MHT CET 2024 30 April Shift 2 PCM 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. What is the enzyme responsible for converting trypsinogen into trypsin?

(A) Pepsin

(B) Enterokinase

(C) Amylase

(D) Lipase

Correct Answer: (B) Enterokinase

Solution: Trypsinogen is an inactive enzyme (zymogen) secreted by the pancreas into the small intestine. Its activation into trypsin is mediated by enterokinase, an enzyme secreted by the duodenal cells. Enterokinase specifically cleaves a peptide bond in trypsinogen, converting it into its active form, trypsin. Trypsin then catalyzes the activation of other zymogens like chymotrypsinogen, playing a crucial role in protein digestion.

Other options are incorrect because:

- Pepsin is active in the stomach, not involved in trypsinogen activation.
- Amylase breaks down carbohydrates, not proteins.
- Lipase digests fats and has no role in trypsinogen activation.

Conclusion: Enterokinase is the enzyme that converts trypsinogen into trypsin.

Quick Tip

Enterokinase is essential for protein digestion as it initiates the activation cascade of pancreatic zymogens in the small intestine.

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2. How many DNA copies are produced after five cycles of PCR (Polymerase Chain Reaction)?

(A) 16

(B) 32

(C) 64

(D) 128

Correct Answer: (B) 32

Solution: Polymerase Chain Reaction (PCR) is a technique used to amplify DNA. In each cycle of PCR, the DNA quantity doubles. If we start with a single DNA molecule, the

number of DNA copies after n cycles is given by the formula:

$$\text{Number of DNA copies} = 2^n$$

For $n = 5$:

$$\text{Number of DNA copies} = 2^5 = 32$$

Thus, after five cycles of PCR, 32 DNA copies are produced.

Other options are incorrect because:

- $2^4 = 16$ corresponds to four cycles.
- $2^6 = 64$ corresponds to six cycles.
- $2^7 = 128$ corresponds to seven cycles.

Conclusion: After five cycles, PCR produces 32 DNA copies.

Quick Tip

In PCR, the DNA doubles with each cycle. Use the formula 2^n, where n is the number of cycles, to calculate the number of DNA copies.

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3. Which of the following is a function of the hypothalamus?

(A) Homeostasis

(B) Memory Formation

(C) Visual Processing

(D) Motor Coordination

Correct Answer: (A) Homeostasis

Solution: The hypothalamus is a small but critical region of the brain located below the thalamus. Its primary role is maintaining homeostasis, which involves regulating vital physiological processes such as:

- Body temperature
- Hunger and thirst
- Sleep-wake cycles
- Hormonal balance through the pituitary gland

Other options are incorrect because:

- Memory formation is primarily managed by the hippocampus.

- Visual processing is controlled by the occipital lobe of the brain.

- Motor coordination is a function of the cerebellum and motor cortex.

Conclusion: The hypothalamus is responsible for regulating homeostasis, making option (A) the correct answer.

Quick Tip

The hypothalamus acts as the control center for maintaining internal balance in the body by regulating critical physiological functions.

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4. Cerebrospinal fluid (CSF) uses were given below. Identify the incorrect use by eliminating it.

(A) Cushioning the brain and spinal cord

(B) Removing metabolic waste

(C) Transporting nutrients to the brain

(D) Transmitting nerve impulses

Correct Answer: (D) Transmitting nerve impulses

Solution: Cerebrospinal fluid (CSF) serves multiple critical functions:

- Cushioning the brain and spinal cord: CSF acts as a protective buffer to prevent mechanical injuries.

- Removing metabolic waste: CSF helps in clearing waste products from the brain.

- Transporting nutrients to the brain: CSF facilitates the delivery of essential nutrients to brain cells.

However, CSF does not transmit nerve impulses. Nerve impulses are carried by neurons using electrical and chemical signaling mechanisms.

Conclusion: The incorrect use of CSF is transmitting nerve impulses, which is the function of neurons.

Quick Tip

CSF plays essential roles in protection, waste removal, and nutrient transport, but it does not participate in nerve impulse transmission.

