

MHT CET 2024 30 April Shift 1 Question Paper with Solutions

General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question booklet contains 150 Multiple Choice Questions (MCQs).
2. Section-A: Physics & Chemistry - 50 Questions each and Section-B: Mathematics - 50 Questions.
3. Choice and sequence for attempting questions will be as per the convenience of the candidate.
4. Read each question carefully.
5. Determine the one correct answer out of the four available options given for each question.
6. Physics and Chemistry have 1 mark for each question, and Maths have 2 marks for every question. There shall be no negative marking.
7. No mark shall be granted for marking two or more answers of the same question, scratching, or overwriting.
8. Duration of the paper is 3 Hours.

1. Roan Cattle is an example of —

- (1) Incomplete Dominance
- (2) Codominance
- (3) Complete Dominance
- (4) Polygenic Inheritance

Correct Answer: (2) Codominance

Solution: Roan cattle exhibit a coat color pattern where both red and white hairs are visible and fully expressed, making it a classic case of codominance. In codominance, both alleles in a heterozygous organism are equally expressed, without blending, resulting in a phenotype that simultaneously shows both traits.

For instance, in roan cattle, the red allele expresses red hairs, and the white allele expresses white hairs, leading to a mixture of red and white on the coat. Neither allele is recessive, and both contribute to the phenotype equally.

Conclusion: Roan cattle are an example of codominance, where both alleles are equally and visibly expressed.

Quick Tip

Codominance occurs when both alleles in a heterozygote are fully expressed, resulting in a phenotype that displays both traits equally.

2. Ti plasmid is obtained from —

- (1) Escherichia coli
- (2) Agrobacterium tumefaciens
- (3) Bacillus subtilis
- (4) Saccharomyces cerevisiae

Correct Answer: (2) Agrobacterium tumefaciens

Solution: The Ti (tumor-inducing) plasmid is a naturally occurring plasmid found in the bacterium Agrobacterium tumefaciens. This bacterium uses the Ti plasmid to transfer a specific DNA segment into plant cells, leading to the formation of crown gall tumors.

In genetic engineering, the tumor-inducing genes on the Ti plasmid are replaced with desired

genes, enabling scientists to introduce beneficial traits into plants, such as pest resistance or improved nutritional content. This mechanism has made the Ti plasmid a crucial tool in plant biotechnology.

Conclusion: The Ti plasmid, obtained from *Agrobacterium tumefaciens*, is widely used in genetic engineering to modify plant genomes.

Quick Tip

The Ti plasmid's natural ability to transfer DNA has been harnessed for creating genetically modified plants with enhanced traits.

3. Which of the following best describes the widely accepted root pressure theory in plants?

- (1) It explains the mechanism of water movement through transpiration pull.
- (2) It describes the active uptake of minerals from the soil.
- (3) It refers to the pressure exerted by roots to push water upwards through the xylem.
- (4) It relates to the diffusion of gases in plant cells.

Correct Answer: (3) It refers to the pressure exerted by roots to push water upwards through the xylem.

Solution: Root pressure is a mechanism in plants that helps move water from roots to shoots, particularly when transpiration rates are low. It is generated by the active transport of ions into the root xylem, which lowers the water potential. As a result, water enters the xylem through osmosis, creating a positive pressure that pushes water upwards.

This process is significant during the early morning or at night when transpiration is minimal, ensuring that plants maintain hydration and nutrient flow. However, root pressure is insufficient for water transport in tall plants, where transpiration pull plays a dominant role.

Conclusion: Root pressure is a vital mechanism that helps in the upward movement of water during low transpiration conditions.

Quick Tip

Root pressure contributes to water movement in plants, especially during low transpiration, but it is not the primary mechanism in tall plants.

4. Which of the following statements about the prostate gland is correct?

- (1) It is responsible for producing insulin.
- (2) It secretes a fluid that nourishes and transports sperm.
- (3) It regulates the levels of calcium in the blood.
- (4) It is involved in the filtration of blood to produce urine.

Correct Answer: (2) It secretes a fluid that nourishes and transports sperm.

Solution: The prostate gland is a key component of the male reproductive system. It secretes a fluid that forms part of the semen. This fluid contains enzymes and nutrients essential for sperm health and motility. One of its major components is prostate-specific antigen (PSA), which helps liquefy semen, making it easier for sperm to travel.

The prostate gland also contains smooth muscle fibers that assist in propelling semen during ejaculation. Other options are incorrect because the prostate does not produce insulin (a function of the pancreas), regulate calcium levels (handled by the parathyroid glands), or filter blood (a role of the kidneys).

