CUET PG 2026 Life Science Question Paper with Solutions

Time Allowed :1 Hour 30 Minutes	**Maximum Marks :**300	**Total Questions :**75

General Instructions

Read the following instructions very carefully and strictly follow them:

- The Question Paper consists of 75 Multiple Choice Questions (MCQs).
- Total marks for the exam is 300.
- The total duration is 90 minutes; a, timer on the screen will display the remaining time, and the exam will automatically submit when the time reaches zero.
- For every correct answer, 4 marks (+4) will be awarded to the candidate, and a 1 mark (-1) will be deducted for every incorrect answer.
- Question papers are available in both English and Hindi.

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: (B) p53

Solution:
Topic: Cell Cycle Regulation
The cell cycle is controlled by various checkpoints that ensure DNA is intact before division. Tumor suppressor proteins act as regulatory signals to prevent the multiplication of damaged cells.
Steps:

- **Understanding the Question:** We need to identify the specific regulatory protein known as the "guardian of the genome" because of its ability to stop the cell cycle when DNA is damaged.
- **Key Formulas and Approach:** Focus on tumor suppressors. When DNA damage is detected, a specific protein acts as a transcription factor to trigger repair or cell death.
- **Detailed Solution:**
  1. The protein **p53** acts as a cellular monitor for DNA damage.
  2. Upon detecting stress or damage, p53 levels rise and it induces the expression of p21, which inhibits CDKs to halt the cell cycle in the G1 phase.

3. This pause allows time for DNA repair; if repair is impossible, p53 triggers apoptosis (programmed cell death).
4. Because it preserves the integrity of the genetic material by preventing mutations from being passed on, it is nicknamed the "guardian of the genome."

> Quick Tip
>
> Think of p53 as a "Security Guard." It patrols the DNA; if it finds a problem, it sounds the alarm to stop the cycle and fix the error before allowing the "factory" (cell) to continue.

---

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: (B) Denaturation → Annealing → Extension

Solution:
Topic: Molecular Biology (PCR)
Polymerase Chain Reaction (PCR) is a technique used to make millions of copies of a specific DNA segment through repeated cycles of heating and cooling.
Steps:

- **Understanding the Question:** The question asks for the chronological order of the three main thermal phases that occur in one single PCR cycle.
- **Key Formulas and Approach:** PCR follows a logical physical process: first, separate the strands; second, let primers find their match; third, build the new strands.
- **Detailed Solution:**
  1. **Denaturation:** High heat ($\sim 94^{\circ}C$) is applied to break the hydrogen bonds between DNA strands, turning double-stranded DNA into single strands.
  2. **Annealing:** The temperature is lowered ($\sim 50 - 65^{\circ}C$) so that DNA primers can bind (anneal) to their complementary sequences on the template strands.
  3. **Extension:** The temperature is raised slightly ($\sim 72^{\circ}C$) so that *Taq polymerase* can add dNTPs to the primers, synthesizing a new DNA strand.

> Quick Tip
>
> Use the mnemonic **D.A.E.** (like the word "Day"): **D**enaturation (Unzip) → **A**nnealing (Stick) → **E**xtension (Grow).

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: (B) Nitrate (NO_3^-)

Solution:
Topic: Plant Nutrition
Plants require nitrogen for growth, but they cannot utilize the abundant N_2 in the atmosphere directly. They must absorb inorganic nitrogen from the soil.
Steps:

- **Understanding the Question:** Which specific chemical form of nitrogen do plants primarily take up through their roots from the soil solution?
- **Key Formulas and Approach:** Nitrogen in the soil is converted by bacteria through nitrification. Most plants prefer the form that is most stable and available in aerated soils.
- **Detailed Solution:**
  1. Although plants can absorb ammonium (NH_4^+), **Nitrate (NO_3^-)** is the most prevalent and mobile form of nitrogen in most agricultural soils.
  2. Bacteria in the soil convert ammonia into nitrite and then into nitrate.
  3. Once absorbed, the plant reduces nitrate back to ammonium internally to incorporate it into amino acids.

Quick Tip

While N_2 is in the air and NH_3 is in fertilizers, **Nitrate (NO_3^-)** is the actual "ready-to-drink" version for most plant roots in the soil.

