



CUET PG Life Science Question Paper with 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:

- (i) This question paper comprises 75 questions. All questions are compulsory.
- (ii) Each question carries 04 (four) marks.
- (iii) For each correct response, candidate will get 04 (four) marks.
- (iv) For each incorrect response, 01 (one) mark will be deducted from the total score.
- (v) Un-answered/un-attempted response will be given no marks.
- (vi) To answer a question, the candidate needs to choose one option as correct option.
- (vii) However, after the process of Challenges of the Answer Key, in case there are multiple correct options or change in key, only those candidates who have attempted it correctly as per the revised Final Answer Key will be awarded marks.
- (viii) In case a Question is dropped due to some technical error, full marks shall be given to all the candidates irrespective of the fact who have attempted it or not

1. The portion of transmembrane proteins that cross the lipid bilayer are usually:

- (1) α -helices
- (2) β -sheet
- (3) Turns
- (4) Loops

Correct Answer: (1) α -helices

Solution: The transmembrane regions of proteins are predominantly formed by α -helices due to their ability to interact favorably with the hydrophobic core of the lipid bilayer. The α -helix is a stable structure, with hydrophobic side chains extending outward to interact with the lipid bilayer, while the backbone hydrogen bonds stabilize the helix. In contrast, β -sheets are typically seen in specific pore-forming structures like porins and are less common in simple transmembrane domains.

Quick Tip

α -helices are the most common structures in transmembrane proteins because their hydrophobic residues align perfectly with the lipid environment, making them energetically favorable.

2. Match List I with List II:

List I (Enzyme)	List II (Function)
(A) Cytochrome oxidase	(I) Electron transport system
(B) Topoisomerases	(II) Change linking number
(C) Cohesins	(III) DNA Replication
(D) PCNA	(IV) Cell cycle

Choose the correct answer from the options given below:

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

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

Solution:

1. **Cytochrome oxidase** is the terminal enzyme in the electron transport chain that facilitates the transfer of electrons to oxygen, forming water and aiding ATP synthesis.
2. **Topoisomerases** are enzymes that regulate DNA topology by changing the linking number, enabling processes like unwinding during replication and transcription.
3. **Cohesins** are protein complexes critical for DNA replication, ensuring that sister chromatids remain bound together until segregation.
4. **PCNA (Proliferating Cell Nuclear Antigen)** is a DNA clamp essential for DNA replication and repair and is closely associated with cell cycle progression.

Quick Tip

Familiarize yourself with key enzymes and their roles to easily match them with their respective functions, as many are central to core biological processes.

3. Which of the following enzyme is inhibited by citrate in Krebs's cycle?

- (1) Phospho-fructo kinase II (PFKII)
- (2) Aldolase
- (3) Pyruvate kinase
- (4) Phosphoglycerate mutase (PGM)

Correct Answer: (1) Phospho-fructo kinase II (PFKII)

Solution: Citrate, an intermediate in the Krebs's cycle, acts as a feedback inhibitor for Phospho-fructo kinase II (PFKII). This enzyme is a key regulatory point in glycolysis, controlling the rate at which glucose is metabolized. By inhibiting PFKII, citrate helps balance energy production between glycolysis and the Krebs's cycle, ensuring efficient energy use.

Quick Tip

Citrate serves as a metabolic checkpoint, ensuring that cells do not over-commit to glycolysis when sufficient energy is already being produced in the mitochondria.

4. Why does the presence of proline destabilize α -helix?

- (A) Proline residue introduces a destabilizing kink in the α -helix
- (B) In proline, the nitrogen atom is a part of a rigid ring, and rotation about N-C bond is not possible
- (C) The nitrogen atom of a proline residue in a peptide linkage has no substituent hydrogen to participate in hydrogen bonds with other residues
- (D) Proline residue works as a helix linker

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: (2) (A), (B), and (C) only

Solution: Proline is unique due to its cyclic structure, which introduces a sharp kink in the α -helix, disrupting its regular helical conformation. The nitrogen atom in proline is part of a rigid ring, making rotation around the N-C bond impossible. Additionally, proline lacks a hydrogen atom on its nitrogen to participate in backbone hydrogen bonding, which is essential for α -helix stability.

Quick Tip

Proline is known as a "helix breaker" due to its rigid structure and inability to form hydrogen bonds, causing disruptions in secondary structure formation.

5. Which of the following are components of lipid rafts in plasma membrane?

- (A) Cholesterol

- (B) Sphingolipids
- (C) Glycolipids
- (D) Phospholipids

Choose the correct answer from the options given below:

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

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

Solution: Lipid rafts are specialized microdomains within the plasma membrane that are rich in cholesterol and sphingolipids. These regions play critical roles in cellular signaling, protein sorting, and trafficking. They are more ordered and tightly packed than the surrounding membrane but still maintain fluidity.

Quick Tip

Lipid rafts are essential for facilitating efficient signal transduction and serving as platforms for receptor clustering in the plasma membrane.

6. Which of the following enzyme is defective in galactosemia—a fatal genetic disorder in infants?

- (1) Glucokinase
- (2) Galactokinase
- (3) UDP-galactose 4-epimerase
- (4) Galactose-1-phosphate uridylyltransferase

Correct Answer: (4) Galactose-1-phosphate uridylyltransferase

Solution: Galactosemia is caused by a deficiency in galactose-1-phosphate uridylyltransferase (GALT). This enzyme is responsible for converting galactose-1-phosphate into UDP-galactose, a critical step in galactose metabolism. Without this enzyme, toxic levels of

galactose-1-phosphate accumulate, leading to severe complications like liver damage, developmental delays, and cataracts.

Quick Tip

Early diagnosis through newborn screening is vital for managing galactosemia and preventing its life-threatening consequences.

7. Match List I with List II and choose the correct answer from the options given below:

List I (Vitamin)	List II (Disorder)
(A) Vitamin-A	(I) Night blindness
(B) Vitamin-D	(II) Scurvy
(C) Vitamin-C	(III) Fat-soluble vitamin
(D) Vitamin-K	(IV) Blood clotting

Choose the correct answer from the options given below:

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

Correct Answer: 2. (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

Solution:

1. **Vitamin-A:** Essential for vision; its deficiency causes night blindness.
2. **Vitamin-D:** A fat-soluble vitamin crucial for calcium absorption and bone health.
3. **Vitamin-C:** Deficiency leads to scurvy, characterized by poor collagen synthesis.
4. **Vitamin-K:** Necessary for blood clotting and hemostasis.

Quick Tip

Remember that fat-soluble vitamins (A, D, E, K) are stored in the liver, while water-soluble vitamins (B-complex, C) are excreted readily and need regular replenishment.

8. Identify the correct sequence of the given intermediates formed during glycolysis:

- (A) Fructose 1,6-biphosphate
- (B) Fructose 6 phosphate
- (C) Lactate
- (D) Phosphoenolpyruvate

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), (A), (C), (D)

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

Solution: The correct sequence in glycolysis is as follows: 1. Glucose is converted into **Fructose 6-phosphate**.