Conclusion: The prostate gland secretes fluid that nourishes and supports sperm, which is vital for male fertility.

Quick Tip

The prostate gland plays a crucial role in male fertility by producing fluids that support sperm motility and protect sperm in the female reproductive tract.

5. Which of the following correctly lists the stages of human embryo development in order?

- (1) Morula, Blastocyst, Gastrulation, Neurulation
- (2) Blastocyst, Morula, Neurulation, Gastrulation

(3) Neurulation, Gastrulation, Morula, Blastocyst

(4) Gastrulation, Neurulation, Blastocyst, Morula

Correct Answer: (1) Morula, Blastocyst, Gastrulation, Neurulation

Solution: Human embryonic development follows a specific sequence of stages:

- Morula: This stage involves the formation of a solid ball of cells resulting from repeated divisions of the zygote.

- Blastocyst: The morula develops a fluid-filled cavity, leading to the formation of the blastocyst, which implants in the uterine wall.

- Gastrulation: During this stage, the three germ layers (ectoderm, mesoderm, and endoderm) are formed, laying the groundwork for all major organs.

- Neurulation: This stage marks the development of the neural tube, which later becomes the central nervous system.

The correct order of these stages is Morula → Blastocyst → Gastrulation → Neurulation.

Conclusion: The accurate sequence of human embryo development stages is (1) Morula, Blastocyst, Gastrulation, Neurulation.

Quick Tip

Understanding the stages of embryonic development provides insights into normal growth processes and helps identify developmental disorders early.

6. What is the effect of an increase in substrate concentration on an enzyme-catalyzed reaction?

(1) The rate of reaction decreases.

(2) The rate of reaction increases.

(3) The rate of reaction remains unchanged.

(4) The enzyme becomes inactive.

Correct Answer: (2) The rate of reaction increases.

Solution: When the substrate concentration is increased, the reaction rate initially rises because more substrate molecules can bind to the enzyme's active sites, forming more enzyme-substrate complexes. However, this increase continues only until all active sites on

the enzyme molecules are saturated.

Beyond this saturation point, adding more substrate does not affect the reaction rate, as the enzyme operates at its maximum velocity (V_{\max}). This behavior is described by Michaelis-Menten kinetics.

Equation:

$$\text{Rate of reaction} = \frac{V_{\max}[S]}{K_m + [S]}$$

Here, K_m is the substrate concentration at which the reaction rate is half of V_{\max} .

Conclusion: The reaction rate increases with substrate concentration until the enzyme becomes saturated, after which the rate plateaus.

Quick Tip

Enzymes work most efficiently up to a certain substrate concentration, beyond which the reaction rate cannot increase further due to enzyme saturation.

7. Neurohypophysis is differentiated into the following parts except:

- (1) Pars nervosa
- (2) Pars distalis
- (3) Median eminence
- (4) Infundibular stalk

Correct Answer: (2) Pars distalis

Solution: The neurohypophysis, also known as the posterior pituitary, is primarily involved in the storage and release of hormones like oxytocin and vasopressin produced by the hypothalamus. It consists of the following parts:

- Pars nervosa: The main region responsible for hormone release.
- Median eminence: A connection point between the hypothalamus and the pituitary gland.
- Infundibular stalk: The bridge connecting the hypothalamus to the posterior pituitary.

However, the pars distalis is part of the adenohypophysis (anterior pituitary) and is not associated with the neurohypophysis.

Conclusion: Pars distalis belongs to the anterior pituitary and is not a part of the neurohypophysis.

Quick Tip

The neurohypophysis acts as a storage and release site for hypothalamic hormones, while the adenohypophysis is responsible for producing hormones like growth hormone and ACTH.

8. Which hormone inhibits the growth of plants?

- (1) Auxin
- (2) Cytokinin
- (3) Gibberellin
- (4) Abscisic acid

Correct Answer: (4) Abscisic acid

Solution: Abscisic acid (ABA) is a plant hormone that inhibits growth by suppressing processes like cell elongation and division. It plays a vital role in:

- Inducing seed dormancy, which prevents germination under unfavorable conditions.
- Regulating stomatal closure to conserve water during drought.
- Inhibiting shoot and root growth to ensure the plant conserves resources during stress.

Unlike auxins, cytokinins, and gibberellins, which promote growth, ABA serves as a growth suppressant, particularly under environmental stress conditions.

Conclusion: Abscisic acid is the primary hormone that inhibits plant growth, particularly during stress.

Quick Tip

Abscisic acid helps plants cope with drought and other adverse conditions by conserving water and energy through growth inhibition.

