:

(1) (A), (B), (C), (D)
(2) (A), (B), (D), (C)
(3) (B), (D), (A), (C)
(4) (A), (D), (C), (B)

Correct Answer: (1) (A), (B), (C), (D)

Solution:

Step 1: Understanding the question.
The question asks for the correct sequence of intermediates involved in the citric acid cycle (Krebs cycle). The citric acid cycle is a crucial metabolic pathway that produces energy through the oxidation of acetyl-CoA.

Step 2: Analyzing the options.
(A) Citrate: Citrate is the first intermediate formed when acetyl-CoA combines with oxaloacetate.
(B) Succinyl CoA: Succinyl-CoA is formed after the conversion of -ketoglutarate.
(C) -ketoglutarate: -Ketoglutarate is formed after the decarboxylation of isocitrate.

(D) Oxaloacetate: Oxaloacetate is the last intermediate and is regenerated after the final reactions of the citric acid cycle.

Step 3: Conclusion.
The correct order of intermediates is **(A), (B), (C), (D)**, reflecting their synthesis in the citric acid cycle.

Quick Tip

In the citric acid cycle, intermediates undergo sequential transformations, starting from citrate and ending with oxaloacetate.

---

56. Which of the following statements is/are true about agglutination?

(A) Excess antibody inhibits agglutination reactions.
(B) Coombs test works on the principle of agglutination.
(C) Agglutination reactions work only with soluble antigens.
(D) The antibody titer is the lowest dilution of serum at which agglutination is observed.

Choose the correct answer from the options given below:

(1) (A), (B), and (D) only
(2) (A) and (B) only
(3) (C) and (D) only
(4) (B), (C) and (D) only

Correct Answer: (1) (A), (B), and (D) only

Solution:

Step 1: Understanding the question.
The question asks to identify the correct statements about agglutination, which is the clumping of cells or particles due to antigen-antibody interactions.

Step 2: Analyzing the options.
(A) Excess antibody inhibits agglutination reactions: Correct — Too much antibody can cause the agglutination reaction to become inefficient or inhibited.
(B) Coombs test works on the principle of agglutination: Correct — The Coombs test detects antibodies bound to red blood cells by agglutination.

(C) Agglutination reactions work only with soluble antigens: This is incorrect. Agglutination reactions can also work with particulate antigens, such as bacteria or red blood cells.
(D) The antibody titer is the lowest dilution of serum at which agglutination is observed: Correct — The titer refers to the lowest concentration of antibody that still produces visible agglutination.

Step 3: Conclusion.
The correct statements are **(A), (B), and (D)**, so the correct answer is **(1)**.

Quick Tip

In agglutination tests, the proper concentration of antibodies is essential for accurate results, and the Coombs test is a classic example of such a test.

---

57. Arrange the steps in RNA synthesis in the correct order.

(A) Release of polymerase
(B) Release of sigma factor followed by elongation
(C) Recognition of promoter by sigma factor
(D) Identification of terminator site

Choose the correct answer from the options given below:

(1) (A), (B), (C), (D)
(2) (C), (B), (D), (A)
(3) (B), (A), (D), (C)
(4) (C), (A), (D), (B)

Correct Answer: (2) (C), (B), (D), (A)

Solution:

Step 1: Understanding the question.
This question is asking to arrange the steps involved in RNA synthesis (transcription) in the correct sequence.

Step 2: Analyzing the options.
(A) Release of polymerase: This step occurs when RNA polymerase is released from the complex to start transcription.
(B) Release of sigma factor followed by elongation: The sigma factor is released once

RNA polymerase binds to the promoter region, followed by the elongation phase of RNA synthesis.
(C) Recognition of promoter by sigma factor: The sigma factor recognizes and binds to the promoter, initiating transcription.
(D) Identification of terminator site: This happens towards the end of the transcription process, where the RNA polymerase recognizes the terminator sequence.

Step 3: Conclusion.
The correct order of steps is **(C), (B), (D), (A)**. The sigma factor first recognizes the promoter, then elongation begins, followed by termination, and finally, the polymerase is released.