5. What type of relationship exists between sea anemones and clownfish?

(A) Predation

(B) Mutualism

(C) Parasitism

(D) Competition

Correct Answer: (B) Mutualism

Solution: The relationship between sea anemones and clownfish is mutualistic, where both organisms benefit:

- Clownfish receive protection from predators by living among the sea anemones' stinging tentacles, which deter predators.

- Sea anemones benefit from the cleaning of their tentacles by clownfish and nutrients provided by the fish's waste.

Other options are incorrect because:

- Predation: One organism eats another, which does not describe this relationship.

- Parasitism: One organism benefits at the expense of the other, which is not the case here.

- Competition: Both organisms do not compete for resources.

Conclusion: The relationship between sea anemones and clownfish is mutualistic.

Quick Tip

Mutualism is a symbiotic relationship where both species benefit, enhancing their chances of survival and reproduction.

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6. What was the historical use of cellophane tubes in hemodialysis?

(A) Providing structural support to dialysis machines

(B) Acting as semipermeable membranes

(C) Delivering medication to patients

(D) Filtering blood cells directly

Correct Answer: (B) Acting as semipermeable membranes

Solution: Cellophane tubes were used in early hemodialysis machines due to their

semipermeable properties.

- These tubes allowed waste products like urea and creatinine to pass through while retaining essential components like proteins and blood cells.

- This selective filtration was critical for removing toxins from the blood while maintaining its composition.

Other options are incorrect because:

- Cellophane tubes were not designed for structural support, delivering medication, or directly filtering blood cells.

Conclusion: The historical use of cellophane tubes in hemodialysis was due to their semipermeable nature.

Quick Tip

Semipermeable membranes like cellophane tubes are essential for hemodialysis, enabling selective removal of waste products from the blood.

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7. Which of the following statements about the pharynx and larynx is/are correct?

(A) The pharynx serves as a pathway for both food and air.

(B) The larynx is involved in the production of sound.

(C) The pharynx contains the vocal cords.

(D) The larynx prevents food from entering the trachea.

Choose the correct options from the given below: (1) 1 and 2 only

(2) 1, 2, and 4

(3) 1, 2, and 3

(4) 1, 2, 3, and 4

Correct Answer: (2) 1, 2, and 4

Solution: The pharynx and larynx serve important roles in the respiratory and digestive systems:

- The pharynx serves as a pathway for both food and air: It connects the nasal cavity to the esophagus and trachea.

- The larynx is involved in the production of sound: It contains the vocal cords, which

vibrate to produce sound.

- The vocal cords are located in the larynx, not the pharynx: This makes statement (C) incorrect.

- The larynx prevents food from entering the trachea: The epiglottis, a flap of tissue, closes over the trachea during swallowing.

Conclusion: Statements 1, 2, and 4 are correct.

Quick Tip

The pharynx and larynx coordinate to route food and air properly and enable vocalization through the vocal cords.

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8. Arrange the following steps of the action potential mechanism in the correct order:

(A) Depolarization

(B) Repolarization

(C) Polarization

(D) Resting Potential

Choose the correct options from the given below: (1) 1, 3, 2, 4

(2) 1, 2, 3, 4

(3) 4, 3, 2, 1

(4) 3, 1, 2, 4

Correct Answer: (4) 3, 1, 2, 4

Solution: The action potential in neurons is an electrical impulse that enables nerve communication. It occurs in distinct phases:

The correct sequence is:

$$\text{Polarization} \rightarrow \text{Depolarization} \rightarrow \text{Repolarization} \rightarrow \text{Resting Potential}$$

- Polarization: The neuron is at its resting potential (-70 mV) due to the Na^+/K^+ pump. - Depolarization: Sodium channels open, Na^+ ions flow in, causing a positive membrane potential. - Repolarization: Potassium channels open, allowing K^+ to exit the cell, restoring negativity. - Resting Potential: The Na^+/K^+ pump reestablishes the resting ionic gradients.

Conclusion: The sequence is 3 (Polarization), 1 (Depolarization), 2 (Repolarization), 4

(Resting Potential).