9. Which enzyme is responsible for cleaning neurotransmitters in the synaptic cleft?

- (1) Acetylcholinesterase
- (2) DNA polymerase
- (3) RNAase
- (4) Lipase

Correct Answer: (1) Acetylcholinesterase

Solution: Acetylcholinesterase is the enzyme that hydrolyzes acetylcholine in the synaptic cleft. This reaction breaks acetylcholine into acetate and choline, effectively terminating the nerve signal. Efficient acetylcholine breakdown ensures the post-synaptic neuron is not overstimulated.

Significance in Neural Function: - Prevents continuous activation of the post-synaptic neuron.

- Maintains precision in synaptic signaling.
- Facilitates muscle relaxation after contraction.

Conclusion: Acetylcholinesterase is critical for regulating synaptic transmission by clearing acetylcholine from the synaptic cleft.

Quick Tip

Inhibitors of acetylcholinesterase, like nerve agents, cause overstimulation of neurons by preventing acetylcholine breakdown.

10. Which of the following diseases is a result of protein deficiency?

- (1) Scurvy
- (2) Rickets
- (3) Kwashiorkor
- (4) Beriberi

Correct Answer: (3) Kwashiorkor

Solution: Kwashiorkor is caused by a severe deficiency of protein in the diet. It primarily affects children who consume enough calories but lack adequate protein intake. Symptoms include:

- Edema: Caused by reduced plasma proteins that disrupt fluid balance.
- Fatty liver: Resulting from impaired lipid transport.
- Growth retardation: Due to insufficient amino acids for cellular functions.
- Skin and hair changes: Including discoloration and flakiness.

Kwashiorkor is distinct from marasmus, which is caused by overall calorie deficiency.

Conclusion: Protein deficiency leads to kwashiorkor, characterized by edema, poor growth, and liver abnormalities.

Quick Tip

Kwashiorkor highlights the importance of protein-rich diets, especially during childhood, to support growth and development.

11. Which hormone is NOT produced by the Islets of Langerhans in the pancreas?

- (1) Insulin
- (2) Glucagon
- (3) Somatostatin
- (4) Adrenaline

Correct Answer: (4) Adrenaline

Solution: The Islets of Langerhans in the pancreas consist of different types of cells that produce hormones involved in glucose regulation: - Beta cells produce insulin, which lowers blood glucose levels.

- Alpha cells produce glucagon, which increases blood glucose levels.

- Delta cells produce somatostatin, which regulates the secretion of both insulin and glucagon.

Adrenaline, however, is not produced by the pancreas. It is synthesized by the adrenal medulla and is involved in the "fight or flight" response, increasing heart rate and blood glucose levels.

Conclusion: Adrenaline is not produced by the Islets of Langerhans; it is secreted by the adrenal glands.

Quick Tip

The Islets of Langerhans are responsible for regulating blood glucose through the secretion of insulin, glucagon, and somatostatin.

12. The enzyme bromelain, found in pineapples, is primarily used for:

- (1) Protein synthesis
- (2) Protein digestion
- (3) Carbohydrate metabolism
- (4) Lipid digestion

Correct Answer: (2) Protein digestion

Solution: Bromelain is a mixture of proteolytic enzymes extracted from the stem and fruit of pineapples. It is primarily used for breaking down proteins into peptides and amino acids.

Bromelain's applications include:

- Aiding in protein digestion by breaking down dietary proteins in the stomach.
- Tenderizing meat by degrading muscle fibers, making the meat softer.
- Anti-inflammatory properties, which help reduce swelling and pain in conditions such as arthritis.

Bromelain's proteolytic activity makes it useful in both culinary and medicinal contexts.

Conclusion: Bromelain is an enzyme that facilitates protein digestion and has additional applications in medicine and food processing.

Quick Tip

Bromelain is not only a digestive aid but also serves as a natural remedy for inflammation and wound healing.

13. Which of the following processes is NOT part of cellular respiration?

- (1) Glycolysis
- (2) Krebs Cycle
- (3) Calvin Cycle
- (4) Electron Transport Chain

Correct Answer: (3) Calvin Cycle

Solution: Cellular respiration involves the breakdown of glucose to generate energy in the form of ATP. The primary processes involved are:

- Glycolysis: Breakdown of glucose into pyruvate, generating ATP and NADH.
- Krebs Cycle (Citric Acid Cycle): Further breakdown of pyruvate to produce ATP, NADH,

and FADH_2 , with carbon dioxide as a byproduct.

- Electron Transport Chain: Utilizes NADH and FADH_2 to drive ATP synthesis through oxidative phosphorylation.