Quick Tip

Transcription begins with the recognition of the promoter by the sigma factor and ends with the identification of the terminator sequence, marking the release of the polymerase.

---

58. What is the function of impellers in a fermentor?

(1) To increase the turbulence
(2) To monitor temperature and pH
(3) For oxygen mixing
(4) To stir the medium

Correct Answer: (3) For oxygen mixing

Solution:

Step 1: Understanding the question.
The question is asking about the function of impellers in a fermentor, which is a vessel used for fermentation processes. Impellers are used to mix the contents within the fermentor.

Step 2: Analyzing the options.
(1) To increase the turbulence: This is partly true. Impellers create turbulence, but the primary purpose is to ensure proper mixing.
(2) To monitor temperature and pH: This is incorrect. Monitoring temperature and pH is usually done with sensors, not by the impellers.
(3) For oxygen mixing: Correct — Impellers help in mixing the contents of the fermentor to ensure oxygen is evenly distributed throughout the medium, which is essential for aerobic fermentation.
(4) To stir the medium: This is also true to some extent, but the main purpose of stirring

is to mix the contents, ensuring proper oxygenation, not just stirring.

Step 3: Conclusion.
The correct answer is **(3) For oxygen mixing**, as the primary role of impellers is to ensure efficient oxygen distribution within the fermentor for optimal microbial growth and fermentation.

Quick Tip

In fermentation, efficient oxygen mixing is critical, and impellers play a key role in ensuring that the oxygen is evenly distributed in the culture medium.

---

59. Which of the following enzymes is responsible for synthesis of mRNA in prokaryotes?

(1) RNA Polymerase I
(2) RNA Polymerase III
(3) RNA Polymerase II
(4) RNase H

Correct Answer: (3) RNA Polymerase II

Solution:

Step 1: Understanding the question.
The question is asking about the enzyme responsible for synthesizing mRNA in prokaryotes. RNA polymerase is the enzyme that catalyzes the synthesis of RNA from a DNA template.

Step 2: Analyzing the options.
(1) RNA Polymerase I: This is incorrect. RNA polymerase I primarily synthesizes rRNA, not mRNA.
(2) RNA Polymerase III: This is incorrect. RNA polymerase III is involved in the synthesis of tRNA and other small RNAs, not mRNA.
(3) RNA Polymerase II: Correct — In prokaryotes, RNA polymerase II is responsible for synthesizing mRNA.
(4) RNase H: This is incorrect. RNase H degrades the RNA strand of RNA-DNA hybrids and does not synthesize mRNA.

Step 3: Conclusion.
The correct enzyme for synthesizing mRNA in prokaryotes is **RNA Polymerase II**.

Quick Tip

In prokaryotes, RNA polymerase synthesizes mRNA, whereas other polymerases handle tRNA and rRNA synthesis.

---

60. Which of the following is an example of DNA containing virus?

(1) Rabies virus
(2) Polio virus
(3) HIV Virus
(4) Smallpox virus

Correct Answer: (4) Smallpox virus

Solution:

Step 1: Understanding the question.
The question asks for an example of a DNA-containing virus. Viruses can be classified based on the type of genetic material they contain, either RNA or DNA.

Step 2: Analyzing the options.
(1) Rabies virus: This is incorrect. Rabies virus is an RNA virus.
(2) Polio virus: This is incorrect. Polio virus is an RNA virus.
(3) HIV Virus: This is incorrect. HIV is a retrovirus, which contains RNA as its genetic material.
(4) Smallpox virus: Correct — Smallpox virus is a DNA virus that contains double-stranded DNA as its genetic material.

Step 3: Conclusion.
The correct answer is **(4) Smallpox virus**, as it is a DNA-containing virus.

Quick Tip

DNA viruses typically replicate within the host cell nucleus, while RNA viruses generally replicate in the cytoplasm.

---

61. Which of the following tests are used to check spoilage of milk?

(A) Clot on boiling test
(B) Resazurin reduction assay
(C) MBRT
(D) MPN test

Choose the correct answer from the options given below:

(1) (A), (B), (D) only
(2) (B) and (C) only
(3) (A), (B), (C) and (D)
(4) (A), (B) and (C) only

Correct Answer: (4) (A), (B) and (C) only

Solution:

Step 1: Understanding the question.
The question asks about tests used to check the spoilage of milk. Several tests are used to assess the quality and spoilage of milk based on microbial activity.