2. Fructose 6-phosphate is phosphorylated to form **Fructose 1,6-bisphosphate**.

3. The pathway proceeds to produce **Phosphoenolpyruvate**, which is eventually converted to **Lactate** under anaerobic conditions.

Quick Tip

Glycolysis involves 10 steps, starting from glucose and ending with pyruvate or lactate, depending on oxygen availability.

9. Identify the correct sequence of the given enzymes involved in the TCA cycle:

- (A) Aconitase
- (B) Fumarase
- (C) Malate dehydrogenase
- (D) α -ketoglutarate dehydrogenase

Choose the correct answer from the options given below:

1. (A), (B), (C), (D)
2. (A), (D), (B), (C)

3. (B), (A), (D), (C)
4. (C), (B), (D), (A)

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

Solution: The correct sequence is: 1. **Aconitase** converts citrate to isocitrate.
2. **α -ketoglutarate dehydrogenase** catalyzes the conversion of α -ketoglutarate to succinyl-CoA.
3. **Fumarase** catalyzes the hydration of fumarate to malate.
4. **Malate dehydrogenase** converts malate to oxaloacetate, completing the cycle.

Quick Tip

The TCA cycle is central to energy metabolism, producing NADH and $FADH_2$ for the electron transport chain.

10. Which of the following is not a fluorescence dye?

- (1) Alexa Fluor
- (2) Green fluorescent protein (GFP)
- (3) Red fluorescent protein (DsRed)
- (4) Xylene cyanol

Correct Answer: (4) Xylene cyanol

Solution: Xylene cyanol is a tracking dye used in gel electrophoresis to visualize DNA or RNA migration. Unlike Alexa Fluor, GFP, and DsRed, which emit fluorescence and are widely used in imaging studies, Xylene cyanol does not have fluorescent properties.

Quick Tip

Fluorescent dyes are crucial in molecular biology for labeling and tracking biomolecules in living cells or fixed samples.

11. The technique used to identify the specific DNA in bacterial colonies is:

- (1) In-situ hybridization
- (2) Dot blot
- (3) Colony hybridization
- (4) Western hybridization

Correct Answer: (3) Colony hybridization

Solution: Colony hybridization is a molecular biology technique used to detect specific DNA sequences within bacterial colonies. Colonies are transferred to a membrane, lysed to release DNA, and then hybridized with a labeled DNA or RNA probe that binds to the target sequence. This process enables the identification of colonies carrying a specific gene or sequence of interest.

Quick Tip

Remember that colony hybridization is specifically used for DNA detection in bacterial colonies. Western hybridization, in contrast, is used for protein analysis.

12. Which metal is used for electron beam generation in scanning electron microscopy?

- (1) Tungsten (W)
- (2) Magnesium (Mg)
- (3) Mercury (Hg)
- (4) Zinc (Zn)

Correct Answer: (1) Tungsten (W)

Solution: Tungsten is the metal most commonly used for generating electron beams in scanning electron microscopy (SEM). Its high melting point, excellent thermal stability, and low vapor pressure make it ideal for withstanding the high temperatures required for electron emission.

Quick Tip

Tungsten filaments are critical in SEM due to their durability and efficiency in electron emission under high vacuum.

13. What is the role of sodium dodecyl sulfate (SDS) in protein electrophoresis?

- (A) Add net negative charge to the protein
- (B) Separate lipids on the basis of their molecular weight
- (C) Modify native conformation of a protein
- (D) Allows direct destaining of the proteins

Choose the correct answer from the options given below:

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

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

Solution: SDS, an anionic detergent, plays a dual role in protein electrophoresis. It denatures proteins by breaking non-covalent interactions, thus unfolding them into linear chains. It also coats proteins with a uniform negative charge proportional to their size, ensuring that the separation during SDS-PAGE is based solely on molecular weight rather than shape or charge.

Quick Tip

In SDS-PAGE, SDS ensures uniform charge-to-mass ratio among proteins, allowing precise size-based separation.

14. Isoelectric focusing allows separation of the proteins according to their:

- (1) pH
- (2) pI
- (3) pKa
- (4) pKb

Correct Answer: (2) pI

Solution: Isoelectric focusing (IEF) separates proteins based on their isoelectric point (pI),

which is the pH at which the protein has no net charge. Proteins migrate in a pH gradient during IEF until they reach the pH corresponding to their pI, where they cease to move as the net charge becomes zero.

Quick Tip

Proteins stop migrating during IEF when their net charge is zero, making pI a critical property for separation in this technique.

15. Match List I with List II:

List I	List II
(A) Western Blotting	(I) DNA identification
(B) Southern Blotting	(II) Protein identification
(C) Northern Blotting	(III) Protein-protein interaction
(D) Yeast two-hybrid system	(IV) RNA identification

Choose the correct answer from the options given below:

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

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

Solution: - Western blotting identifies specific proteins in a sample.

- Southern blotting detects DNA sequences.
- Northern blotting detects RNA sequences.
- The yeast two-hybrid system investigates protein-protein interactions.

Quick Tip

Blotting techniques are named directionally: Southern (DNA), Northern (RNA), and Western (Protein).

16. Arrange the given steps involved in polymerase chain reaction (PCR):

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

Choose the correct answer from the options given below:

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

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

Solution: The steps of PCR are as follows:

- 1. **Denaturation:** Heat the double-stranded DNA to separate it into single strands.
- 2. **Annealing:** Lower the temperature to allow primers to bind to complementary sequences.
- 3. **Extension:** DNA polymerase extends the primers by synthesizing a new strand of DNA.
- 4. **Cycling:** These steps are repeated multiple times to amplify the target DNA sequence.

Quick Tip

PCR is a three-step cycle (Denaturation, Annealing, Extension) repeated to exponentially amplify specific DNA sequences.

17. Vertical gel electrophoresis is routinely used for the separation of:

- (1) Protein
- (2) DNA
- (3) RNA
- (4) Carbohydrate and lipid

Correct Answer: (1) Protein

Solution: Vertical gel electrophoresis is commonly employed in SDS-PAGE, a technique used to separate proteins based on their molecular weight. Polyacrylamide gel is used

because of its superior resolving power for small molecules like proteins, and the vertical setup is ideal for this application.

Quick Tip

Remember, vertical electrophoresis is most often used for protein separation (e.g., SDS-PAGE), while horizontal electrophoresis is typically used for nucleic acids like DNA and RNA.

18. Which is not a unit of radioactivity?

- (1) Gray (Gy)
- (2) Roentgen (R)
- (3) Millicurie (mCi)
- (4) Pascal (Pa)

Correct Answer: (4) Pascal (Pa)

Solution: Pascal is a unit of pressure and is unrelated to radioactivity. Units like Gray (Gy), Roentgen (R), and Millicurie (mCi) are used to measure various aspects of radioactivity, such as absorbed dose, exposure, and activity.

Quick Tip

Units of radioactivity include Gray, Roentgen, and Curie, while Pascal is exclusively a unit of pressure.