The Calvin Cycle, in contrast, is a part of photosynthesis and involves the fixation of carbon dioxide into glucose in plants. It does not occur in cellular respiration.

Conclusion: The Calvin Cycle is not part of cellular respiration, as it is associated with photosynthesis.

Quick Tip

The Calvin Cycle occurs in photosynthetic organisms to synthesize glucose, while cellular respiration breaks glucose down to produce ATP.

14. Approximately how long is the DNA molecule in a single human cell if stretched out?

- (1) 2 meters
- (2) 2 centimeters
- (3) 2 kilometers
- (4) 2 micrometers

Correct Answer: (1) 2 meters

Solution: The DNA molecule in a single human cell measures approximately 2 meters when fully extended. To fit inside the nucleus, which is only about $6 \mu\text{m}$ in diameter, the DNA undergoes an intricate packaging process:

1. The DNA is tightly wound around histone proteins to form nucleosomes.
2. These nucleosomes coil into chromatin fibers.
3. The chromatin is further folded and looped to form chromosomes during cell division.

This highly organized structure ensures efficient storage of genetic material while allowing accessibility for replication and transcription processes.

Conclusion: Despite its significant length, DNA is compactly folded to fit within the nucleus of a cell.

Quick Tip

The efficient packaging of DNA enables cells to store vast amounts of genetic information in a very small space while maintaining functionality.

15. Which disease is characterized by symptoms such as dehydration, excessive loss of water in urine, and absence of glucose in the urine?

- (1) Diabetes Mellitus
- (2) Diabetes Insipidus
- (3) Hyperthyroidism
- (4) Addison's Disease

Correct Answer: (2) Diabetes Insipidus

Solution: Diabetes Insipidus (DI) is a condition that disrupts the body's ability to regulate water balance, resulting in excessive thirst and the production of large volumes of dilute urine. Unlike Diabetes Mellitus, where glucose is present in the urine, DI involves no glucose in the urine. The primary cause is either:

- Central DI: Insufficient secretion of antidiuretic hormone (ADH) by the hypothalamus or pituitary gland.
- Nephrogenic DI: A reduced ability of the kidneys to respond to ADH.

Symptoms include dehydration, frequent urination, and extreme thirst, which can lead to complications if not managed promptly.

Conclusion: Diabetes Insipidus is marked by excessive water loss in urine, absence of glucose in the urine, and significant dehydration.

Quick Tip

Diabetes Insipidus differs from Diabetes Mellitus in that it involves water balance issues caused by ADH abnormalities, not glucose metabolism.

CHEMISTRY

1. In an acidic buffer, if the ratio of base to acid concentration is increased by 100 times,

then find the increase in pH of the buffer solution.

- (1) 1
- (2) 2
- (3) 0
- (4) 4

Correct Answer: (2) 2

Solution: The pH of a buffer solution can be calculated using the Henderson-Hasselbalch equation:

$$\text{pH} = \text{pKa} + \log\left(\frac{[\text{A}^-]}{[\text{HA}]}\right)$$

Here, $[\text{A}^-]$ is the concentration of the conjugate base, and $[\text{HA}]$ is the concentration of the acid.

If the ratio $\frac{[\text{A}^-]}{[\text{HA}]}$ is increased by 100 times, the change in pH (ΔpH) is calculated as:

$$\Delta\text{pH} = \log(100)$$

Since $\log(100) = 2$, the pH of the buffer increases by 2 units.

Conclusion: A 100-fold increase in the base-to-acid ratio leads to an increase of 2 units in the pH of the acidic buffer.

Quick Tip

In buffer solutions, changes in the base-to-acid ratio directly affect the pH. For every tenfold increase in this ratio, the pH increases by 1 unit.

2. What is an example of a thermoplastic?

- (1) PHBV
- (2) Polystyrene
- (3) Nylon 6,6
- (4) Bakelite

Correct Answer: (2) Polystyrene

Solution: Polystyrene is a thermoplastic polymer, meaning it softens when heated and hardens upon cooling. This property allows it to be remelted and reshaped multiple times,

making it suitable for various applications like packaging materials, disposable cups, and insulation products.

In contrast, materials like Bakelite are thermosetting polymers. Thermosets undergo irreversible chemical changes during curing and cannot be remelted or reshaped. Nylon 6,6 is a type of synthetic fiber and is not categorized as a thermoplastic.

Conclusion: Polystyrene is a thermoplastic, characterized by its ability to be melted and reshaped repeatedly without undergoing irreversible changes.

Quick Tip

Thermoplastics like polystyrene are recyclable and widely used due to their flexibility and reusability, unlike thermosetting plastics, which are rigid and permanent after setting.