Step 2: Analyzing the options.
(A) Clot on boiling test: Correct — This test is used to determine the heat stability of milk, which is affected by microbial spoilage.
(B) Resazurin reduction assay: Correct — This test measures the reduction of resazurin dye, which is an indicator of microbial activity.
(C) MBRT: Correct — The Milk Bacteriological Resazurin Test (MBRT) measures the degree of bacterial contamination in milk.
(D) MPN test: This is incorrect. The Most Probable Number (MPN) test is used for determining bacterial counts but is not specifically used for milk spoilage.

Step 3: Conclusion.
The correct answer is **(4) (A), (B) and (C) only**, as these tests are directly related to the spoilage of milk.

Quick Tip

The clot on boiling test and resazurin reduction assay are commonly used to determine the quality of milk based on microbial activity.

---

62. Which of the following is not a feature of peptide bond?

(1) Partial double bond character
(2) Planar
(3) Linear
(4) Rigid

Correct Answer: (3) Linear

Solution:

Step 1: Understanding the question.
The question asks about the features of a peptide bond, which is the bond between two amino acids in proteins. Peptide bonds have several specific characteristics.

Step 2: Analyzing the options.
(1) Partial double bond character: Correct — Peptide bonds exhibit partial double bond character due to resonance, which restricts rotation around the bond.
(2) Planar: Correct — The peptide bond is planar because of the partial double bond character. The atoms involved are in the same plane.
(3) Linear: This is incorrect. The peptide bond is not linear; it has restricted rotation due to its partial double bond character, and it is planar.
(4) Rigid: Correct — The peptide bond is rigid and does not allow free rotation due to the partial double bond character.

Step 3: Conclusion.
The correct answer is **(3) Linear**, as peptide bonds are not linear but rather rigid and planar.

Quick Tip

Peptide bonds are rigid and planar due to the partial double bond character, which restricts rotation around the bond.

---

63. Which of the following media is used for isolation of Staphylococcus?

(1) McConkey Agar
(2) Mannitol Salt agar
(3) SS Agar
(4) Lowstein Jenson Medium

Correct Answer: (2) Mannitol Salt agar

Solution:

Step 1: Understanding the question.
The question asks about the media used for isolating Staphylococcus, which is a genus of bacteria.

Step 2: Analyzing the options.
(1) McConkey Agar: This is incorrect. McConkey agar is selective for Gram-negative bacteria and is used for isolating enteric bacteria, not Staphylococcus.
(2) Mannitol Salt agar: Correct — Mannitol Salt agar is a selective medium that inhibits the growth of most bacteria except for Staphylococcus species, which can ferment mannitol, turning the medium yellow.
(3) SS Agar: This is incorrect. SS agar is used for isolating Salmonella and Shigella species, not Staphylococcus.
(4) Lowstein Jenson Medium: This is incorrect. Lowstein Jenson medium is used for isolating Mycobacterium tuberculosis, not Staphylococcus.

Step 3: Conclusion.
The correct answer is **(2) Mannitol Salt agar**, as it is specifically designed for the isolation of Staphylococcus.

Quick Tip

Mannitol Salt agar is selective for Staphylococcus and differential for mannitol fermentation, which is used to distinguish between Staphylococcus aureus and other species.

---

64. Which of the following is exclusively a recessive X-linked trait?

(1) Cystic fibrosis
(2) Red green colour blindness
(3) Baldness
(4) Albinism

Correct Answer: (2) Red green colour blindness

Solution:

Step 1: Understanding the question.
The question is asking about a trait that is recessive and X-linked, meaning it is carried on the X chromosome and manifests only when both X chromosomes carry the allele.