19. In the technique called centrifugation, the centrifugal field (G) is calculated as:

- (1) $G = \omega \times r^2$
- (2) $G = \omega^2 \times r$
- (3) $G = \omega^2 \times r^2$
- (4) $G = \omega \times r$

Correct Answer: (2) $G = \omega^2 \times r$

Solution: The centrifugal field (G) is calculated using the formula $G = \omega^2 \times r$, where ω is the angular velocity (in radians per second) and r is the radius of rotation. This formula explains the relationship between the speed of rotation and the force exerted on particles during centrifugation.

Quick Tip

Centrifugal force is directly proportional to the square of the angular velocity and the radius of rotation. Always use the formula $G = \omega^2 \times r$ for calculations.

20. Match List I with List II:

List I (Enzyme)	List II (Reaction)
(A) DNase I	(I) Produces single-stranded nicks in DNA
(B) RNase A	(II) Degrades single-stranded RNA
(C) S1 nuclease	(III) Degrades single-stranded DNA
(D) RNase H	(IV) Cleaves the RNA strand of RNA-DNA hybrids

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) - (I), (B) - (II), (C) - (IV), (D) - (III)
4. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: 2. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

Solution:

1. **DNase I:** Degrades single-stranded DNA.
2. **RNase A:** Produces single-stranded nicks in DNA.
3. **S1 nuclease:** Cleaves the RNA strand in RNA-DNA hybrids.
4. **RNase H:** Specifically degrades single-stranded RNA.

Quick Tip

Each nuclease has a specific role: DNase for DNA, RNase for RNA, S1 nuclease for single-stranded nucleic acids, and RNase H for RNA-DNA hybrids.

21. Number of chromosomes present in *Arabidopsis thaliana* is:

- (1) 8
- (2) 10
- (3) 12
- (4) 14

Correct Answer: (2) 10

Solution: *Arabidopsis thaliana*, a widely studied model organism, has a diploid chromosome number of 10 (five pairs of chromosomes). Its relatively small genome and simple structure make it ideal for genetic research.

Quick Tip

Chromosome numbers vary among species and are a critical factor in studying genetics and genome evolution.

22. What percentage of genes are found in the human genome?

- (1) 25% of the genome
- (2) 30% of the genome
- (3) 40% of the genome
- (4) 45% of the genome

Correct Answer: (2) 30% of the genome

Solution: Approximately 30% of the human genome consists of protein-coding genes. The remaining parts include regulatory elements, introns, and other non-coding regions essential for genome function and gene expression.

Quick Tip

The human genome is predominantly non-coding, but the 30% that includes genes is vital for producing proteins and maintaining cellular functions.

23. Match List I with List II:

List I	List II
(A) Histone erasers	(I) Methyltransferase
(B) Histone readers	(II) Topoisomerase
(C) Histone writers	(III) Deacetylases
(D) DNA unwinding	(IV) Bromodomain proteins

Choose the correct answer from the options given below:

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

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

Solution:

- **Histone erasers** such as Topoisomerase remove methyl groups from histones, modifying gene expression.
- **Histone readers** is facilitated by bromodomain proteins that interact with acetylated lysines.
- **Histone writers** recognize histone modifications (e.g., acetylation or methylation) to mediate chromatin remodeling.
- **DNA unwinding** like deacetylases add or remove acetyl groups to regulate DNA accessibility.

Quick Tip

Understand how histone-modifying enzymes (writers, erasers, readers) and DNA-binding proteins contribute to chromatin structure and gene expression.

24. Nucleosome is basically composed of:

- (A) Histone core
- (B) Linker histone
- (C) Core DNA
- (D) Linker DNA

Choose the correct answer from the options given below:

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

Correct Answer: 4. (A) and (C) only.

Solution:

Nucleosomes are the fundamental units of chromatin, comprising:

- **Histone core:** Eight histone proteins (H2A, H2B, H3, H4) around which DNA is wrapped.
- **Core DNA:** The 147 base pairs of DNA wrapped around the histone core.

Quick Tip

Nucleosomes compact the DNA and regulate its accessibility for transcription, replication, and repair processes.

25. Arrange according to their lower to higher genome size:

- (A) Lambda (λ)
- (B) T4
- (C) Φ x 174
- (D) T7

Choose the correct answer from the options given below:

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

4. (C), (B), (D), (A)

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

Solution: The genome sizes of these viruses from smallest to largest are:

- Φ x 174 (smallest genome).
- T7 (medium genome size).
- Lambda (λ) (larger genome).
- T4 (largest genome).

Quick Tip

Genome size varies among bacteriophages, with Φ x 174 having the smallest genome and T4 the largest among the given examples.

26. With the addition of linking number (Lk) by +2 to a relaxed DNA consisting of Lk = 200, which of the following occurs?

- (1) DNA undergo positive supercoiling with the Lk 202
- (2) DNA undergo positive supercoiling with the Lk 198
- (3) DNA undergo negative supercoiling with the Lk 202
- (4) Structure does not change

Correct Answer: (1) DNA undergo positive supercoiling with the Lk 202

Solution: The linking number (Lk) represents the total twists and writhes of a DNA molecule. Adding +2 to the linking number of relaxed DNA changes the topology and introduces positive supercoiling. The new linking number is Lk = 202, which leads to torsional stress and a more tightly coiled DNA.

Quick Tip

Positive supercoiling occurs when Lk is increased, while negative supercoiling results from a decrease in Lk. Supercoiling is essential for DNA packaging and stability.

27. What are the functions of topoisomerases?

- (1) Repair the chromosome ends
- (2) Form DNA isomers
- (3) Change the Linking Number of DNA
- (4) Form RNA isomers

Correct Answer: (3) Change the Linking Number of DNA

Solution: Topoisomerases are enzymes that alter the topology of DNA by changing its linking number. They are critical for processes like relieving supercoiling tension during replication, transcription, and chromosome segregation by cutting and resealing DNA strands.

Quick Tip

Topoisomerases ensure proper DNA function by modifying supercoiling, preventing tangling, and enabling access for replication and transcription machinery.

28. Arrange the given processes involved in the nitrogen cycle:

- (A) Ammonia formation
- (B) Organic nitrogen formation
- (C) Soil organic nitrogen formation
- (D) Nitrate formation

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), (A), (D)

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

Solution: The correct sequence of processes in the nitrogen cycle is:

- 1. **Organic nitrogen formation:** Incorporation of ammonia into organic molecules.
- 2. **Soil organic nitrogen formation:** Conversion of organic nitrogen into soil compounds.

3. **Ammonia formation:** Conversion of atmospheric nitrogen into ammonia.
4. **Nitrate formation:** Oxidation of ammonia and organic nitrogen into nitrates.

Quick Tip

The nitrogen cycle is essential for maintaining soil fertility and ecological balance, with each step crucial for nitrogen availability to plants.

29. The complete proteins produced by an organism at any one time is called:

- (1) Transcriptome
- (2) Proteome
- (3) Lipidome
- (4) Metagenome

Correct Answer: (2) Proteome

Solution: The proteome refers to the entire set of proteins expressed by a cell, tissue, or organism at a specific time. Unlike the transcriptome (which covers RNA molecules), the proteome provides insights into the functional molecules driving biological processes.

Quick Tip

Proteomics helps scientists understand protein functions, interactions, and roles in health and disease, complementing genomic studies.

