MHT CET 2024 22 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.

Which of the following statements best describes the relationship between the hormones ANF and Angiotensin 2 in terms of their physiological effects on the body?

(A) ANF promotes sodium reabsorption, while Angiotensin 2 dilates blood vessels.

(B) ANF dilates blood vessels, while Angiotensin 2 promotes sodium reabsorption.

(C) Both ANF and Angiotensin 2 promote sodium reabsorption.

(D) Both ANF and Angiotensin 2 dilate blood vessels.

Correct Answer: (B) ANF dilates blood vessels, while Angiotensin 2 promotes sodium reabsorption.

Solution:

Role of ANF (Atrial Natriuretic Factor)

ANF is secreted by the heart's atrial cells in response to increased blood pressure and blood volume. It serves to:

- Dilate blood vessels, reducing blood pressure.
- Increase sodium excretion by reducing sodium reabsorption in the kidneys.
- Decrease blood volume by promoting water excretion.

Role of Angiotensin 2

Angiotensin 2 is a key hormone in the Renin-Angiotensin-Aldosterone System (RAAS). Its effects include:

- Inducing vasoconstriction to increase blood pressure.
- Promoting sodium reabsorption in the kidneys, which increases blood volume.
- Stimulating aldosterone release, further enhancing sodium and water retention.

Comparing ANF and Angiotensin 2

- ANF primarily works to lower blood pressure and sodium levels by promoting vasodilation and sodium excretion.
- Angiotensin 2 increases both blood pressure and sodium levels by inducing vasoconstriction and promoting sodium reabsorption.

Thus, ANF and Angiotensin 2 have opposing effects.

Conclusion: ANF dilates blood vessels, while Angiotensin 2 promotes sodium reabsorption.

Quick Tip

ANF and Angiotensin 2 have opposite functions:

- ANF reduces blood pressure and promotes sodium excretion.
- Angiotensin 2 raises blood pressure and promotes sodium retention.

These roles are crucial for fluid balance and blood pressure regulation.

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2. Which of the following factors ensures that coding for the same amino acid, such as methionine and valine, using identical anticodons remains non-ambiguous?

(A) Redundancy of the genetic code.

(B) Degeneracy of the genetic code.

(C) Complementary base pairing between codons and anticodons.

(D) The presence of start and stop codons in the mRNA.

Correct Answer: (B) Degeneracy of the genetic code.

Solution:

Understanding the genetic code.

The genetic code consists of codons, each a triplet of nucleotides in mRNA that specifies an amino acid during protein synthesis.

What is degeneracy of the genetic code?

Degeneracy refers to the phenomenon where multiple codons can encode the same amino acid. For example:

- Methionine is specified by one codon: AUG.
- Valine is encoded by four codons: GUU, GUC, GUA, GUG.

Even though several codons can represent the same amino acid, each codon corresponds to only one amino acid, ensuring clarity during translation.

How degeneracy ensures clarity.

The degeneracy of the genetic code allows multiple codons to specify the same amino acid, ensuring there is no ambiguity in protein synthesis.

Degeneracy ensures precise translation and avoids ambiguity in protein synthesis.

Quick Tip

Degeneracy allows multiple codons to encode the same amino acid, enhancing the robustness and flexibility of protein synthesis.

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3. In males, the penis is analogous to which structure in females?

(A) Urethra.

(B) Labia majora.

(C) Clitoris.

(D) Vagina.

Correct Answer: (C) Clitoris.

Solution:

Understanding anatomical analogy.

Analogous structures in males and females arise from similar embryonic tissues but differentiate according to sex-specific hormonal influences.

Development of the penis and clitoris.

- Both the penis in males and the clitoris in females develop from the genital tubercle during early embryonic development.
- Testosterone leads to the formation of the penis, while the absence of significant testosterone results in the formation of the clitoris.

Functional comparison.

While the penis serves both reproductive and urinary functions, the clitoris is primarily a sensory organ. However, both share a similar structure containing erectile tissue and sensory nerve endings.

The clitoris in females is analogous to the penis in males.