---

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: (B) Nucleus

Solution:
Topic: Cell Biology (Cell Fractionation)
Cellular fractionation uses differential centrifugation to separate organelles based on their size and density.
Steps:

- **Understanding the Question:** We need to identify which organelle is heavy enough to settle (pellet) at a relatively low speed of 1000g.
- **Key Formulas and Approach:** Larger and denser particles sediment faster at lower gravitational forces (g). Smaller particles require much higher speeds.
- **Detailed Solution:**
  1. At the lowest speed (**1000g**), the largest and heaviest components like the **Nucleus** and whole cells settle first.
  2. At medium speeds ($\sim 10,000 - 20,000g$), mitochondria and lysosomes pellet.
  3. At very high speeds ($\sim 100,000g$), microsomes (ER fragments) and small vesicles settle.
  4. Ribosomes, being the smallest, require the highest speeds and longest times to pellet.

> Quick Tip
>
> Think of centrifugation like a race to the bottom: the "Heavyweights" (Nuclei) finish first at low speeds, while the "Lightweights" (Ribosomes) stay floating until pushed very hard.

---

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: (A) Positive electrode (Anode)

Solution:
Topic: Molecular Biology (Gel Electrophoresis)
Gel electrophoresis is a method used to separate DNA fragments based on their length by pulling them through a gel matrix using an electric current.
Steps:

- **Understanding the Question:** To determine the direction of migration, we must know the electrical charge of DNA and basic laws of electrostatics.
- **Key Formulas and Approach:** DNA contains a phosphate backbone (PO_4^{3-}). Opposite charges attract.

- **Detailed Solution:**
  1. DNA is a **negatively charged** molecule because of the phosphate groups in its sugar-phosphate backbone.
  2. When placed in an electric field, a negative molecule will move away from the negative pole (cathode) and toward the **positive pole (anode)**.
  3. As the fragments move toward the anode, the gel matrix acts as a sieve, allowing smaller fragments to move faster than larger ones.

> Quick Tip
>
> Remember: **DNA is Negative**, so it runs to the **Red** (Positive/Anode). "Run to the Red" is a common laboratory phrase for electrophoresis.

---

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: (B) Cholesterol and sphingolipids

Solution:
Topic: Cell Membrane Structure
The plasma membrane is not uniform; it contains specific microdomains called lipid rafts that are more rigid and organized than the surrounding phospholipid bilayer.
Steps:

- **Understanding the Question:** The question asks for the two specific types of molecules that pack together to create these stabilized "rafts" in the membrane.
- **Key Formulas and Approach:** Lipid rafts are defined by their resistance to detergents and their high concentration of saturated lipids and stabilizing sterols.
- **Detailed Solution:**
  1. Lipid rafts are enriched in **Cholesterol**, which acts as a "glue" to stabilize the domain.
  2. They also contain high concentrations of **Sphingolipids**, which have longer and more saturated hydrocarbon tails compared to standard phospholipids.
  3. This combination allows for tighter packing, creating a stable platform for signaling proteins.

> Quick Tip
>
> Think of lipid rafts as "solid ice" floating in a "liquid ocean" of phospholipids. The "ice" is made of **Cholesterol and Sphingolipids**.

7. Which immunoglobulin class is primarily involved in mucosal immunity?
(A) IgG
(B) IgA
(C) IgM
(D) IgE

Correct Answer: (B) IgA

Solution:
Topic: Immunology (Antibodies)
Immunoglobulins (antibodies) are categorized into five classes (IgG, IgA, IgM, IgE, IgD), each serving a unique role in the body's defense system.
Steps:

- **Understanding the Question:** Which class of antibody is secreted onto surfaces like the gut, respiratory tract, and in body fluids like saliva?
- **Key Formulas and Approach:** Focus on secretory immunity. One specific antibody forms dimers and is transported across epithelial cells.
- **Detailed Solution:**
  1. **IgA** is the predominant antibody found in mucosal secretions (tears, saliva, colostrum, and secretions from the genitourinary and digestive tracts).
  2. It exists as a dimer (two units joined by a J-chain) in secretions, which makes it resistant to digestion by enzymes in those environments.
  3. Its primary role is to prevent pathogens from attaching to and penetrating the epithelial lining.

Quick Tip

Remember: **IgA = "Surface" Armor.** It is found in everything that "leaves" or "lines" the body (tears, spit, milk, mucus).