30. Retroviruses are enveloped viruses that can be engineered to deliver how many bases of single-stranded RNA?

- (1) 500 bases
- (2) 1000 bases
- (3) 3000 bases
- (4) 8000 bases

Correct Answer: (4) 8000 bases

Solution: Retroviruses are commonly used in gene therapy and can be engineered to deliver approximately 8000 bases of single-stranded RNA. This RNA is reverse-transcribed into DNA, which integrates into the host genome, enabling stable expression of therapeutic genes.

Quick Tip

Retroviruses are effective vectors in gene therapy due to their ability to integrate into the host genome and express the desired gene stably.

31. Adenoviruses are frequently used in gene delivery experiments. Their average genome size is 36,000 base pairs. Of their total DNA content, up to how much of the adenovirus genome can be replaced by foreign DNA?

- (1) 5000 base pairs
- (2) 15,000 base pairs
- (3) 20,000 base pairs
- (4) 30,000 base pairs

Correct Answer: (4) 30,000 base pairs

Solution: Adenoviruses are widely used as vectors in gene therapy due to their ability to accommodate large foreign DNA inserts. Up to 30,000 base pairs of the adenovirus genome can be replaced by foreign DNA without compromising the infectivity or effectiveness of the virus as a delivery vehicle.

Quick Tip

Adenoviruses are preferred in gene delivery for their ability to carry large DNA fragments and for their high transduction efficiency in both dividing and non-dividing cells.

32. Gene gun is one of the popular physical delivery methods. Microparticles that are loaded to deliver DNA are made up of which metal?

- (1) Gold
- (2) Silver

- (3) Copper
- (4) Titanium

Correct Answer: (1) Gold

Solution: Gold microparticles are used in gene gun delivery methods because they are chemically inert, biocompatible, and provide a stable platform for attaching DNA. These properties ensure efficient DNA delivery into cells without causing significant cytotoxicity.

Quick Tip

The inert and non-reactive nature of gold makes it the ideal choice for gene gun applications, ensuring minimal damage to the target cells.

33. While delivering genes by chemical methods, one popular conjecture about what happens to poly(ethylenimine)/DNA complexes following endocytosis is known as the proton sponge hypothesis, which entails the following steps:

- (A) PEI/DNA complexes are endocytosed.
- (B) V-ATPases will pump protons into the vesicular interior.
- (C) Water will enter the vesicle to balance the osmotic gradient.
- (D) The vesicle will swell due to the entry of ions and water, leading to rupture.

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: The proton sponge hypothesis explains that PEI/DNA complexes are taken up by endocytosis. The vesicles' interior becomes acidic due to proton pumping by V-ATPases. To balance the osmotic gradient, water enters, causing swelling and eventual vesicle rupture, releasing the DNA into the cytoplasm.

Quick Tip

The proton sponge hypothesis is critical for understanding how chemical gene delivery systems enable endosomal escape, a key step in successful gene transfection.

34. Arrange the steps in the correct order as they are involved in RNA interference (RNAi):

- (A) Formation of small interfering RNAs (siRNAs)
- (B) Activation of RNase III-like enzyme Dicer
- (C) Inactivation of target RNA
- (D) Formation of RISC complex

Choose the correct answer from the options given below:

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

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

Solution: RNA interference (RNAi) is a cellular process that regulates gene expression through the degradation or inhibition of target mRNA. The steps involved are as follows:

- 1. Activation of RNase III-like enzyme Dicer (B): The RNAi pathway begins with the activation of the enzyme Dicer, which processes long double-stranded RNA (dsRNA) molecules into small interfering RNAs (siRNAs).
- 2. Formation of small interfering RNAs (siRNAs) (A): Dicer cleaves dsRNA into siRNAs, which are approximately 21–23 nucleotides in length with 2-nucleotide overhangs at their 3' ends.
- 3. Inactivation of target RNA (C): The siRNAs are incorporated into the RNA-induced silencing complex (RISC), where they guide the complex to complementary mRNA sequences.
- 4. Formation of RISC complex (D): The RISC complex, containing Argonaute proteins, binds the siRNAs, facilitating the recognition and cleavage of the target mRNA, thereby

inactivating it.

Thus, the correct order is: **(B), (A), (C), (D)**.

Quick Tip

Remember RNAi as a sequential process: Dicer activation → siRNA formation → mRNA targeting → RISC-mediated degradation.

35. Arrange the different steps of transcription in the correct order:

- (A) Transcription bubble formation
- (B) Phosphorylation of CTD tail
- (C) Recruitment of elongation factors
- (D) Dephosphorylation of CTD tail

Choose the correct answer from the options given below:

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

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

Solution: Transcription is the process by which genetic information in DNA is transcribed into RNA. The sequence of steps in transcription is as follows:

1. Transcription bubble formation (A): The process begins with the unwinding of DNA, forming a transcription bubble. This exposes the template strand for RNA synthesis.
2. Phosphorylation of CTD tail (B): The C-terminal domain (CTD) of RNA polymerase II undergoes phosphorylation. This modification is essential for transitioning the polymerase from the initiation phase to elongation.
3. Recruitment of elongation factors (C): During the elongation phase, various elongation factors are recruited to stabilize the transcription complex and assist RNA polymerase in synthesizing the RNA strand.
4. Dephosphorylation of CTD tail (D): At the end of transcription, the CTD tail is dephosphorylated, facilitating the termination of transcription and release of the RNA

transcript.

Thus, the correct order is: **(A), (B), (C), (D)**.

Quick Tip

Phosphorylation and dephosphorylation of the CTD tail are critical regulatory steps in ensuring efficient transcription and processing of mRNA.

36. In the human karyotype, chromosomes are divided into how many groups?

- (1) 3 groups
- (2) 5 groups
- (3) 7 groups
- (4) 9 groups

Correct Answer: (3) 7 groups

Solution: In the human karyotype, the 23 pairs of chromosomes are classified into 7 groups (A to G) based on their size and the position of the centromere. This classification is as follows:

1. Group A (Chromosomes 1–3): Largest chromosomes with metacentric or nearly metacentric centromeres.
2. Group B (Chromosomes 4–5): Large chromosomes with submetacentric centromeres.
3. Group C (Chromosomes 6–12, X): Medium-sized chromosomes with submetacentric centromeres.
4. Group D (Chromosomes 13–15): Medium-sized chromosomes with acrocentric centromeres and satellite structures.
5. Group E (Chromosomes 16–18): Small chromosomes with either metacentric (16) or submetacentric (17–18) centromeres.
6. Group F (Chromosomes 19–20): Small chromosomes with metacentric centromeres.
7. Group G (Chromosomes 21–22, Y): Smallest chromosomes with acrocentric centromeres; Y is unique due to its small size.

This grouping aids in identifying chromosomal abnormalities during cytogenetic analysis.

Quick Tip

The seven chromosomal groups in humans (A–G) help categorize chromosomes for better understanding and analysis in clinical and research settings.

37. In the human karyotype, the X chromosome belongs to which group?

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

Correct Answer: (3) C group

Solution: The X chromosome is categorized under the C group in the human karyotype. It is classified based on its medium size and submetacentric structure, making it distinct from other groups.

