

CUET PG 2026 Life Science Question Paper with Solutions(Memory Based)

Time Allowed :1 Hour 30 Mins	Maximum Marks :300	Total Questions :75
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General Instructions

Read the following instructions very carefully and strictly follow them:

- The exam lasts 90 minutes (1 hour 30 minutes).
- There are 75 Multiple Choice Questions (MCQs) to be answered.
- +4 marks for every correct answer. -1 mark (negative marking) for every incorrect answer. 0 marks for unanswered or un-attempted questions.
- For any discrepancy in questions, the English version is considered final (except for language-specific papers).
- Click one of the four options to choose an answer.
- You must click "Save & Next" to confirm your response. Only saved answers are considered for evaluation.
- Use "Mark for Review & Next" to flag a question for later. You can unselect or change your answer using the "Clear Response" button.
- All calculations must be done on the Rough Sheets provided at the centre. These must be returned to the invigilator after the exam.

1. Which protein is often referred to as the "guardian of the genome" due to its role in cell cycle arrest?

- (A) p21
- (B) p53
- (C) Cyclin D
- (D) Rb protein

Correct Answer: (2) p53

Solution:

Concept: The cell cycle is tightly regulated by several proteins that ensure DNA integrity and proper cell division. When DNA damage occurs, specific proteins halt the cell cycle so that the cell can repair the damage before continuing division. One of the most important regulatory proteins involved in this process is **p53**.

p53 is often called the "**guardian of the genome**" because it monitors DNA damage and prevents the proliferation of genetically unstable cells. If DNA damage is detected, p53 activates pathways that either pause the cell cycle for repair or trigger programmed cell death (apoptosis) if the damage is irreparable.

Step 1: Understanding the role of p53 in the cell cycle.

The protein p53 is a tumor suppressor that responds to cellular stress such as DNA damage. When activated, p53 functions as a transcription factor and stimulates the expression of genes involved in cell cycle arrest.

Step 2: Cell cycle arrest through p53 activity.

p53 activates the transcription of the gene encoding **p21**. The p21 protein inhibits cyclin-dependent kinases (CDKs), preventing progression from the G1 phase to the S phase of the cell cycle. This pause allows the cell time to repair damaged DNA.

Step 3: Why p53 is called the “guardian of the genome”.

Because p53 prevents the replication of damaged DNA and maintains genomic stability, it acts as a safeguard for the genetic material of the cell. If DNA damage cannot be repaired, p53 can initiate apoptosis, thereby preventing the propagation of mutated cells.

Thus, the protein known as the “guardian of the genome” is **p53**.

Quick Tip

Quick Memory Trick:

p53 = Protects DNA.

Whenever DNA damage occurs, p53 stops the cell cycle and either repairs the DNA or eliminates the damaged cell.

2. What is the standard sequence of steps in a PCR (Polymerase Chain Reaction) cycle?

- (A) Annealing → Denaturation → Extension
- (B) Denaturation → Annealing → Extension
- (C) Extension → Denaturation → Annealing
- (D) Annealing → Extension → Denaturation

Correct Answer: (2) Denaturation → Annealing → Extension

Solution:

Concept: Polymerase Chain Reaction (PCR) is a molecular biology technique used to amplify a specific segment of DNA. It involves repeated cycles of temperature changes that allow DNA strands to separate, primers to bind, and new DNA strands to be synthesized. Each PCR cycle consists of three main steps.

Step 1: Denaturation.

The reaction mixture is heated to about ($94^{\circ}\text{C} - 98^{\circ}\text{C}$). At this high temperature, the double-stranded DNA separates into two single strands as the hydrogen bonds between complementary bases break.

Step 2: Annealing.

The temperature is lowered to approximately ($50^{\circ}\text{C} - 65^{\circ}\text{C}$). At this stage, short DNA primers bind (anneal) to the single-stranded DNA templates.

Step 3: Extension (Elongation).

The temperature is raised to around (72°C), which is the optimal temperature for the enzyme Taq polymerase. Thus, the correct order of PCR steps is: [Denaturation → Annealing → Extension]

Quick Tip

Remember PCR steps using the mnemonic **DAE**:
Denaturation → Annealing → Extension.