Quick Tip

Each phase of the action potential is essential for propagating electrical signals efficiently in the nervous system.

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9. Which of the following is a primary source of ethylene?

(A) Animals, particularly mammals

(B) Plants, particularly fruits

(C) Fungi, particularly molds

(D) Bacteria, particularly soil bacteria

Correct Answer: (B) Plants, particularly fruits

Solution: Ethylene is a gaseous plant hormone responsible for processes such as fruit ripening, leaf abscission, and flower wilting.

Its primary source is plants, especially ripening fruits, which produce ethylene in significant amounts to accelerate ripening.

Ethylene production is commercially harnessed to ripen fruits like bananas and tomatoes during transportation.

Conclusion: Plants, particularly ripening fruits, are the primary source of ethylene.

Quick Tip

Ethylene is widely used in agriculture to control and synchronize the ripening process for efficient marketing.

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10. What is the definition of geitonogamy?

(A) Transfer of pollen from the anther of one flower to the stigma of another flower on the same plant.

(B) Transfer of pollen from the anther of one plant to the stigma of a flower on a different plant.

(C) Self-pollination where pollen from the same flower fertilizes the ovule.

(D) Cross-pollination between genetically distinct individuals.

Correct Answer: (A) Transfer of pollen from the anther of one flower to the stigma of another flower on the same plant.

Solution: Geitonogamy is a type of self-pollination where pollen is transferred between flowers of the same plant.

It differs from autogamy, which occurs within the same flower, and cross-pollination, which involves different plants.

Conclusion: Geitonogamy involves pollen transfer between flowers of the same plant.

Quick Tip

Geitonogamy reduces genetic diversity compared to cross-pollination but ensures reproductive success.

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11. What is the definition of spermatogenesis?

(A) The process of egg cell formation in females.

(B) The process of sperm cell development in males.

(C) The fusion of sperm and egg during fertilization.

(D) The maturation of gametes within the plant reproductive system.

Correct Answer: (B) The process of sperm cell development in males.

Solution: Spermatogenesis is the biological process through which male gametes (sperm cells) are produced in the testes.

- The process begins with spermatogonia (germ cells) undergoing mitosis to form primary spermatocytes.

- The primary spermatocytes undergo meiosis I to produce secondary spermatocytes, which then undergo meiosis II to form spermatids.

- Finally, spermatids mature into functional sperm cells (spermatozoa) through a process called spermiogenesis.

Conclusion: Spermatogenesis is essential for male fertility and provides sperm cells necessary for reproduction.

Quick Tip

Spermatogenesis occurs continuously in males after puberty, ensuring a steady supply of sperm throughout their reproductive life.

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12. Which of the following statements correctly define euploidy and aneuploidy?

(A) Euploidy refers to the presence of an abnormal number of chromosomes, while aneuploidy refers to a complete set of chromosomes.

(B) Euploidy refers to the maintenance of the complete set of chromosomes, while aneuploidy refers to the presence of an abnormal number of chromosomes.

(C) Both euploidy and aneuploidy refer to variations in chromosome number without any abnormalities.

(D) Euploidy is related to the structure of chromosomes, whereas aneuploidy is related to their number.

Correct Answer: (B) Euploidy refers to the maintenance of the complete set of chromosomes, while aneuploidy refers to the presence of an abnormal number of chromosomes.

Solution:

- Euploidy is the condition in which a cell contains a complete set of chromosomes. Examples include haploid (n), diploid (2n), triploid (3n), and tetraploid (4n). - Aneuploidy is the presence of an abnormal number of chromosomes, such as an extra or missing chromosome.

- Examples of aneuploidy include trisomy 21 (Down syndrome) and Turner syndrome (45, X). - Euploidy ensures normal development, whereas aneuploidy often leads to genetic disorders.

Conclusion: Euploidy maintains the complete set of chromosomes, while aneuploidy results in abnormalities in chromosome numbers.

Quick Tip

Euploidy is critical for genetic stability, whereas aneuploidy often leads to developmental and genetic disorders.