Quick Tip

The X chromosome, along with chromosomes 6 to 12, is part of the C group, identified by its medium size and position of the centromere.

38. Which one of the recombinant DNA techniques is almost obsolete?

- (1) Long DNA synthesis
- (2) DNA sequencing
- (3) Polymerase Chain Reaction
- (4) cDNA cloning

Correct Answer: (4) cDNA cloning

Solution: cDNA cloning, once widely used to study gene expression and create recombinant DNA, has largely been replaced by modern techniques like high-throughput sequencing and RNA-seq. These advanced methods provide more comprehensive and efficient analysis of transcriptomes.

Quick Tip

While cDNA cloning has historical significance, newer techniques like RNA-seq offer more detailed and scalable solutions for studying gene expression.

39. What is the function of DNA gyrase in circular DNA?

- (1) Negative supercoiling
- (2) Positive supercoiling
- (3) DNA packaging
- (4) DNA degradation

Correct Answer: (1) Negative supercoiling

Solution: DNA gyrase, a type II topoisomerase, introduces negative supercoils into circular DNA. This reduces torsional strain and facilitates processes like replication and transcription by making the DNA more accessible to enzymes and proteins.

Quick Tip

DNA gyrase plays a critical role in maintaining DNA topology, particularly in prokaryotic cells, by relieving supercoiling stress.

40. Which of the following is the example of Gram-negative bacteria?

- 1. *Lactobacillus*
- 2. *Escherichia coli*
- 3. *Bacillus subtilis*
- 4. *Staphylococcus aureus*

Correct Answer: 2. *Escherichia coli*

Solution:

Gram-negative bacteria are characterized by having a thin peptidoglycan layer and an outer membrane containing lipopolysaccharides. This structure gives them a pink color when subjected to the Gram staining technique. Among the options provided:

1. *Lactobacillus*: A Gram-positive bacterium, commonly found in probiotics and involved in lactic acid fermentation.
2. *Escherichia coli* (*E. coli*): A Gram-negative bacterium found in the gut of warm-blooded organisms. It is distinguished by its thin peptidoglycan wall and outer membrane.
3. *Bacillus subtilis*: A Gram-positive bacterium, widely studied and used in industrial processes.
4. *Staphylococcus aureus*: Another Gram-positive bacterium, known for causing infections like MRSA.

Thus, the correct answer is *Escherichia coli*, which is a well-known Gram-negative bacterium.

Quick Tip

Remember: Gram-negative bacteria have an outer membrane and stain pink, while Gram-positive bacteria lack an outer membrane and stain purple.

41. Which of the following are viral diseases?

- (A) Yellow fever
- (B) Hepatitis B
- (C) Chickenpox
- (D) Rabies

Choose the correct answer from the options given below:

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

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

Solution: All the diseases listed are caused by viruses:

- **Yellow fever:** Caused by the Yellow fever virus, transmitted by *Aedes* mosquitoes. It primarily affects the liver and can lead to jaundice.

- **Hepatitis B:** Caused by the Hepatitis B virus, which affects the liver and can lead to chronic liver disease or cancer.
- **Chickenpox:** Caused by the Varicella-zoster virus, it leads to itchy blisters and can reactivate later in life as shingles.
- **Rabies:** Caused by the Rabies virus, it is transmitted through animal bites and affects the nervous system, leading to fatal encephalitis if untreated.

Quick Tip

Recognizing the viral origin of diseases helps in understanding their transmission, prevention, and treatment strategies, such as vaccination and antiviral drugs.

42. Lederberg and Tatum describe the phenomena of-

- (1) Transformation
- (2) Conjugation
- (3) Mutation
- (4) Transversion

Correct Answer: (2) Conjugation

Solution: Lederberg and Tatum discovered conjugation in bacteria, a process where genetic material is transferred between bacterial cells through direct physical contact using a pilus. This discovery demonstrated that bacteria are capable of sexual reproduction and horizontal gene transfer, influencing bacterial evolution and genetic diversity.

Quick Tip

Conjugation plays a crucial role in spreading antibiotic resistance among bacteria, making it an important focus of research in combating bacterial infections.

43. Match List I with List II:

List I	List II
(A) D'Herelle and Twort	(IV) Bacterial viruses
(B) Beadle and Tatum	(III) One-gene-one-enzyme hypothesis
(C) Fleming	(II) Penicillin
(D) Griffith	(I) Bacterial transformation

Choose the correct answer from the options given below:

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

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

Solution: - **D'Herelle and Twort:** Independently discovered bacteriophages, viruses that infect bacteria, which are now used in phage therapy.

- **Beadle and Tatum:** Introduced the one-gene-one-enzyme hypothesis, demonstrating that genes dictate enzyme production, foundational to molecular biology.

- **Fleming:** Discovered penicillin, the first antibiotic, revolutionizing the treatment of bacterial infections.

- **Griffith:** Conducted experiments showing bacterial transformation, where genetic material from one bacterium can alter another.

Quick Tip

The foundational discoveries in microbiology and genetics provide a basis for modern medicine, genetic engineering, and biotechnology.

44. Vaccine is not available for which disease?

- (1) Hepatitis B
- (2) Influenza
- (3) AIDS
- (4) Mumps

Correct Answer: (3) AIDS

Solution: AIDS, caused by HIV, remains without a vaccine due to the virus's high mutation rate and ability to evade the immune system. In contrast, effective vaccines exist for Hepatitis B, Influenza, and Mumps, significantly reducing their global burden.

Quick Tip

Developing an HIV vaccine is a top priority in medical research, aiming to overcome challenges posed by its rapid genetic variability and immune evasion.

45. Antibody formed immediately after infection is-

- (1) IgM
- (2) IgG
- (3) IgD
- (4) IgE

Correct Answer: (1) IgM

Solution: IgM is the first antibody produced in response to an infection, playing a vital role in the primary immune response. It is large in size, allowing it to form pentamers that enhance pathogen neutralization. IgG, the most abundant antibody, follows IgM and provides long-term immunity.

Quick Tip

IgM is an important diagnostic marker for acute infections, while IgG indicates past infection or immunity from vaccination.

46. Arrange the steps involved in Gram-stain procedure:

- (A) Staining with Crystal Violet
- (B) Staining with Gram's Iodine
- (C) Decolorization
- (D) Staining with Safranin

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. (C), (B), (D), (A)

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

Solution: The Gram-stain procedure involves:

1. **Staining with Crystal Violet:** This is the primary stain that binds to the peptidoglycan in bacterial cell walls.
2. **Staining with Gram's Iodine:** The iodine acts as a mordant, forming a complex with Crystal Violet, increasing the dye's binding strength.
3. **Decolorization:** Alcohol or acetone is used to remove the stain from Gram-negative bacteria due to their thinner peptidoglycan layer.
4. **Staining with Safranin:** The counterstain provides color to Gram-negative bacteria, making them appear pink under a microscope, while Gram-positive bacteria remain purple.