3. Which nitrogen source is most commonly used by plants for inorganic nitrogen fixation?

- (A) Nitrite (NO_2^-)
- (B) Nitrate (NO_3^-)
- (C) Ammonia (NH_3)
- (D) Molecular nitrogen (N_2)

Correct Answer: (2) Nitrate (NO_3^-)

Solution:

Concept: Plants require nitrogen for the synthesis of essential biomolecules such as amino acids, nucleic acids, and chlorophyll. However, plants cannot directly utilize atmospheric nitrogen (N_2). *Instead, they absorb nitrogen from the soil mainly in inorganic forms.*

Step 1: Forms of nitrogen available in soil.

The major inorganic nitrogen forms present in soil are: [NO_3^- ; (nitrate) and NH_4^+ ; (ammonium)]

Step 2: Most commonly absorbed nitrogen form.

Among these forms, **nitrate** (NO_3^-) *is the most abundant and commonly absorbed form of nitrogen by plants in aerated soils.*

Step 3: Utilization in plant metabolism.

Once absorbed, nitrate is reduced first to nitrite and then to ammonium inside plant cells. This ammonium is incorporated into amino acids through biochemical pathways such as the GS-GOGAT cycle.

Therefore, the most commonly used inorganic nitrogen source by plants is nitrate (NO_3^-).

Quick Tip

Plants mainly absorb nitrogen as nitrate (NO_3^-) from soil. Remember : Nitrate = Major plant nitrogen source.

4. During cellular fractionation, which organelle typically forms part of the pellet when centrifuged at 1000g for 10 minutes?

- (A) Ribosomes
- (B) Nucleus
- (C) Endoplasmic Reticulum
- (D) Lysosomes

Correct Answer: (2) Nucleus

Solution:

Concept: Cellular fractionation is a laboratory technique used to separate cellular components based on their size and density using differential centrifugation. During centrifugation, heavier and larger organelles sediment faster and form pellets at lower centrifugal speeds.

Step 1: Principle of differential centrifugation.

When a homogenized cell extract is centrifuged at increasing speeds, organelles sediment in the order of their size and density. Larger organelles pellet first, while smaller components remain in the supernatant.

Step 2: Low-speed centrifugation.

At approximately (1000g) for about 10 minutes, the largest and heaviest cellular structures sediment. These typically include: [Nuclei, unbroken cells, and large cell debris]

Step 3: Subsequent centrifugation steps.

Higher centrifugal forces are required to pellet smaller organelles:

- (10,000g): mitochondria and lysosomes
- (100,000g): microsomes and fragments of endoplasmic reticulum
- (>100,000g): ribosomes

Thus, during centrifugation at (1000g) for 10 minutes, the organelle that forms part of the pellet is the nucleus.

Quick Tip

In differential centrifugation:

Low speed → Large organelles (Nucleus)

Higher speed → Smaller organelles.

5. In gel electrophoresis of DNA, toward which electrode do the DNA fragments migrate?

- (A) Positive electrode (Anode)
- (B) Negative electrode (Cathode)
- (C) Both electrodes equally
- (D) They do not migrate

Correct Answer: (1) Positive electrode (Anode)

Solution:

Concept: Gel electrophoresis is a technique used to separate DNA fragments based on their size by applying an electric field across a gel matrix. DNA molecules carry an overall negative charge due to the presence of phosphate groups in their backbone.

Step 1: Charge on DNA molecules.

The backbone of DNA contains phosphate groups, each carrying a negative charge.

As a result, DNA fragments behave as negatively charged molecules in an electric field.

Step 2: Movement in an electric field.

When an electric current is applied, negatively charged molecules migrate toward the positively charged electrode (anode).

Step 3: Separation in the gel matrix.

As DNA fragments move through the agarose gel, smaller fragments migrate faster and travel farther than larger fragments, allowing separation based on size.

Therefore, DNA fragments migrate toward the positive electrode (anode) during gel electrophoresis.

Quick Tip

DNA has a negative phosphate backbone. Hence in electrophoresis:
DNA → moves toward the positive electrode (Anode).