Step 2: Analyzing the options.
(1) Cystic fibrosis: This is incorrect. Cystic fibrosis is an autosomal recessive genetic disorder, not X-linked.
(2) Red green colour blindness: Correct — Red-green color blindness is a recessive X-linked trait, meaning males (XY) are more likely to be affected because they only have one X chromosome.
(3) Baldness: This is incorrect. Baldness is influenced by multiple genes, including autosomal genes, and may not be exclusively X-linked.
(4) Albinism: This is incorrect. Albinism is an autosomal recessive disorder, not X-linked.

Step 3: Conclusion.
The correct answer is **(2) Red green colour blindness**, as it is a recessive X-linked trait.

Quick Tip

X-linked traits affect males more frequently, as they have only one X chromosome. Recessive X-linked traits manifest in males with only one copy of the allele.

---

65. In a dihybrid cross, if the percentage of recombinant trait is 20%, what will be the distance between the genes?

(1) 2 map units/centimorgan
(2) 10 map units/centimorgan
(3) 20 map units/centimorgan
(4) 5 map units/centimorgan

Correct Answer: (3) 20 map units/centimorgan

Solution:

Step 1: Understanding the question.
This question asks about the distance between two genes based on the percentage of recombinant offspring in a dihybrid cross. The distance between genes is measured in map units (centimorgans).

Step 2: Analyzing the options.
The recombinant frequency (RF) is directly related to the distance between two genes. The recombinant frequency is given by the formula:

$$\text{RF} = \frac{\text{Number of recombinant offspring}}{\text{Total offspring}} \times 100$$

If the RF is 20%, the distance between the genes is 20 map units/centimorgan.

Step 3: Conclusion.
The correct answer is **(3) 20 map units/centimorgan**, as the recombinant frequency of 20% corresponds to a distance of 20 map units.

Quick Tip

The recombinant frequency is directly proportional to the map distance between two genes. 1% recombinant frequency corresponds to 1 map unit (centimorgan).

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66. Which of the following is not a primary metabolite?

(1) Enzymes
(2) Antibiotics
(3) Ethanol
(4) Amino acids

Correct Answer: (2) Antibiotics

Solution:

Step 1: Understanding the question.
The question asks to identify the substance that is not a primary metabolite. Primary metabolites are substances that are produced during normal growth and metabolism of an organism.

Step 2: Analyzing the options.
(1) Enzymes: This is incorrect. Enzymes are proteins that catalyze biochemical reactions and are considered primary metabolites.
(2) Antibiotics: Correct — Antibiotics are secondary metabolites, produced by certain microorganisms, not involved in normal growth or reproduction.
(3) Ethanol: This is incorrect. Ethanol is a byproduct of fermentation and can be considered a primary metabolite in some organisms.
(4) Amino acids: This is incorrect. Amino acids are essential components of proteins and are considered primary metabolites.

Step 3: Conclusion.
The correct answer is **(2) Antibiotics**, as antibiotics are secondary metabolites.

Quick Tip

Primary metabolites are directly involved in growth, development, and reproduction, while secondary metabolites like antibiotics have specialized functions, often for defense.

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67. What is the mode of action of alcohol as a sanitizer and disinfectant?

(1) Alkylating agent
(2) Oxidizing agent
(3) Protein denaturant
(4) Cationic surfactant

Correct Answer: (3) Protein denaturant

Solution:

Step 1: Understanding the question.
The question is asking about the mechanism by which alcohol acts as a sanitizer and disinfectant. Alcohol is known for its antimicrobial properties.

Step 2: Analyzing the options.
(1) Alkylating agent: This is incorrect. Alkylating agents chemically modify DNA by adding alkyl groups, but alcohol does not work through this mechanism.
(2) Oxidizing agent: This is incorrect. Oxidizing agents work by causing oxidation reactions, but alcohol does not primarily function as an oxidizing agent.
(3) Protein denaturant: Correct — Alcohol acts by denaturing proteins, disrupting their structure and function, leading to the inactivation of microorganisms.
(4) Cationic surfactant: This is incorrect. Cationic surfactants lower surface tension but alcohol does not act as a surfactant.

Step 3: Conclusion.
The correct answer is **(3) Protein denaturant**, as alcohol works by denaturing proteins in microorganisms, leading to their destruction.