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: (C) (A = T)

Solution:
Topic: Molecular Genetics (DNA Structure)
Erwin Chargaff discovered that DNA composition follows specific rules regarding the ratio of nitrogenous bases, which later helped Watson and Crick build the double helix model.
Steps:

- **Understanding the Question:** Which pair of DNA bases always exists in a 1:1 ratio because they pair with each other?
- **Key Formulas and Approach:** Chargaff's Rule states that in double-stranded DNA, the amount of Purines = the amount of Pyrimidines. Specifically, $[A] = [T]$ and $[G] = [C]$.
- **Detailed Solution:**
  1. Adenine (A) always hydrogen bonds with Thymine (T).
  2. Guanine (G) always hydrogen bonds with Cytosine (C).
  3. Therefore, in any double-stranded DNA molecule, the total number of A's must equal the total number of T's ($A = T$), and the number of G's must equal the number of C's ($G = C$).

> Quick Tip
>
> Think of DNA as a puzzle: A only fits with T, and G only fits with C. You can't have one side of the puzzle piece without the other!

---

9. What happens to the Vmax of an enzyme-catalyzed reaction when the substrate concentration is equal to the Km?
(A) $(V = V_{max})$
(B) $(V = \frac{V_{max}}{2})$
(C) $(V = 2V_{max})$
$(D)(V = 0)$

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

Solution:
Topic: Enzyme Kinetics
The Michaelis-Menten model describes how the initial rate of an enzymatic reaction changes with the concentration of the substrate.
Steps:

- **Understanding the Question:** What is the velocity (V) of a reaction when the amount of substrate (S) exactly matches the Michaelis constant (K_m)?
- **Key Formulas and Approach:** Use the Michaelis-Menten Equation: $V = \frac{V_{max}[S]}{K_m + [S]}$.
- **Detailed Solution:**

1. Substitute $[S] = K_m$ into the equation:
2. $V = \frac{V_{max} \cdot K_m}{K_m + K_m}$
3. $V = \frac{V_{max} \cdot K_m}{2 \cdot K_m}$
4. The K_m terms cancel out, leaving $V = \frac{V_{max}}{2}$.
5. This shows that K_m is defined as the substrate concentration at which the reaction rate is exactly half of its maximum.

> **Quick Tip**
>
> K_m is essentially the "Halfway Point." It tells you how much substrate you need to get the enzyme running at 50% speed.

---

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: (B) Adrenaline (Epinephrine)

Solution:
Topic: Endocrinology (Stress Hormones)
The "fight or flight" response is an evolutionary survival mechanism that prepares the body to either stay and deal with a threat or run away to safety.
Steps:

- **Understanding the Question:** Which hormone is released almost instantly by the adrenal glands to increase heart rate and energy during a sudden crisis?
- **Key Formulas and Approach:** Differentiate between acute stress (instant) and chronic stress (long-term).
- **Detailed Solution:**
  1. **Adrenaline (Epinephrine)** is secreted by the adrenal medulla in response to acute stress.
  2. It causes immediate physiological changes: increased heart rate, dilation of pupils, and mobilization of glucose for energy.
  3. While Cortisol is also a stress hormone, it is involved in long-term stress regulation rather than the immediate "fight or flight" burst.

Quick Tip

Think of **Adrenaline** as the "Turbo Button" for your body. It's for fast, immediate action. **Cortisol** is more like a "Slow Burn" for long-lasting stress.

---

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

Correct Answer: (B) Allolactose

Solution:
Topic: Gene Regulation (lac operon)
The *lac* operon is a set of genes in bacteria used for lactose metabolism. It is only turned on when lactose is present and glucose is absent.
Steps:

- **Understanding the Question:** What is the actual signal molecule that binds to the repressor to "turn on" the genes?
- **Key Formulas and Approach:** Distinguish between the sugar source (lactose) and the chemical signal (the inducer).
- **Detailed Solution:**
  1. When lactose enters the cell, a small amount is converted by the enzyme β-galactosidase into an isomer called **Allolactose**.
  2. Allolactose acts as the **inducer** by binding to the *lac* repressor protein.
  3. This binding causes the repressor to change shape and release the DNA, allowing RNA polymerase to transcribe the genes.
  4. Thus, while lactose is the "fuel," Allolactose is the actual "key" that unlocks the operon.