6. What is the primary composition of lipid rafts found in plasma membranes?

- (A) Phospholipids and carbohydrates
- (B) Cholesterol and sphingolipids
- (C) Proteins and nucleic acids
- (D) Glycoproteins and triglycerides

Correct Answer: (2) Cholesterol and sphingolipids

Solution:

Concept: Lipid rafts are specialized microdomains in the plasma membrane that are more ordered and tightly packed than the surrounding membrane. They serve as platforms for cell signaling, membrane trafficking, and protein sorting.

Step 1: Structure of the plasma membrane.

The plasma membrane mainly consists of phospholipids, proteins, and cholesterol arranged in a fluid mosaic structure. However, some regions form distinct microdomains called lipid rafts.

Step 2: Composition of lipid rafts.

Lipid rafts are enriched in: [Cholesterol and Sphingolipids] These molecules pack tightly together, creating a more ordered and less fluid region of the membrane.

Step 3: Functional importance.

These domains help organize membrane proteins involved in signaling pathways and play roles in processes such as endocytosis and immune responses.

Thus, the primary composition of lipid rafts is cholesterol and sphingolipids.

Quick Tip

Lipid Rafts = Cholesterol + Sphingolipids. These domains act as signaling platforms in the plasma membrane.

7. Which immunoglobulin class is primarily involved in mucosal immunity?

- (A) IgG
- (B) IgA
- (C) IgM
- (D) IgE

Correct Answer: (2) IgA

Solution:

Concept: Immunoglobulins (antibodies) are proteins produced by plasma cells that play a crucial role in the immune response. Different classes of immunoglobulins have distinct functions in the body.

Step 1: **Understanding mucosal immunity.**

Mucosal surfaces such as the respiratory tract, gastrointestinal tract, and urogenital tract are constantly exposed to pathogens. Specialized immune mechanisms protect these surfaces.

Step 2: **Role of IgA.**

Immunoglobulin A (IgA) is the primary antibody found in mucosal secretions including:

- Saliva
- Tears
- Breast milk
- Intestinal secretions

Step 3: **Function of IgA.**

IgA prevents pathogens from attaching to mucosal epithelial cells and neutralizes toxins and viruses before they enter tissues.

Thus, the immunoglobulin primarily responsible for mucosal immunity is IgA.

Quick Tip

IgA = Mucosal Antibody.
Found in saliva, tears, mucus, and breast milk.

8. According to Chargaff's rules, which base relationship is constant across all species?

- (A) (A = C)
- (B) (A = G)
- (C) (A = T)
- (D) (G = T)

Correct Answer: (3) (A = T)

Solution:

Concept: Chargaff's rules describe the base composition relationships found in double-stranded DNA. These rules were discovered by the biochemist Erwin Chargaff and helped in understanding the structure of DNA.

Step 1: **Complementary base pairing in DNA.**

In double-stranded DNA, nitrogenous bases pair specifically through hydrogen bonding: [Adenine (A) ↔ Thymine (T), Guanine (G) ↔ Cytosine (C)]

Step 2: **Chargaff's base ratio observation.**

Chargaff observed that in DNA extracted from different organisms: [A = T and G = C]

Step 3: **Implication of the rule.**

Although the overall base composition may vary among species, the pairing rule ensures that the amount of adenine is always equal to thymine, and guanine equals cytosine.

Thus, according to Chargaff's rules, the constant base relationship is: [A = T]

Quick Tip

Chargaff Rule:

(A = T) and (G = C).

Purines equal pyrimidines in double-stranded DNA.

9. What happens to the V_{max} of an enzyme-catalyzed reaction when the substrate concentration is equal to the K_m ?

- (A) ($V = V_{max}$)
- (B) ($V = \frac{V_{max}}{2}$)
- (C) ($V = 2V_{max}$)
- (D) ($V = 0$)

Correct Answer: (2) ($V = \frac{V_{max}}{2}$)

Solution:

Concept: The relationship between substrate concentration and reaction velocity in enzyme-catalyzed reactions is described by the Michaelis–Menten equation: [$V = \frac{V_{max}[S]}{K_m + [S]}$] where (V) is the reaction velocity, (V_{max}) is the maximum velocity, (K_m) is the Michaelis constant, and ([S]) is the substrate concentration.