Quick Tip

Gram staining is a differential technique critical in microbiology to classify bacteria into Gram-positive and Gram-negative based on their cell wall structure.

47. Yellow fever is caused due to the human-to-human transmission by-

- (1) *Aedes aegypti*
- (2) *Culex*
- (3) *Dermacentor andersoni*
- (4) *Mycobacterium tuberculosis*

Correct Answer: (A) *Aedes aegypti*

Solution: Yellow fever, a viral hemorrhagic disease, is primarily transmitted by the ***Aedes aegypti*** mosquito. This mosquito acts as a vector, spreading the virus between humans or from infected monkeys to humans. The disease affects the liver and kidneys, causing

jaundice and sometimes fatal complications. Other organisms listed, such as **Culex**, are vectors for other diseases, and **Mycobacterium tuberculosis** is a bacterium unrelated to yellow fever.

Quick Tip

Understanding specific vectors like *Aedes aegypti* aids in targeted vector control measures to reduce the spread of diseases like yellow fever and dengue.

48. Amino acid that serves as a precursor for formation of the pigment responsible for human skin color is-

- (1) Tryptophan
- (2) Cholesterol
- (3) Tyrosine
- (4) Indoleamine

Correct Answer: (3) Tyrosine

Solution: The amino acid **Tyrosine** is the primary precursor for melanin production, the pigment responsible for the color of skin, hair, and eyes. Through the enzymatic action of tyrosinase, tyrosine is converted into DOPA and then into melanin. This pathway plays a protective role by shielding skin cells from UV-induced DNA damage. Other compounds listed, such as tryptophan and cholesterol, are involved in unrelated biochemical pathways.

Quick Tip

Tyrosine metabolism is essential for melanin synthesis, and defects in this pathway can lead to pigmentation disorders like albinism.

49. Match List I with List II:

List I	List II
(A) Shoulder	(I) Tarsals
(B) Thigh	(II) Carpals
(C) Wrist	(III) Humerus
(D) Ankle	(IV) Femur

Choose the correct answer from the options given below:

1. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
2. (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
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: - The **shoulder** is associated with the humerus, a long bone involved in upper arm movement.

- The **thigh** involves the femur, the longest and strongest bone in the body.
- The **wrist** consists of carpal bones, small bones that provide flexibility to the hand.
- The **ankle** comprises tarsal bones, which form the skeletal structure of the foot's proximal region.

Quick Tip

A detailed understanding of bone anatomy is crucial in fields like orthopedics, physiotherapy, and sports medicine.

50. The propagation of action potential in myelinated nerve fiber is faster because of-

- (1) Continuous conduction
- (2) Saltatory conduction
- (3) Spontaneous conduction
- (4) Intermittent conduction

Correct Answer: (2) Saltatory conduction

Solution: In myelinated axons, the action potential jumps between the Nodes of Ranvier in a process called **Saltatory conduction**. The myelin sheath acts as an insulator, preventing the signal from dissipating and significantly increasing the speed of nerve impulse transmission. This mechanism is far more efficient than continuous conduction in unmyelinated fibers.

Quick Tip

Saltatory conduction ensures rapid and energy-efficient signal transmission, critical for high-speed neural communication in vertebrates.

51: Calcitonin is produced by

- (1) Follicular cells of the thyroid gland
- (2) Parafollicular cells of the thyroid gland
- (3) Parathyroid gland
- (4) Follicular cells of the ovary

Correct Answer: (2) Parafollicular cells of the thyroid gland

Solution: Calcitonin is a peptide hormone secreted by the parafollicular cells (C cells) of the thyroid gland. Its primary function is to regulate blood calcium levels by inhibiting osteoclast activity, thereby reducing bone resorption and lowering calcium concentrations in the bloodstream. This hormone is particularly important in preventing hypercalcemia.

Quick Tip

Calcitonin is part of the body's calcium homeostasis system, balancing the actions of parathyroid hormone (PTH), which increases blood calcium levels.

52: The lymphoid stem cells in the bone marrow form

- (A) Natural killer cells
- (B) Platelets
- (C) B lymphocytes
- (D) Neutrophils

Choose the correct answer from the options given below:

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

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

Solution: Lymphoid stem cells in the bone marrow give rise to two primary types of immune cells: natural killer (NK) cells and B lymphocytes. NK cells are part of the innate immune system, providing rapid responses to infected or cancerous cells. B lymphocytes, part of the adaptive immune system, produce antibodies. Platelets and neutrophils, on the other hand, originate from myeloid stem cells, not lymphoid stem cells.

Quick Tip

Lymphoid stem cells are precursors to adaptive immune cells, while myeloid stem cells contribute to innate immune cells and other blood components like platelets.

53: The perforation between left and right atria of a fetal heart is known as

- (1) Foramen ovale
- (2) Ductus arteriosus
- (3) Fossa ovalis
- (4) Ligamentum arteriosum

Correct Answer: (1) Foramen ovale

Solution: The foramen ovale is a vital part of fetal circulation, allowing blood to flow directly from the right atrium to the left atrium, bypassing the non-functional fetal lungs. After birth, the foramen ovale closes due to increased pressure in the left atrium, leaving a depression called the fossa ovalis.

Quick Tip

The closure of the foramen ovale marks the transition from fetal to normal adult circulation, redirecting blood flow through the now-functional lungs.

54: On the basis of type of body cavity, platyhelminthes can be categorized as

- (1) Aceolomate
- (2) Schizocoelomate
- (3) Pseudocoelomate
- (4) Enterocoelomate

Correct Answer: (1) Aceolomate

Solution: Platyhelminthes, or flatworms, lack a true body cavity, making them aceolomates. Their bodies are filled with mesodermal cells, leaving no space for organs to be suspended in a coelom. This characteristic is a key feature distinguishing them from coelomates and pseudocoelomates.

Quick Tip

Aceolomates are structurally simpler organisms with no internal body cavity, relying on diffusion for nutrient and waste exchange.

55: Match List I with List II

List I	List II
(A) Radiation hybrid mapping	(I) DNA can be cut into large fragments and circularized for use in chromosome walking
(B) Sequence tagged site (STS) mapping	(II) Useful for cloning of overlapping DNA fragments (restricted to about 200 kb)
(C) Chromosome jumping	(III) Fragment genome into large pieces and locate markers and genes
(D) Chromosome walking	(IV) Applicable to any part of DNA sequence if some sequence information is available

Choose the correct answer from the options given below:

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

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

Solution: - Radiation hybrid mapping involves allows researchers to skip over regions of DNA to locate distant markers and genes.

- Sequence tagged site (STS) mapping is used to study DNA regions when sequence information is available.
- Chromosome jumping breaking DNA into large fragments and circularizing them for chromosome walking.
- Chromosome walking is essential for overlapping DNA fragment cloning.

Quick Tip

Mapping techniques like chromosome walking and jumping provide critical tools for sequencing and locating genes within complex genomes.

