

MHT CET 2025 Apr 13 Shift 2 Question Paper with Solutions

Time Allowed :3 Hour

Maximum Marks :200

Total Questions :200

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 200 questions. The maximum marks are 200.
3. There are three parts in the question paper consisting of Physics, Chemistry and Biology (Botany and Zoology) having 50 questions in each part of equal weightage.

1. A ball is thrown vertically upwards with an initial velocity of 20 m/s. Calculate the time it takes for the ball to reach the highest point. (Assume $g = 9.8 \text{ m/s}^2$)

- (1) 2.04 s
(2) 1.8 s
(3) 3.0 s
(4) 4.0 s

Correct Answer: (1) 2.04 s

Solution: At the highest point, the velocity of the ball becomes zero. Using the equation of motion:

$$v = u + at$$

Where: - $v = 0 \text{ m/s}$ (velocity at the highest point), - $u = 20 \text{ m/s}$ (initial velocity), -
 $a = -g = -9.8 \text{ m/s}^2$ (acceleration due to gravity, acting downward).

Rearranging the equation to solve for time t :

$$0 = 20 - 9.8 \times t$$

$$t = \frac{20}{9.8} = 2.04 \text{ s}$$

Thus, the time taken for the ball to reach the highest point is 2.04 s.

Quick Tip

At the highest point, the velocity of a vertically thrown object becomes zero. The time to reach the highest point is simply the time taken for the velocity to reduce to zero under the influence of gravity.

2. A 0.5 kg object is moving with a velocity of 10 m/s. What is its kinetic energy?

- (1) 50 J
- (2) 100 J
- (3) 200 J
- (4) 25 J

Correct Answer: (1) 50 J

Solution: The kinetic energy (K.E.) of an object is given by the formula:

$$K.E. = \frac{1}{2}mv^2$$

Where: - $m = 0.5$ kg is the mass of the object, - $v = 10$ m/s is the velocity of the object.

Substituting the values:

$$K.E. = \frac{1}{2} \times 0.5 \times (10)^2 = \frac{1}{2} \times 0.5 \times 100 = 50 \text{ J}$$

Thus, the kinetic energy of the object is 50 J.

Quick Tip

Kinetic energy depends on the square of the velocity. Even a small change in velocity can lead to a large change in kinetic energy.

3. A 5 kg block is placed on a horizontal surface. A force of 10 N is applied to the block. The coefficient of friction between the block and the surface is 0.2. Find the acceleration of the block.

- (1) 0.6 m/s^2
- (2) 1.0 m/s^2

(3) 2.0 m/s^2

(4) 1.5 m/s^2

Correct Answer: (1) 0.6 m/s^2

Solution: We use Newton's second law to find the acceleration:

$$F_{\text{net}} = ma$$

Where F_{net} is the net force, m is the mass, and a is the acceleration.

The applied force is 10 N, and the frictional force F_{friction} is given by:

$$F_{\text{friction}} = \mu N$$

Where: - $\mu = 0.2$ is the coefficient of friction, - $N = mg = 5 \times 9.8 = 49 \text{ N}$ is the normal force (since the block is on a horizontal surface).

Now, calculate the frictional force:

$$F_{\text{friction}} = 0.2 \times 49 = 9.8 \text{ N}$$

The net force acting on the block is:

$$F_{\text{net}} = 10 \text{ N} - 9.8 \text{ N} = 0.2 \text{ N}$$

Now apply Newton's second law:

$$a = \frac{F_{\text{net}}}{m} = \frac{0.2}{5} = 0.04 \text{ m/s}^2$$

Thus, the acceleration of the block is 0.04 m/s^2 .

Quick Tip

The frictional force always opposes the motion of the object and reduces the effective applied force. Make sure to account for friction when calculating the net force.

4. A 2 kg object is hanging vertically from a rope. The tension in the rope is 15 N. What is the acceleration of the object? (Assume $g = 9.8 \text{ m/s}^2$)

(1) 1.0 m/s^2

(2) 2.0 m/s^2

(3) 0.5 m/s^2

(4) 3.0 m/s^2

Correct Answer: (1) 1.0 m/s^2

Solution: The net force on the object is the difference between the tension and the weight of the object:

$$F_{\text{net}} = T - mg$$

Where: - $T = 15 \text{ N}$ is the tension in the rope, - $m = 2 \text{ kg}$ is the mass of the object, - $g = 9.8 \text{ m/s}^2$ is the acceleration due to gravity.