Step 1: **Substitute the condition ([S] = K_m).**

If the substrate concentration is equal to the Michaelis constant : [$V = \frac{V_{max}K_m}{K_m + K_m}$]

Step 2: Simplify the expression. $[V = V_{max} \frac{K_m}{2K_m}]$

Step 3: Final result. $[V = \frac{V_{max}}{2}]$

Thus, when the substrate concentration equals (K_m), the reaction velocity is half of the maximum

Quick Tip

Key enzyme kinetics rule: When ($[S] = K_m$), the reaction velocity is ($\frac{V_{max}}{2}$).

10. Which hormone is primarily responsible for the "fight or flight" response in human physiology?

- (A) Cortisol
- (B) Adrenaline (Epinephrine)
- (C) Insulin
- (D) Thyroxine

Correct Answer: (2) Adrenaline (Epinephrine)

Solution:

Concept: The "fight or flight" response is a physiological reaction that occurs when the body encounters a stressful or threatening situation. This response prepares the body for rapid action.

Step 1: Role of the sympathetic nervous system.

When the brain perceives danger, the sympathetic nervous system stimulates the adrenal medulla to release hormones into the bloodstream.

Step 2: Release of adrenaline.

The adrenal medulla secretes the hormone adrenaline (epinephrine), which rapidly prepares the body to respond to stress.

Step 3: Physiological effects of adrenaline.

Adrenaline produces several immediate effects:

- Increases heart rate and blood pressure
- Dilates airways in the lungs
- Increases blood glucose levels
- Redirects blood flow to muscles

These changes enable the body to either confront the threat or escape from it.

Therefore, the hormone primarily responsible for the "fight or flight" response is adrenaline (epinephrine).

Quick Tip

Fight or Flight Hormone = Adrenaline.
Released from the adrenal medulla during stress.

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11. In the lac operon, which molecule acts as the inducer to initiate transcription?
- (A) Lactose
 - (B) Allolactose
 - (C) Glucose
 - (D) Galactose

Correct Answer: (2) Allolactose

Solution:

Concept: The lac operon is a gene regulatory system found in *E. coli* that controls the metabolism of lactose. It is an example of an inducible operon, meaning that transcription is normally off but can be activated in the presence of an inducer molecule.

Step 1: Structure of the lac operon.

The lac operon consists of:

- Structural genes: (lacZ), (lacY), (lacA)
- Promoter and operator regions
- A regulatory gene producing the lac repressor

Step 2: Role of the lac repressor.

In the absence of lactose, the lac repressor protein binds to the operator region and blocks RNA polymerase from transcribing the structural genes.

Step 3: Action of the inducer molecule.

When lactose enters the cell, a small portion of it is converted into allolactose. Allolactose binds to the lac repressor and changes its shape, preventing it from binding to the operator.

Step 4: Initiation of transcription.

Once the repressor is removed from the operator, RNA polymerase can bind to the promoter and initiate transcription of the lac operon genes.

Thus, the molecule that acts as the true inducer of the lac operon is allolactose.

Quick Tip

Lac Operon Inducer = Allolactose.
It binds the lac repressor and allows transcription.

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12. Which technique is specifically used to detect the presence of a specific DNA sequence in a sample?
- (A) Western blotting
 - (B) Southern blotting
 - (C) Northern blotting

(D) ELISA

Correct Answer: (2) Southern blotting

Solution:

Concept: Blotting techniques are widely used in molecular biology to detect specific biomolecules such as DNA, RNA, or proteins. Each blotting method is designed for a particular type of molecule.

Step 1: Understanding blotting techniques.

Different blotting methods detect different biomolecules:

- Southern blotting → DNA
- Northern blotting → RNA
- Western blotting → Proteins

Step 2: Principle of Southern blotting.

In Southern blotting, DNA fragments are first separated by gel electrophoresis. These fragments are then transferred onto a membrane and hybridized with a labeled DNA probe that is complementary to the target sequence.

Step 3: Detection of specific DNA sequences.

If the probe binds to the complementary DNA sequence on the membrane, the presence of the specific DNA fragment can be detected using radioactive or fluorescent signals.

Therefore, the technique used to detect a specific DNA sequence is Southern blotting.