Quick Tip

Analogous structures like the penis and clitoris develop from the same embryonic origins but differentiate based on hormonal influences, illustrating the significance of embryology in anatomy.

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4. Which of the following enzymes is secreted by the urinary bladder?

(A) Amylase.

(B) Urease.

(C) Renin.

(D) The urinary bladder does not typically secrete enzyme.

Correct Answer: (D) The urinary bladder does not typically secrete enzyme.

Solution:

Function of the urinary bladder.

The urinary bladder's role is to store and expel urine; it does not secrete enzymes.

Reviewing the options.

- **Amylase:** Secreted by the pancreas and salivary glands, not the urinary bladder.
- **Urease:** Found in some bacteria but not secreted by the urinary bladder.
- **Renin:** Secreted by the kidneys to regulate blood pressure, not by the urinary bladder.
- **Urinary bladder:** The urinary bladder does not secrete any enzymes; its role is storage and excretion of urine.

The correct answer is: The urinary bladder does not typically secrete enzyme.

Quick Tip

The urinary bladder is a storage organ for urine, not involved in enzyme secretion. Enzymes like renin and amylase are secreted by specialized organs like the kidneys and pancreas.

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5. Which of the following statements about pollen grains is incorrect? (A) Pollen grains develop from megaspores.

(B) Pollen grains contain two cells: a generative cell and a tube cell.

(C) Pollen grains are released from the stigma during pollination.

(D) Pollen grains play a crucial role in the reproductive process of seed plants.

Correct Answer: (A) Pollen grains develop from megaspores.

Solution:

Pollen grain development.

Pollen grains develop from microspores, not megaspores. Microspores are formed in the male reproductive organs of flowering plants.

Examining the options.

- **Option (B):** Pollen grains contain two cells: a generative cell and a tube cell. The generative cell divides into two sperm cells.
- **Option (C):** Pollen grains are released from the anthers, not the stigma, during pollination.
- **Option (D):** Pollen grains carry male gametes, playing a critical role in fertilization.

Conclusion.

The statement that pollen grains develop from megaspores is incorrect. They develop from microspores.

The correct answer is: Pollen grains develop from megaspores.

Quick Tip

Pollen grains are formed from microspores, part of the male reproductive system, while megaspores are involved in the female reproductive system.

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6. Which of the following statements is correct regarding the number of codons and their degeneracy?

(A) There are 20 codons, and all of them exhibit degeneracy.

(B) There are 64 codons, and none of them exhibit degeneracy.

(C) There are 64 codons, and some of them exhibit degeneracy.

(D) There are 20 codons, and none of them exhibit degeneracy.

Correct Answer: (C) There are 64 codons, and some of them exhibit degeneracy.

Solution:

Understanding codons and degeneracy.

The genetic code consists of 64 codons, made up of triplets of nucleotides. These codons encode 20 amino acids and include stop codons.

Explanation of degeneracy.

Degeneracy means that multiple codons can encode the same amino acid. For example:

- Leucine is encoded by six codons.
- Methionine is encoded by a single codon.

Conclusion.

There are 64 codons, and some exhibit degeneracy, ensuring that the genetic code is efficient and adaptable.

The correct answer is: There are 64 codons, and some of them exhibit degeneracy.

Quick Tip

Degeneracy of the genetic code ensures redundancy, allowing multiple codons to encode the same amino acid and minimizing the impact of mutations.

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7. Which of the following is an emulsion?

(A) Butter.

(B) Mist.

(C) Milk.

(D) Jellies.

Correct Answer: (C) Milk.

Solution:

Definition of an emulsion.

An emulsion is a colloidal mixture where one liquid is dispersed in another liquid that is immiscible. Common examples of emulsions include milk and mayonnaise.

Reviewing the options.

- **Butter:** Butter is a colloid, but it is a water-in-fat dispersion, not an emulsion.
- **Mist:** Mist is an aerosol, not an emulsion.
- **Milk:** Milk is an emulsion, where fat globules are dispersed in water.
- **Jellies:** Jellies are gels, not emulsions.

Conclusion.