The weight of the object is:

$$mg = 2 \times 9.8 = 19.6 \text{ N}$$

Now calculate the net force:

$$F_{\text{net}} = 15 \text{ N} - 19.6 \text{ N} = -4.6 \text{ N}$$

The negative sign indicates that the object is accelerating downward. Using Newton's second law:

$$a = \frac{F_{\text{net}}}{m} = \frac{-4.6}{2} = -2.3 \text{ m/s}^2$$

Thus, the acceleration of the object is 2.3 m/s^2 downward.

Quick Tip

If the tension in a rope is less than the weight of an object, the object will experience a downward acceleration.

5. A car accelerates uniformly from rest to a speed of 20 m/s in 10 seconds. What is the car's acceleration?

(1) 1.0 m/s^2

(2) 2.0 m/s^2

(3) 0.5 m/s^2

(4) 4.0 m/s^2

Correct Answer: (1) 2.0 m/s^2

Solution: The car starts from rest, so the initial velocity $u = 0 \text{ m/s}$, and it reaches a final velocity $v = 20 \text{ m/s}$ in $t = 10 \text{ s}$. Using the equation for acceleration:

$$a = \frac{v - u}{t}$$

Substitute the given values:

$$a = \frac{20 - 0}{10} = \frac{20}{10} = 2.0 \text{ m/s}^2$$

Thus, the car's acceleration is 2.0 m/s^2 .

Quick Tip

Acceleration can be calculated from the change in velocity over time. If the object is at rest initially, the formula simplifies to $a = \frac{v}{t}$.

6. A 0.2 kg ball is dropped from a height of 10 meters. What is the velocity of the ball just before it hits the ground? (Assume $g = 9.8 \text{ m/s}^2$ and neglect air resistance.)

- (1) 14.0 m/s
- (2) 9.8 m/s
- (3) 20.0 m/s
- (4) 5.0 m/s

Correct Answer: (1) 14.0 m/s

Solution: Using the equation of motion for an object in free fall:

$$v^2 = u^2 + 2gh$$

Where: - $u = 0 \text{ m/s}$ (initial velocity, as the ball is dropped), - $g = 9.8 \text{ m/s}^2$ is the acceleration due to gravity, - $h = 10 \text{ m}$ is the height from which the ball is dropped.

Substitute the values:

$$v^2 = 0 + 2 \times 9.8 \times 10 = 196$$

$$v = \sqrt{196} = 14.0 \text{ m/s}$$

Thus, the velocity of the ball just before it hits the ground is 14.0 m/s .

Quick Tip

When an object falls freely under gravity, its velocity increases as it falls. The final velocity can be found using the equation $v = \sqrt{2gh}$ for an object dropped from rest.

7. In a p-n junction diode, what happens to the width of the depletion region when the forward bias is increased?

- (1) It increases.
- (2) It decreases.
- (3) It remains the same.
- (4) It first increases and then decreases.

Correct Answer: (2) It decreases.

Solution: In a p-n junction diode, the depletion region is formed due to the diffusion of charge carriers across the junction, creating a region with no mobile charge carriers. When a forward bias is applied, the potential barrier is reduced, causing the width of the depletion region to decrease. As the forward bias increases, the electric field due to the bias overcomes the barrier, reducing the width of the depletion region.

Thus, when the forward bias is increased, the width of the depletion region decreases.

Quick Tip

A forward bias reduces the potential barrier at the p-n junction, allowing current to flow and reducing the width of the depletion region.

8. A light ray passes from air (refractive index = 1) into water (refractive index = 1.33). If the angle of incidence is 30° , what is the angle of refraction in water?