Quick Tip

Blotting rule:

Southern → DNA

Northern → RNA

Western → Protein

13. What is the role of Topoisomerase during the process of DNA replication?

- (A) Synthesizes RNA primers
- (B) Unwinds the DNA helix
- (C) Relieves supercoiling ahead of the replication fork
- (D) Joins Okazaki fragments

Correct Answer: (3) Relieves supercoiling ahead of the replication fork

Solution:

Concept: During DNA replication, the double helix must unwind to allow replication machinery to access the DNA strands. This unwinding creates tension and

supercoiling ahead of the replication fork, which must be relieved to allow replication to continue smoothly.

Step 1: Action of helicase.

DNA helicase unwinds the double helix by breaking hydrogen bonds between complementary base pairs. This unwinding generates torsional strain and supercoiling in the DNA ahead of the replication fork.

Step 2: Role of topoisomerase.

Topoisomerase enzymes relieve this tension by temporarily cutting one or both strands of the DNA molecule.

Step 3: Relief of supercoiling.

After cutting the DNA, topoisomerase allows the DNA strands to rotate and release the accumulated tension. The enzyme then reseals the broken DNA strands.

This process prevents excessive twisting and ensures smooth progression of the replication machinery.

Thus, the primary role of topoisomerase during DNA replication is to relieve supercoiling ahead of the replication fork.

Quick Tip

Replication enzymes memory trick:

Helicase → Unwinds DNA

Topoisomerase → Relieves supercoiling

Ligase → Joins Okazaki fragments

14. Which amino acid is the universal initiator for protein synthesis in eukaryotes?

- (A) Methionine
- (B) Valine
- (C) Leucine
- (D) Alanine

Correct Answer: (1) Methionine

Solution:

Concept: Protein synthesis (translation) begins with a specific initiator amino acid that is incorporated into the first position of the growing polypeptide chain. The initiator amino acid is delivered by a specialized initiator tRNA that recognizes the start codon on mRNA.

Step 1: Start codon in translation.

The process of translation typically begins at the start codon: [AUG] This codon signals the ribosome to begin protein synthesis.

Step 2: Initiator amino acid in eukaryotes.

In eukaryotic cells, the codon (AUG) codes for the amino acid methionine. A special initiator tRNA carrying methionine recognizes this start codon and binds to the ribosome to initiate translation.

Step 3: Difference between prokaryotes and eukaryotes.

Although methionine is also the starting amino acid in prokaryotes, it is modified into N-formylmethionine (fMet) in bacteria.

Thus, the universal initiator amino acid for protein synthesis in eukaryotes is methionine.

Quick Tip

Start Codon (AUG) → Methionine.

In prokaryotes: (fMet) (formyl-methionine).

In eukaryotes: Methionine.

15. What are the two primary components of a Typhoid Vi vaccine?

- (A) Vi capsular polysaccharide and carrier protein
- (B) Lipopolysaccharide and toxin
- (C) Attenuated bacteria and adjuvant
- (D) DNA plasmid and viral vector

Correct Answer: (1) Vi capsular polysaccharide and carrier protein

Solution:

Concept: Typhoid fever is caused by the bacterium *Salmonella enterica* serovar Typhi. One of the important virulence factors of this bacterium is the Vi (virulence) capsular polysaccharide antigen, which plays a key role in immune evasion. Vaccines targeting this antigen help the immune system recognize and combat the pathogen.

Step 1: Vi capsular polysaccharide antigen.

The Vi antigen is a polysaccharide capsule present on the surface of *Salmonella Typhi*. This antigen is used as the main immunogenic component of the Typhoid Vi vaccine.

Step 2: Need for a carrier protein.

Polysaccharides alone often produce weak immune responses, particularly in young children. To enhance immunogenicity, the Vi polysaccharide is conjugated to a carrier protein.

Step 3: Formation of the conjugate vaccine.

When the Vi capsular polysaccharide is linked to a carrier protein (such as tetanus toxoid), it stimulates a stronger and longer-lasting immune response.

Thus, the two primary components of a Typhoid Vi vaccine are: [Vi capsular polysaccharide + carrier protein]

Quick Tip

Typhoid Vi Vaccine = Vi Polysaccharide + Carrier Protein.

This conjugation enhances immune response and memory.