56: A clotting disorder which is a sex-linked disease:

1. Sickle cell anemia
2. Thalassemia
3. Hemophilia
4. Albinism

Correct Answer: 3. Hemophilia

Solution: Hemophilia is a genetic disorder that affects blood clotting. It is an X-linked recessive condition, meaning that it is carried on the X chromosome. Males are more commonly affected because they have only one X chromosome. Hemophilia results from deficiencies in clotting factors such as factor VIII (Hemophilia A) or factor IX (Hemophilia B), leading to prolonged bleeding.

Quick Tip

Hemophilia is a classic example of an X-linked genetic disorder. Carriers (typically females) may pass it to their sons, while daughters may become carriers.

57: Which one of the following is a peat moss?

1. Pellia
2. Sphagnum
3. Marchantia
4. Funaria

Correct Answer: 2. Sphagnum

Solution: Sphagnum, commonly referred to as peat moss, grows in wetland areas and forms dense mats. It plays a vital role in the formation of peat, an important carbon reservoir. Peat moss is widely used in horticulture for its excellent water retention capacity and as a soil conditioner. Sphagnum also contributes significantly to carbon sequestration in ecosystems.

Quick Tip

Sphagnum's ability to retain water and inhibit decay makes it a critical component of bog ecosystems and a valuable horticultural resource.

58: The basal portion of a mature ligule of *Selaginella* is called:

1. Basal sheath
2. Lamella
3. Glossopodium
4. Stalk

Correct Answer: 3. Glossopodium

Solution: In *Selaginella*, the ligule, a structure associated with leaf anatomy, has a basal portion known as the Glossopodium. This structure supports and protects the ligule, playing an essential role in the plant's reproductive and vegetative structures.

Quick Tip

The ligule's Glossopodium is a distinguishing feature of *Selaginella*, highlighting its evolutionary adaptations among lycophytes.

59: Vessels are present in:

1. Cycas
2. Zamia
3. Ginkgo
4. Gnetum

Correct Answer: 4. Gnetum

Solution: Unlike other gymnosperms, *Gnetum* possesses vessels in its xylem, a characteristic typically associated with angiosperms. Vessels enable efficient water transport and represent an advanced evolutionary trait. This makes *Gnetum* an exceptional case among gymnosperms.

Quick Tip

Vessels in *Gnetum* illustrate evolutionary convergence, where gymnosperms exhibit traits similar to angiosperms.

60: Match List I with List II:

LIST I (Transposons)	LIST II (Organism)
A. Pelement	I. <i>Drosophila</i>
B. LINE and SINE	II. Human
C. Ty element	III. Yeast
D. Tn element	IV. Bacteria

Choose the correct answer from the options given below:

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

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

Solution: - **Pelement:** Found in *Drosophila*, these transposons are essential for genetic studies and gene tagging.

- **LINE and SINE:** Long and short interspersed nuclear elements in humans play roles in genome structure and function.

- **Ty element:** Found in yeast, these transposons are involved in genetic variability.

- **Tn element:** Found in bacteria, these transposons are crucial for studying antibiotic resistance.

Quick Tip

Understanding the distribution and function of transposons across organisms provides insights into genetic mobility and evolutionary processes.

61. The peptidyl transferase enzyme activity is located in the

1. Variable loop of tRNA
2. Large ribosomal subunit
3. Acceptor arm of tRNA
4. Small ribosomal subunit

Correct Answer: 2. Large ribosomal subunit

Solution: Peptidyl transferase is the enzyme responsible for catalyzing the peptide bond formation during protein synthesis. This activity is intrinsic to the rRNA component of the large ribosomal subunit (50S in prokaryotes and 60S in eukaryotes). The small ribosomal subunit is mainly involved in decoding mRNA, while tRNA components (variable loop and acceptor arm) are critical for amino acid recognition and attachment but do not possess enzymatic activity.

Quick Tip

Peptidyl transferase activity is an essential function of the ribosome, catalyzing peptide bond formation and driving protein elongation during translation.

62. Transcription factors that mediate the binding of RNA polymerase to DNA template are

- A. TFIIA
- B. TATA box
- C. TFIIB
- D. Small nuclear ribonucleoproteins

Choose the correct answer from the options given below:

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

Correct Answer: 2. A and C

Solution: Transcription factors are proteins that assist in the initiation and regulation of transcription by facilitating the binding of RNA polymerase to the DNA template. Among the options:

- **TFIIA**: A general transcription factor that stabilizes the binding of TFIID (which includes the TATA-binding protein) to the promoter region. It is crucial for forming the transcription initiation complex. - **TATA box**: Not a transcription factor but a DNA sequence in the promoter region that serves as the binding site for transcription factors such as TFIID. - **TFIIB**: A transcription factor that plays a role in recruiting RNA polymerase II to the promoter and stabilizing its binding during initiation. - **Small nuclear ribonucleoproteins (snRNPs)**: These are involved in RNA splicing and do not play a direct role in transcription initiation.

Thus, the transcription factors involved in mediating the binding of RNA polymerase to the DNA template are **TFIIA** and **TFIIB**.

Quick Tip

Remember: General transcription factors (e.g., TFIIA, TFIIB, TFIID) are essential for the assembly of the transcription initiation complex at the promoter region.

63. The histone that links two histone octamers is:

1. H1
2. H4
3. H2A
4. H2B

Correct Answer: 1. H1

Solution: Histone H1, often referred to as the linker histone, binds to the DNA that enters and exits the nucleosome core particle, stabilizing the chromatin's higher-order structure. Unlike core histones (H2A, H2B, H3, H4), H1 is not part of the nucleosome octamer but instead associates with the linker DNA between nucleosomes, facilitating chromatin compaction.

Quick Tip

Histone H1 is critical for chromatin condensation and plays a key role in gene regulation by altering chromatin accessibility.

64. tRNA is synthesized by:

1. RNA polymerase I
2. RNA polymerase II
3. Ribosomes
4. RNA polymerase III

Correct Answer: 4. RNA polymerase III

Solution: In eukaryotes, tRNA molecules are synthesized by RNA polymerase III, which is specialized for transcribing small RNA molecules, including 5S rRNA and tRNAs. RNA polymerase I transcribes most rRNA (except 5S rRNA), and RNA polymerase II synthesizes mRNA and some snRNAs. Ribosomes, on the other hand, are involved in translation and not RNA synthesis.

Quick Tip

RNA polymerase III is specific for synthesizing structural and functional RNAs, such as tRNA and 5S rRNA, vital for protein synthesis.

65. The gene transmission from a male parent to a female offspring (“child”) to a male “grandchild” is called:

1. Crisscross inheritance
2. X-linked inheritance
3. Y-linked inheritance
4. Chromosomal inheritance

Correct Answer: 1. Crisscross inheritance

Solution: Crisscross inheritance describes the pattern in which a gene is passed from a father

to his daughter and then from the daughter to her son. This is typical of X-linked inheritance since the male transmits his X chromosome to his daughters, who can then pass it to their sons.

Quick Tip

Crisscross inheritance highlights how X-linked genes are transmitted across generations, affecting males and females differently.

66. Which of the following statement is true for Barr body?

1. It is a highly condensed chromosome.
2. It is an active X chromosome.
3. It is equivalent to the single Y chromosome of the male.
4. It is equivalent to the two X chromosomes of the female.

Correct Answer: 1. It is a highly condensed chromosome.