Milk is the correct example of an emulsion among the given options.

The correct answer is: Milk.

Quick Tip

An emulsion consists of two immiscible liquids where one is dispersed in the other. Milk is a classic example of a fat-in-water emulsion.

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8. When a stem of a plant is cut a few inches above the soil and xylem sap is seen flowing out through the cut end, this exudation is considered evidence for the existence of root pressure. Who proposed the theory of root pressure?

(A) Robert Hooke.

(B) Stephen Hales.

(C) Joseph Priestley.

(D) Gregor Mendel.

Correct Answer: (C) Joseph Priestley.

Solution:

Understanding root pressure.

Root pressure is the pressure generated in the roots as they actively absorb water and minerals from the soil, driving the movement of xylem sap upwards.

Historical context.

The theory of root pressure, along with observations of sap exudation, was proposed and studied by Joseph Priestley. This phenomenon highlights the importance of osmotic gradients in water transport within plants.

Clarifying the options.

- **Robert Hooke:** Known for his contributions to cell theory, not root pressure.
- **Stephen Hales:** Known for plant physiology studies but did not propose root pressure.
- **Gregor Mendel:** Known for genetics, unrelated to root pressure.

The correct answer is: Joseph Priestley.

Quick Tip

Root pressure helps explain the upward movement of water in plants, a concept central to plant physiology. Joseph Priestley's work was key in demonstrating this process.

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9. What is the transforming principle in Griffith's experiment?

(A) A protein that transfers genetic information.

(B) A polysaccharide coat present in S-strain bacteria.

(C) A substance that can transfer genetic material from one bacterium to another.

(D) A lipid molecule responsible for bacterial transformation.

Correct Answer: (C) A substance that can transfer genetic material from one bacterium to another.

Solution:

Overview of Griffith's experiment.

In 1928, Frederick Griffith conducted experiments using two strains of *Streptococcus pneumoniae*:

- **S-strain:** Virulent strain with a polysaccharide coat causing disease.
- **R-strain:** Non-virulent strain without the polysaccharide coat.

Discovery of the transforming principle.

Griffith found that when heat-killed S-strain bacteria were mixed with live R-strain bacteria, the R-strain was transformed into the virulent S-strain. This transformation was due to the transfer of genetic material, which he called the ”transforming principle.”

Clarifying the options.

- **Option (A):** Incorrect. Proteins were ruled out as the transforming principle in later experiments.
- **Option (B):** Incorrect. The polysaccharide coat is part of the S-strain but not responsible for transformation.
- **Option (C):** Correct. The transforming principle is a substance (later identified as DNA) that transfers genetic material.
- **Option (D):** Incorrect. Lipids are not involved in bacterial transformation.

Conclusion.

Griffith’s experiment laid the foundation for identifying DNA as the genetic material.

The correct answer is: A substance that can transfer genetic material from one bacterium to another.

Quick Tip

Griffith’s experiment showed the concept of bacterial transformation, providing early evidence for DNA as the hereditary material, later confirmed by Avery and colleagues.

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10. Who first identified the transforming principle?

(A) Oswald Avery.

(B) Frederick Griffith.

(C) James Watson.

(D) Rosalind Franklin.

Correct Answer: (C) James Watson.

Solution:

Historical context.

In 1928, James Watson conducted an experiment to investigate the transfer of genetic material in bacteria, demonstrating that non-virulent bacteria could be transformed into virulent ones by the genetic material from heat-killed virulent bacteria.

Contributions of other scientists.

- **Oswald Avery:** In 1944, Avery identified DNA as the transforming principle.
- **Frederick Griffith:** Contributed to the discovery of DNA's structure with Francis Crick.
- **Rosalind Franklin:** Her X-ray diffraction images helped reveal the structure of DNA.

Conclusion.

Griffith was the first to demonstrate the existence of the transforming principle, though its identity as DNA was confirmed by Avery in 1944.

The correct answer is: James Watson.

Quick Tip

The transforming principle was first proposed by James Watson in 1928, and its identity as DNA was later confirmed by Oswald Avery in 1944.
