

CUET PG 2025 Biochemistry Memory based Question Paper With Solution

1. Who is the father of microbiology?

Answer:

The father of microbiology is **Louis Pasteur**, a French biologist and chemist who made groundbreaking contributions to the study of microorganisms. He is best known for his discoveries of the principles of vaccination, microbial fermentation, and pasteurization. His work laid the foundation for the field of microbiology.

Louis Pasteur's significant achievements include:

1. **Germ Theory of Disease:** Pasteur's research demonstrated that microorganisms were the cause of many diseases, which revolutionized medicine and public health. Before this, the theory of spontaneous generation (that life could arise from non-living matter) was widely accepted. Pasteur proved that microorganisms were responsible for the fermentation process and the spoilage of food and beverages.
2. **Pasteurization:** Pasteur developed the process of pasteurization, which involves heating liquids (like milk and wine) to kill harmful bacteria without damaging the liquid itself. This process is still widely used today to ensure the safety and longevity of many food and drink products.
3. **Vaccination Development:** Pasteur is credited with developing vaccines for rabies and anthrax. His work in immunology led to the creation of vaccines that have saved millions of lives.

Quick Tip

Louis Pasteur's work not only advanced microbiology but also had a profound impact on public health, medicine, and food safety. He demonstrated the vital role of microorganisms in both diseases and the preservation of food.

2. What is the PCR sequence?

Answer:

Polymerase Chain Reaction (PCR) is a molecular biology technique used to amplify specific segments of DNA. It allows researchers to produce millions of copies of a DNA segment from a small sample. PCR has been instrumental in numerous fields, including genetics, diagnostics, and forensic science. The PCR process consists of three main steps, and the "PCR sequence" refers to the sequence of processes involved in this technique.

The PCR process involves the following steps:

1. **Denaturation:** In this step, the double-stranded DNA template is heated to about 94–98°C for 20–30 seconds, causing the hydrogen bonds between complementary bases to break and the DNA to denature into two single strands.
2. **Annealing:** The reaction temperature is lowered to 50–65°C for about 20–40 seconds to allow short DNA primers to attach (anneal) to the complementary sequences at the 3' ends of the target DNA region. The primers are designed to bind specifically to the target sequence that will be amplified.
3. **Extension (Elongation):** In this step, the temperature is raised to around 75–80°C, optimal for the DNA polymerase enzyme (usually Taq polymerase) to extend the primers by adding nucleotides to form a new strand of DNA complementary to the original strand. This process continues until the entire target DNA region is copied.

These steps are repeated for 20–40 cycles, doubling the DNA amount with each cycle, resulting in millions of copies of the target DNA sequence. The process is highly specific, as the primers only bind to the regions flanking the target sequence.

Quick Tip

PCR is an essential tool in many biological fields, from detecting pathogens to sequencing genes. The key to PCR's success lies in the design of specific primers and the use of a heat-stable DNA polymerase (Taq polymerase), which allows amplification of DNA without degradation during the high-temperature denaturation step.

3. What is the composition of a lipid raft?

Answer:

Lipid rafts are specialized, dynamic microdomains within the cell membrane that are enriched in cholesterol, sphingolipids, and specific proteins. These rafts serve as platforms for the assembly of signaling molecules, influencing cell signaling, membrane trafficking, and protein sorting. They are important in cellular processes such as endocytosis, signal transduction, and pathogen recognition.

Key Components of Lipid Rafts:

1. **Cholesterol:** Cholesterol is a crucial component of lipid rafts, providing structural integrity and promoting the formation of these microdomains by decreasing membrane fluidity. Cholesterol helps in organizing and stabilizing the raft structure by interacting with sphingolipids and other components, making the membrane more ordered compared to surrounding regions.
2. **Sphingolipids:** Sphingolipids, including sphingomyelin and glycosphingolipids, are another major constituent of lipid rafts. These lipids have long, saturated fatty acid chains that align and interact with cholesterol, contributing to the tightly packed, ordered structure of lipid rafts. Sphingolipids play a significant role in the organization of lipid rafts by forming rigid microdomains that are distinct from the rest of the bilayer.
3. **Glycosylphosphatidylinositol (GPI)-anchored proteins:** GPI-anchored proteins are covalently attached to the membrane through a GPI anchor. These proteins are often found in lipid rafts due to their affinity for the lipid-rich environment. GPI-anchored proteins are involved in various cellular processes, including cell signaling and adhesion.
4. **Transmembrane proteins:** Some transmembrane proteins, particularly those involved in signaling, are also enriched in lipid rafts. These proteins are usually involved in receptor signaling, transport processes, or cell-cell interactions. The spatial organization of these proteins within lipid rafts helps in their efficient function in response to external stimuli.
5. **Other Lipids:** Besides sphingolipids and cholesterol, other lipids, such as phospholipids (e.g., phosphatidylserine, phosphatidylcholine), may also be present in lipid rafts, but in smaller quantities. These lipids contribute to the overall structure and fluidity of the raft.