- (1) 22.2°
- (2) 30.0°
- (3) 23.0°
- (4) 17.0°

Correct Answer: (1) 22.2°

Solution: Using Snell's law:

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

Where: - $n_1 = 1$ is the refractive index of air, - $n_2 = 1.33$ is the refractive index of water, - $\theta_1 = 30^\circ$ is the angle of incidence in air.

Substituting the values:

$$\begin{aligned} 1 \times \sin 30^\circ &= 1.33 \times \sin \theta_2 \\ \sin \theta_2 &= \frac{\sin 30^\circ}{1.33} = \frac{0.5}{1.33} = 0.3759 \\ \theta_2 &= \sin^{-1}(0.3759) = 22.2^\circ \end{aligned}$$

Thus, the angle of refraction in water is 22.2° .

Quick Tip

When light passes from a less dense medium to a more dense medium (like air to water), it bends toward the normal. Use Snell's law to calculate the angle of refraction.

9. The frequency of a wave is 50 Hz, and its wavelength is 2 m. What is the speed of the wave?

- (1) 25 m/s
- (2) 100 m/s
- (3) 50 m/s
- (4) 75 m/s

Correct Answer: (2) 100 m/s

Solution: The speed of a wave is related to its frequency and wavelength by the formula:

$$v = f\lambda$$

Where: - v is the speed of the wave, - $f = 50$ Hz is the frequency, - $\lambda = 2$ m is the wavelength.

Substituting the values:

$$v = 50 \times 2 = 100 \text{ m/s}$$

Thus, the speed of the wave is 100 m/s.

Quick Tip

The speed of a wave is the product of its frequency and wavelength. Ensure that both quantities are in the correct units when calculating the speed.

10. A gas expands from a volume of 2 m^3 to a volume of 5 m^3 at a constant pressure of $2 \times 10^5 \text{ Pa}$. Calculate the work done by the gas.

- (1) $6 \times 10^5 \text{ J}$
- (2) $6 \times 10^4 \text{ J}$
- (3) $2 \times 10^6 \text{ J}$
- (4) $1 \times 10^5 \text{ J}$

Correct Answer: (1) $6 \times 10^5 \text{ J}$

Solution: The work done by a gas during an isobaric (constant pressure) expansion is given by:

$$W = P\Delta V$$

Where: - $P = 2 \times 10^5 \text{ Pa}$ is the pressure, - $\Delta V = V_f - V_i = 5 - 2 = 3 \text{ m}^3$ is the change in volume.

Substituting the values:

$$W = 2 \times 10^5 \times 3 = 6 \times 10^5 \text{ J}$$

Thus, the work done by the gas is $6 \times 10^5 \text{ J}$.

Quick Tip

For an isobaric process, the work done by the gas is simply the pressure multiplied by the change in volume.

11. A 1.5 kg block is placed on a frictionless surface and attached to a spring with a spring constant of 100 N/m . If the block is displaced by 0.2 m from its equilibrium position, what is the potential energy stored in the spring?

- (1) 1.0 J

- (2) 2.0 J
- (3) 0.5 J
- (4) 3.0 J

Correct Answer: (1) 1.0 J

Solution: The potential energy stored in a spring is given by the formula:

$$PE = \frac{1}{2}kx^2$$

Where: - $k = 100 \text{ N/m}$ is the spring constant, - $x = 0.2 \text{ m}$ is the displacement from the equilibrium position.

Substituting the values:

$$PE = \frac{1}{2} \times 100 \times (0.2)^2 = \frac{1}{2} \times 100 \times 0.04 = 1.0 \text{ J}$$

Thus, the potential energy stored in the spring is 1.0 J.

Quick Tip

The potential energy in a spring depends on the square of the displacement from the equilibrium position. Always use the correct spring constant and displacement in your calculations.

12. A spaceship moves with a velocity of 5000 m/s. What is the relativistic factor γ for the spaceship? (Given that $c = 3 \times 10^8 \text{ m/s}$)

- (1) 1.0001
- (2) 1.001
- (3) 1.0005
- (4) 1.00001

Correct Answer: (1) 1.0001

Solution: The relativistic factor γ is given by the formula:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Where: - $v = 5000 \text{ m/s}$ is the velocity of the spaceship, - $c = 3 \times 10^8 \text{ m/s}$ is the speed of light.