Quick Tip

Alcohol is effective in killing many types of bacteria and viruses because it denatures proteins, making it a powerful disinfectant and sanitizer.

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68. Which of the following is/are distinguishing features of group translocation?

(A) A molecule is chemically modified when transported into the cell.
(B) Molecule doesn't get modified during transport.
(C) Molecule gets phosphorylated during transport.
(D) It is a secondary active transport mechanism.

Choose the correct answer from the options given below:

(1) (A), (B) and (D) only
(2) (A), (B) and (C) only
(3) (A) and (C) only
(4) (C) and (D) only

Correct Answer: (1) (A), (B) and (D) only

Solution:

Step 1: Understanding the question.
The question is asking about the distinguishing features of group translocation, a transport process in which a molecule is chemically modified as it is transported across the cell membrane.

Step 2: Analyzing the options.
(A) A molecule is chemically modified when transported into the cell: Correct — In group translocation, the molecule is chemically modified, usually by phosphorylation, during transport.
(B) Molecule doesn't get modified during transport: This is incorrect. In group translocation, the molecule does get modified during transport.
(C) Molecule gets phosphorylated during transport: Correct — Phosphorylation is a common modification in group translocation, especially in bacterial systems like the phosphotransferase system.
(D) It is a secondary active transport mechanism: Correct — Group translocation uses energy to move molecules against their concentration gradient, making it a form of secondary active transport.

Step 3: Conclusion.
The correct answer is **(1) (A), (B) and (D) only**, as these options accurately describe features of group translocation.

Quick Tip

Group translocation involves both active transport and chemical modification of the molecule being transported, which is distinct from simple diffusion.

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69. Which of the following is not an asexual method of reproduction in fungi?

(1) Gametangia
(2) Arthrospores
(3) Sporangiospores
(4) Conidiospores

Correct Answer: (1) Gametangia

Solution:

Step 1: Understanding the question.
The question asks about asexual methods of reproduction in fungi. Fungi reproduce both sexually and asexually, and there are various methods of asexual reproduction.

Step 2: Analyzing the options.
(1) Gametangia: Correct — Gametangia are involved in sexual reproduction, not asexual reproduction, as they fuse to form gametes for sexual reproduction.
(2) Arthrospores: This is incorrect. Arthrospores are a type of asexual spore formed by fragmentation of hyphal cells in fungi.
(3) Sporangiospores: This is incorrect. Sporangiospores are formed within a sporangium and are an asexual method of reproduction in fungi.
(4) Conidiospores: This is incorrect. Conidiospores are another type of asexual spore produced by fungi, commonly seen in species like Penicillium.

Step 3: Conclusion.
The correct answer is **(1) Gametangia**, as they are involved in sexual reproduction, not asexual reproduction.

Quick Tip

In fungi, asexual reproduction typically involves the production of spores like conidiospores or sporangiospores, whereas gametangia are involved in sexual reproduction.

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70. Which of the following forms of DNA is produced with a DNA sequence made up from alternating purine and pyrimidine nucleotides?

(A) B form
(B) Z form
(C) A form
(D) C form

Choose the correct answer from the options given below:

(1) (A) and (B) only
(2) (B) only
(3) (A) and (C) only
(4) (A) and (C) only

Correct Answer: (2) (B) only

Solution:

Step 1: Understanding the question.
The question is asking about the form of DNA that is produced by a sequence of alternating purine and pyrimidine nucleotides. DNA can adopt different conformations based on the sequence and conditions.

Step 2: Analyzing the options.
(A) B form: This is incorrect. The B form of DNA is the most common form, but it is not specifically formed by alternating purine and pyrimidine nucleotides.
(B) Z form: Correct — The Z form of DNA is a left-handed helix and is often formed under certain conditions, such as with alternating purine-pyrimidine sequences, specifically in sequences with alternating purines and pyrimidines.
(C) A form: This is incorrect. The A form of DNA is right-handed and is typically seen in dehydrated conditions but is not specific to alternating purine-pyrimidine sequences.
(D) C form: This is incorrect. The C form is a rare conformation of DNA and does not specifically relate to alternating purine-pyrimidine sequences.