Quick Tip

Lactose is the "Guest" arriving at the party, but **Allolactose** is the "Invitation" that actually opens the front door!

---

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: (B) Southern blotting

Solution:
Topic: Molecular Biology Techniques
Blotting techniques allow researchers to identify specific molecules within a complex mixture by transferring them to a membrane and using a probe.
Steps:

- **Understanding the Question:** We need to match the specific "Direction" of the blot name (Southern, Northern, Western) to the molecule it detects (DNA, RNA, Protein).
- **Key Formulas and Approach:** Use the SNOW DROP mnemonic.
- **Detailed Solution:**
  1. **Southern Blotting** (named after Edwin Southern) is used for **DNA**.
  2. **Northern Blotting** is used for **RNA**.
  3. **Western Blotting** is used for **Proteins**.
  4. ELISA is an antibody-based detection method, usually for proteins/antigens, but not a "blotting" technique.

Quick Tip

Use **SNOW DROP**: **S**outhern = **D**NA, **N**orthern = **R**NA, (**O**mit **O**s), **W**estern = **P**rotein.

---

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: (C) Relieves supercoiling ahead of the replication fork

Solution:
Topic: DNA Replication
As the DNA double helix is pulled apart by helicase, the parts of the DNA that are still twisted together become even more tightly wound, creating physical tension.
Steps:

- **Understanding the Question:** What specific enzyme is responsible for preventing the DNA from "tangling" or getting too tight to open?

- **Key Formulas and Approach:** Replication creates "torsional strain." An enzyme must cut, rotate, and reseal the DNA to fix this.
- **Detailed Solution:**
  1. Helicase unwinds the DNA, which causes **supercoiling** (over-twisting) further down the line.
  2. **Topoisomerase** (specifically DNA Gyrase in bacteria) travels ahead of the replication fork.
  3. It makes temporary cuts in the sugar-phosphate backbone, allows the DNA to swivel to release tension, and then glues it back together.
  4. Without it, the DNA would become so tightly knotted that replication would stop.

> Quick Tip
>
> Think of Topoisomerase as a "Detangler." If you pull two strands of a twisted rope apart, the rest of the rope gets knotted; Topoisomerase unties those knots.

---

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:
Topic: Protein Synthesis (Translation)
Translation is the process of building a protein based on the genetic code in mRNA. Every protein starts with a specific "start" signal.
Steps:

- **Understanding the Question:** What is the very first amino acid placed in a growing protein chain in eukaryotic organisms?
- **Key Formulas and Approach:** The universal start codon on mRNA is **AUG**. This codon specifies one particular amino acid.
- **Detailed Solution:**
  1. In eukaryotes, the ribosome searches for the start codon, which is always **AUG**.
  2. The initiator tRNA brings the amino acid **Methionine** to match this AUG codon.
  3. Therefore, almost all eukaryotic proteins begin with Methionine (though it may be removed later after the protein is finished).
  4. (Note: In prokaryotes, the initiator is a slightly modified version called N-formylmethionine).

Quick Tip

AUG is the "School Starts in **AUG**ust" codon. And school starts with **M**ethionine!

---

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: (A) Vi capsular polysaccharide and carrier protein

Solution:
Topic: Immunology (Vaccines)
The Typhoid Vi conjugate vaccine is designed to protect against *Salmonella Typhi* by targeting its protective outer coating.
Steps:

- **Understanding the Question:** What are the two ingredients used in a "conjugate" vaccine to ensure the body builds a strong memory against the bacteria?
- **Key Formulas and Approach:** Conjugate vaccines combine a weak antigen with a strong one to boost the immune response.
- **Detailed Solution:**
  1. The *Salmonella Typhi* bacteria is covered by a sugar-based coating called the **Vi capsular polysaccharide**.
  2. Sugar antigens alone usually don't trigger a strong, long-lasting immune response (especially in children).
  3. By chemically linking (conjugating) this sugar to a **carrier protein**, the vaccine forces the immune system to create a much more powerful T-cell dependent response.

Quick Tip

A conjugate vaccine is like "hiding a pill in a piece of meat" for a dog. The "pill" is the sugar (polysaccharide), and the "meat" is the carrier protein that makes the immune system take notice.