13. Match the following chromosomal abnormalities with their correct definitions:

(A) Monosomy - (D) Presence of only one copy of a particular chromosome.

(B) Nullisomy - (B) Absence of both homologous chromosomes.

(C) Trisomy - (A) Presence of three copies of a particular chromosome.

(D) Tetrasomy - (C) Presence of four copies of a particular chromosome.

Correct Answer: (A) Monosomy - (D) Presence of only one copy of a particular chromosome.

(B) Nullisomy - (B) Absence of both homologous chromosomes.

(C) Trisomy - (A) Presence of three copies of a particular chromosome.

(D) Tetrasomy - (C) Presence of four copies of a particular chromosome.

Solution: Chromosomal abnormalities result from changes in chromosome number: - Monosomy: A single copy of a chromosome (e.g., Turner syndrome). - Nullisomy: Absence of a chromosome pair (lethal condition). - Trisomy: Three copies of a chromosome (e.g., Down syndrome, trisomy 21). - Tetrasomy: Four copies of a chromosome (rare condition).

Conclusion: The correct matching of terms with definitions is provided above.

Quick Tip

Understanding chromosomal abnormalities helps in diagnosing genetic disorders and developmental anomalies.

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14. Which of the following is a dominant autosomal disorder?

(A) Cystic Fibrosis

(B) Huntington's Disease

(C) Sickle Cell Anemia

(D) Hemophilia

Correct Answer: (B) Huntington's Disease

Solution: Huntington's Disease is a genetic condition caused by a single copy of a mutated gene on an autosome, making it a dominant autosomal disorder.

Disorders like Cystic Fibrosis and Sickle Cell Anemia are recessive, requiring two copies of

the mutated gene to manifest. Hemophilia is an X-linked recessive disorder.

Conclusion: Huntington's Disease is the correct answer because it is inherited in a dominant autosomal manner.

Quick Tip

Dominant autosomal disorders are caused by a mutation in just one copy of a gene, whereas recessive disorders require both copies to be mutated.

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15. Which of the following is a restriction endonuclease?

(A) DNA polymerase

(B) RNA polymerase

(C) EcoRI

(D) Ligase

Correct Answer: (C) EcoRI

Solution: EcoRI is an enzyme that recognizes specific DNA sequences and cleaves the DNA at these sites. It is widely used in molecular biology for DNA manipulation.

DNA polymerase and RNA polymerase synthesize DNA and RNA, respectively, while ligase is involved in joining DNA fragments.

Conclusion: EcoRI is the correct answer as it is a restriction endonuclease.

Quick Tip

Restriction endonucleases like EcoRI are essential tools for genetic engineering, enabling precise DNA cutting and modification.

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16. Which component was not found in the early Earth's atmosphere?

(A) Oxygen

(B) Carbon dioxide

(C) Nitrogen

(D) Ammonia

Correct Answer: (A) Oxygen

Solution: The early Earth's atmosphere contained carbon dioxide, nitrogen, and ammonia but lacked oxygen.

Oxygen became abundant later due to the photosynthetic activity of organisms like cyanobacteria, which released oxygen as a byproduct.

Conclusion: Oxygen was not present in the early Earth's atmosphere, making it the correct answer.

Quick Tip

The absence of oxygen in the early atmosphere allowed anoxic conditions that supported the evolution of early life forms.

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17. Which of the following are natural inhibitors produced by plants?

(A) Alkaloids

(B) Terpenoids

(C) Glycosides

(D) All of the above

Correct Answer: (D) All of the above

Solution: Plants produce various natural inhibitors, including alkaloids, terpenoids, and glycosides, as defense mechanisms against herbivores and pathogens.

Each of these compounds plays a specific role in plant protection, such as deterring predators, inhibiting microbial growth, or providing toxic effects.

Conclusion: The correct answer is (D) All of the above, as all these compounds are natural inhibitors produced by plants.

Quick Tip

Natural inhibitors in plants are vital for their defense, enabling them to survive against herbivores, pathogens, and environmental stressors.