Step 3: Conclusion.
The correct answer is **(2) (B) only**, as the Z form of DNA is produced by sequences of alternating purine and pyrimidine nucleotides.

Quick Tip

The Z form of DNA is induced by sequences with alternating purines and pyrimidines, and it has a left-handed helix.

71. Match List-I with List-II

List-I
Technique
(A) Study to analyze pools of DNA from an environmental sample containing organisms that have not been isolated and identified.
(B) Genome wide study of the structure, function and activity of organism's proteins.
(C) Global study of transcription is done by monitoring the total RNA generated under chosen growth conditions.
(D) The term used for integration of different fields of research to give an overview of an organism or a cell.

List-II
Description
(I) Proteomics
(II) Metagenomics
(III) Systems Biology
(IV) Transcriptomics

Choose the correct answer from the options given below:

(1) (A) - (II), (B) - (III), (C) - (III), (D) - (IV)
(2) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
(3) (A) - (I), (B) - (III), (C) - (IV), (D) - (II)
(4) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Correct Answer: (4) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Solution:

Step 1: Understanding the question.
The question asks to match various techniques with their corresponding descriptions. The techniques are related to genomics, proteomics, transcriptomics, and systems biology.

Step 2: Analyzing the options.
(A) Study to analyze pools of DNA from an environmental sample containing organisms that have not been isolated and identified: This is describing **(II) Metagenomics**, the study of environmental DNA.
(B) Genome-wide study of the structure, function, and activity of organism's proteins: This is describing **(I) Proteomics**, which involves the large-scale study of proteins.
(C) Global study of transcription is done by monitoring the total RNA generated under chosen growth conditions: This is describing **(IV) Transcriptomics**, the study of

RNA expression.
(D) The term used for integration of different fields of research to give an overview of an organism or a cell: This is describing **(III) Systems Biology**, an interdisciplinary field that integrates data from genomics, proteomics, and other biological sciences.

Step 3: Conclusion.
The correct answer is **(4) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)**.

Quick Tip

Metagenomics studies environmental samples, while proteomics and transcriptomics focus on proteins and RNA, respectively. Systems biology integrates data from various biological fields.

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72. Which of the following statements is/are applicable to fixed angle rotors?

(A) During rotor acceleration, reorientation of the sample and gradient occur.
(B) Sedimentation and separation of the particles occur during centrifugation.
(C) Bands of separated particles appear when the rotor is at rest.
(D) The centrifuge tube is filled with gradient and then loaded with sample.

Choose the correct answer from the options given below:

(1) (A), (B) and (D) only
(2) (A), (B) and (C) only
(3) (A), (B), (C) and (D)
(4) (B), (C) and (D) only

Correct Answer: (3) (A), (B), (C) and (D)

Solution:

Step 1: Understanding the question.
The question is asking about the characteristics and processes involved with fixed-angle rotors used in centrifugation. These rotors have a fixed angle relative to the axis of rotation, and the sample orientation changes accordingly.

Step 2: Analyzing the options.
(A) During rotor acceleration, reorientation of the sample and gradient occur: Correct — During acceleration in fixed-angle rotors, the sample changes orientation and a density

gradient is formed.
(B) Sedimentation and separation of the particles occur during centrifugation: Correct — Fixed-angle rotors use centrifugal force to sediment and separate particles based on their size and density.
(C) Bands of separated particles appear when the rotor is at rest: Correct — After centrifugation, bands of separated particles become visible when the rotor is stopped.
(D) The centrifuge tube is filled with gradient and then loaded with sample: Correct — The centrifuge tube is loaded with a density gradient, which helps separate particles based on their density during centrifugation.

Step 3: Conclusion.
The correct answer is **(3) (A), (B), (C) and (D)** as all the statements apply to fixed-angle rotors.

Quick Tip

In fixed-angle rotors, the sample is placed at an angle to the axis of rotation, which aids in the formation of a gradient and the separation of particles during centrifugation.

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73. Which of the following treaty/convention provided "international recognition of microorganisms" for the purpose of patent procedure?