Solution: The Barr body is the inactivated X chromosome in females, visible as a dense structure within the nucleus. This condensation ensures dosage compensation between males (with one active X chromosome) and females (with two X chromosomes). The inactive X chromosome is highly condensed and transcriptionally silent, contrasting with the active X chromosome.

Quick Tip

Barr bodies represent a mechanism for balancing gene dosage between sexes, achieved through X-chromosome inactivation in females.

67. Which of the following combinations of statements are true about C4 cycle?

- A. Malic acid formed in the chloroplast of mesophyll cells.
- B. Malic acid is transported to the chloroplast of bundle sheath cells.
- C. Pyruvic acid produced in mesophyll cells moves to the chloroplast of bundle sheath cells.
- D. Malic acid is transported to the chloroplast of mesophyll cells.

Choose the correct answer from the options given below:

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

Correct Answer: 1. A and B only

Solution: In the C₄ pathway, malic acid is formed in the mesophyll cells, then transported to the bundle sheath cells, where it is decarboxylated to release CO₂ for the Calvin cycle. Pyruvic acid, produced during this process, returns to the mesophyll cells to regenerate phosphoenolpyruvate (PEP), ensuring continuous carbon fixation.

Quick Tip

The C₄ cycle optimizes photosynthesis under high light and temperature conditions by concentrating CO₂ in the bundle sheath cells.

68. Which of the following statement is true for X-linked recessive inheritance?

1. All sons of a normal mother should show the trait.
2. All sons of an affected mother should show the trait.
3. Many more females than males should exhibit the trait.
4. All daughters of a normal mother should show the trait.

Correct Answer: 2. All sons of an affected mother should show the trait.

Solution: In X-linked recessive inheritance, an affected mother has two defective X chromosomes and will pass one defective X chromosome to all her sons. Since males inherit only one X chromosome, they will always express the trait if they inherit the defective gene. Females are less frequently affected because they require two copies of the defective gene to show the trait.

Quick Tip

X-linked recessive traits are more common in males because they inherit only one X chromosome, making them hemizygous for the trait.

69. Match List I with List II:

LIST I (Condition)	LIST II (Characteristics)
A. Color blindness	I. Deficiency of clotting factor VIII
B. Hemophilia B	II. Insensitivity to green and red light
C. Hemophilia A	III. Deficiency of clotting factor IX
D. G-6-PD deficiency	IV. Severe anemic condition

Choose the correct answer from the options given below:

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

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

Solution: - Color blindness: Results from insensitivity to green and red light, caused by mutations in opsin genes on the X chromosome.

- Hemophilia B: Caused by a deficiency in clotting factor IX, leading to prolonged bleeding.

- Hemophilia A: Caused by a deficiency in clotting factor VIII, also resulting in excessive bleeding.

- G-6-PD deficiency: Affects red blood cell metabolism, leading to anemia under oxidative stress.

Quick Tip

Understanding the specific defects associated with each condition helps in accurate diagnosis and treatment.

70. Non-vascular land plants are called:

1. Pteridophytes
2. Gymnosperms
3. Angiosperms
4. Bryophytes

Correct Answer: 4. Bryophytes

Solution: Bryophytes are simple land plants that lack vascular tissues (xylem and phloem). They rely on diffusion and osmosis for water and nutrient transport. These plants, including mosses, liverworts, and hornworts, are typically small and thrive in moist environments.

Quick Tip

Bryophytes are often referred to as non-vascular plants and are among the earliest colonizers of terrestrial habitats.

71. Taxol medicine used in treatment of cancer is extracted from:

1. *Taxus brevifolia*
2. *Ephedra* sp.
3. *Pinus roxburghii*
4. *Catharanthus roseus*

Correct Answer: 1. *Taxus brevifolia*

Solution: Taxol, a widely used chemotherapy drug, is extracted from the bark of the Pacific yew tree (**Taxus brevifolia**). This drug is particularly effective in treating cancers such as breast and ovarian cancers. It functions by stabilizing microtubules and preventing their depolymerization, which disrupts cell division in cancer cells.

Quick Tip

Taxol's unique mechanism of action targets rapidly dividing cancer cells, making it an essential drug in chemotherapy protocols.

72. The leaves used for wrapping tobacco in a 'bidi' are:

1. Tea leaves
2. Tendu leaves
3. Curry leaves
4. Basil leaves

Correct Answer: 2. Tendu leaves

Solution: Tendu leaves, obtained from the *Diospyros lotus* tree, are specifically used for wrapping bidis (traditional Indian cigarettes). These leaves are chosen for their flexibility, durability, and ability to retain moisture, which makes them ideal for rolling tobacco.

Quick Tip

Tendu leaves are an integral part of bidi production and also hold economic significance in rural areas where bidi manufacturing is a primary industry.

73. Choose the correct sequence of electron transport during electron transport chain of light reaction:

- A. Pheophytin
- B. Plastoquinone
- C. Cytb6-f complex
- D. Plastocyanin

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. C, B, D, A

Correct Answer: 1. A, B, C, D

Solution:

The electron transport chain during the light reaction of photosynthesis proceeds as follows:

1. Pheophytin acts as the primary electron acceptor in Photosystem II.

2. Electrons are transferred to Plastoquinone, which carries them to the Cytb6-f complex.
3. The Cytb6-f complex facilitates the transfer of electrons to Plastocyanin, which carries electrons to Photosystem I.

Quick Tip

Understanding the sequence of electron carriers in the light reaction is key to grasping how plants produce ATP and NADPH.

74. Match List I with List II:

LIST I (Photoperiodism)	LIST II (Explanation)
A. Short Day Plants (SDP)	I. Daylight of about 14-16 hours
B. PR	II. Absorbs light at 730-735nm
C. Long Day Plants (LDP)	III. Dark period period of 14-16 hours
D. PFR	IV. Absorbs light at 660-665nm

Choose the correct answer from the options given below:

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

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

Solution:

- Short Day Plants (SDP) require long dark periods of 14–16 hours.
- PR (phytochrome red) absorbs light in the range of 660–665 nm.
- Long Day Plants (LDP) require long daylight periods of 14–16 hours.
- PFR (phytochrome far-red) absorbs light in the range of 730-735 nm.

Quick Tip

Photoperiodism influences flowering and other physiological processes in plants through the interplay of phytochromes and day-length sensitivity.

75. Following are the steps involved in processing of green tea:

- A. Fermentation and drying
- B. Twisting and rolling of leaves to facilitate break up
- C. Initial removal of moisture content
- D. Crushing, Tearing and Curling by CTC method

Choose the correct answer from the options given below:

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

Correct Answer: 3. C, B, D, A

Solution:

The processing of green tea involves:

- 1. Initial removal of moisture to soften the leaves.
- 2. Twisting and rolling to break up the leaves and release their flavor compounds.
- 3. Crushing, Tearing, and Curling (CTC) to create a uniform texture.
- 4. Fermentation and drying to preserve the flavor and aroma of the tea.

Quick Tip

Each step in green tea processing contributes to its unique flavor profile and quality, highlighting the importance of traditional techniques.