Quick Tip

Lipid rafts are not static structures; they are dynamic and can change in size and composition in response to cellular signals, making them crucial in organizing and regulating cellular functions, especially in signal transduction and membrane trafficking.

4. Strict vegans lack which vitamin?

Answer:

Strict vegans are at risk of vitamin B12 deficiency because vitamin B12 is predominantly found in animal products like meat, dairy, and eggs. Since vegans do not consume animal-based foods, they often require supplementation or fortified foods to meet their vitamin B12 needs. Vitamin B12 is essential for the production of red blood cells, the maintenance of the nervous system, and DNA synthesis. A deficiency can lead to anemia, nerve damage, and other health issues.

Quick Tip

Vegetarians and vegans should consider B12 supplements or fortified foods to prevent deficiency-related health issues like anemia.

5. Which DNA makes a right-handed helix?

Answer:

A-DNA and B-DNA both make a right-handed helix. These are the two common forms of DNA found in biological systems. In these structures, the helical twist proceeds in the right direction, meaning that if you were to follow the spiral from the bottom to the top, it would twist clockwise. B-DNA is the most prevalent form under physiological conditions, while A-DNA forms under dehydrating conditions.

Quick Tip

Right-handed helices (like B-DNA) are the most stable and common form of DNA, especially under normal cellular conditions.

6. Which DNA makes a left-handed helix?

Answer:

Z-DNA makes a left-handed helix. Unlike the right-handed twists of A-DNA and B-DNA, Z-DNA has a zigzag backbone, and the helix twists in a left-handed direction. Z-DNA is less common and is often formed under certain physiological or experimental conditions, such as high salt concentrations or negative supercoiling.

Quick Tip

Z-DNA is less common and is often induced under specific conditions, such as negative supercoiling or high salt concentrations.

7. What is the most stable form of glucose?

Answer:

The most stable form of glucose is the chair conformation. In the chair conformation, the glucose molecule adopts a stable, three-dimensional form that minimizes steric clashes between atoms. This form is the most energetically favorable and commonly found in nature, particularly in polysaccharides like starch and cellulose.

Quick Tip

Glucose's chair conformation is the most stable, allowing it to fit better into polysaccharide chains like cellulose and starch.

8. What is the linkage in amylose?

Answer:

Amylose consists of glucose units linked by 1-4 glycosidic bonds. This linkage is between the first carbon of one glucose molecule and the fourth carbon of the next. Amylose is a component of starch and forms a helical structure due to the 1-4 linkage.

Quick Tip

Amylose, a form of starch, consists of glucose units linked by 1-4 glycosidic bonds, forming a helical structure that aids in energy storage.

9. What is involved in substrate-level phosphorylation?

Answer:

Substrate-level phosphorylation involves the transfer of a phosphate group from a high-energy substrate molecule to ADP to form ATP. Enzymes such as pyruvate kinase and phosphoglycerate kinase are involved in this process. These enzymes catalyze reactions where a phosphate group is directly transferred to ADP, bypassing the need for the electron transport chain.

Quick Tip

Substrate-level phosphorylation directly generates ATP from high-energy molecules without involving the electron transport chain.

10. After KDEL mutation, it became KEEL. Where did the mutation happen?

Answer:

The mutation in the KDEL sequence occurred at the third position, where the amino acid Aspartic acid (D) was replaced by Glutamic acid (E). The KDEL sequence is a C-terminal signal that helps proteins return to the endoplasmic reticulum from the Golgi apparatus. The mutation from D to E affects the protein's recognition and transport function.

Quick Tip

Single amino acid changes, like in the KDEL to KEEL mutation, can significantly impact protein localization and function.