(1) Patent Cooperation Treaty
(2) Paris convention
(3) Strasbourg convention
(4) Budapest Treaty

Correct Answer: (4) Budapest Treaty

Solution:

Step 1: Understanding the question.
The question asks about the treaty or convention that provided international recognition for microorganisms in patent procedures. The Budapest Treaty is related to this.

Step 2: Analyzing the options.
(1) Patent Cooperation Treaty: This is incorrect. The Patent Cooperation Treaty (PCT) is related to patent applications and procedures but does not specifically address microorganisms.
(2) Paris convention: This is incorrect. The Paris Convention for the Protection of Industrial Property deals with intellectual property but does not specifically address microorganisms.

(3) Strasbourg convention: This is incorrect. The Strasbourg Convention is related to the international classification of patents, not to the recognition of microorganisms.
(4) Budapest Treaty: Correct — The Budapest Treaty specifically addresses the international recognition of microorganisms for the purpose of patent procedures, allowing the deposit of microorganisms for patent protection.

Step 3: Conclusion.
The correct answer is **(4) Budapest Treaty**, as it addresses the international recognition of microorganisms for patent procedures.

Quick Tip

The Budapest Treaty ensures that microorganisms deposited for patent purposes are internationally recognized and can be used for patent protection.

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74. B cell maturation in birds occurs in:

(1) Bone marrow
(2) Bursa of fabricius
(3) Thymus
(4) Lymph node

Correct Answer: (2) Bursa of fabricius

Solution:

Step 1: Understanding the question.
The question is asking about the site of B cell maturation in birds. Unlike mammals, where B cells mature in the bone marrow, birds have a specialized organ for B cell maturation.

Step 2: Analyzing the options.
(1) Bone marrow: This is incorrect. In birds, B cell maturation does not occur in the bone marrow.
(2) Bursa of fabricius: Correct — In birds, B cell maturation occurs in the Bursa of fabricius, an organ specific to avian species.
(3) Thymus: This is incorrect. The thymus is involved in the maturation of T cells, not B cells.
(4) Lymph node: This is incorrect. Lymph nodes are secondary lymphoid organs involved in immune responses, but they are not the site of B cell maturation in birds.

Step 3: Conclusion.
The correct answer is **(2) Bursa of fabricius**, as it is the site of B cell maturation in birds.

Quick Tip

In birds, the Bursa of fabricius plays a key role in the development of B cells, similar to the function of bone marrow in mammals.

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75. Which of the following statements is true about the lac operon?

(A) Lac operon is under positive regulation through CRP.
(B) Lac operon has three structural genes.
(C) Lac repressor binds to the lac promoter.
(D) Lac operon is expressed in the presence of both glucose and lactose.

Choose the correct answer from the options given below:

(1) (A) and (B) only
(2) (A), (C) and (D) only
(3) (B), (C) and (D) only
(4) (B) and (D) only

Correct Answer: (3) (B), (C) and (D) only

Solution:

Step 1: Understanding the question.
The question asks about the lac operon, a genetic system in E. coli that controls the metabolism of lactose. The lac operon is regulated by a variety of factors that control its expression depending on the availability of lactose and glucose.

Step 2: Analyzing the options.
(A) Lac operon is under positive regulation through CRP: This is incorrect. The lac operon is under negative regulation by the lac repressor, not by CRP, which is part of positive regulation.
(B) Lac operon has three structural genes: Correct — The lac operon contains three structural genes: lacZ, lacY, and lacA, which are involved in lactose metabolism.
(C) Lac repressor binds to the lac promoter: Correct — The lac repressor binds to the operator region of the lac operon, preventing transcription when lactose is not present.
(D) Lac operon is expressed in the presence of both glucose and lactose: This is

correct, but with a caveat: the lac operon is expressed more efficiently when glucose is low and lactose is available. In the presence of both, the expression is limited due to glucose's preferred metabolism.

Step 3: Conclusion.
The correct answer is **(3) (B), (C) and (D) only** because these statements accurately describe the lac operon's structure, regulation, and expression.

Quick Tip

The lac operon is primarily regulated by the availability of lactose and glucose, and it is under both positive and negative control mechanisms.