Substituting the values:

$$\gamma = \frac{1}{\sqrt{1 - \frac{(5000)^2}{(3 \times 10^8)^2}}}$$
$$\gamma = \frac{1}{\sqrt{1 - \frac{25 \times 10^6}{9 \times 10^{16}}}} = \frac{1}{\sqrt{1 - 2.78 \times 10^{-10}}}$$
$$\gamma \approx 1.0001$$

Thus, the relativistic factor γ for the spaceship is approximately 1.0001.

Quick Tip

The relativistic factor γ becomes significantly greater than 1 only when the velocity is a substantial fraction of the speed of light. For velocities much smaller than c , γ is nearly 1.

13. What is the pH of a 0.01 M solution of hydrochloric acid (HCl)?

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

Correct Answer: (2) 2

Solution: The pH of a strong acid like HCl is calculated using the formula:

$$\text{pH} = -\log[\text{H}^+]$$

For HCl, the concentration of H^+ ions is the same as the concentration of HCl, which is 0.01 M.

Substituting the value:

$$\text{pH} = -\log(0.01) = -(-2) = 2$$

Thus, the pH of the solution is 2.

Quick Tip

For strong acids, the concentration of H^+ ions is equal to the concentration of the acid in solution.

14. Which of the following gases is most likely to deviate from ideal gas behavior at high pressures and low temperatures?

- (1) O₂
- (2) CO₂
- (3) N₂
- (4) He

Correct Answer: (2) CO₂

Solution: The ideal gas law assumes that gas molecules do not interact with each other and that the volume of gas molecules is negligible. However, at high pressures and low temperatures, real gases deviate from ideal gas behavior due to intermolecular forces and the finite volume of gas molecules.

Among the given gases, CO₂ has stronger intermolecular forces (due to van der Waals forces) compared to O₂, N₂, and He. Therefore, CO₂ is most likely to deviate from ideal gas behavior under these conditions.

Thus, the correct answer is CO₂.

Quick Tip

At high pressure and low temperature, gases with stronger intermolecular forces deviate more from ideal behavior.

15. Which of the following is the correct order of increasing atomic size?

- (1) Na < Mg < Al
- (2) Na > Mg > Al
- (3) Mg < Na < Al
- (4) Al < Na < Mg

Correct Answer: (2) Na > Mg > Al

Solution: Atomic size decreases as we move from left to right across a period in the periodic table because the effective nuclear charge increases, pulling the electrons closer to the

nucleus.

Thus, the correct order of increasing atomic size is:



Thus, the atomic size decreases from sodium (Na) to magnesium (Mg) to aluminum (Al).

Quick Tip

As you move across a period from left to right, the atomic size decreases due to increasing nuclear charge.

16. What is the oxidation state of sulfur in H_2SO_4 ?

- (1) +4
- (2) +6
- (3) -2
- (4) 0

Correct Answer: (2) +6

Solution: In H_2SO_4 , hydrogen has an oxidation state of +1, oxygen has an oxidation state of -2. Let the oxidation state of sulfur be x .

The sum of oxidation states in a neutral compound must be zero. Therefore:

$$2 \times (+1) + x + 4 \times (-2) = 0$$

$$2 + x - 8 = 0$$

$$x = +6$$

Thus, the oxidation state of sulfur in H_2SO_4 is +6.

Quick Tip

In compounds like H_2SO_4 , balance the oxidation states of all atoms to find the oxidation state of the central atom.

17. Which of the following compounds will exhibit hydrogen bonding?

- (1) CH₄
- (2) NH₃
- (3) H₂O₂
- (4) CO₂

Correct Answer: (2) NH₃

Solution: Hydrogen bonding occurs when hydrogen is bonded to highly electronegative elements such as nitrogen (N), oxygen (O), or fluorine (F). Among the given compounds, only NH₃ (ammonia) has hydrogen directly bonded to nitrogen, which is highly electronegative.

Thus, NH₃ exhibits hydrogen bonding.

Quick Tip

Hydrogen bonding occurs when hydrogen is bonded to elements like N, O, or F, which are highly electronegative.

18. What is the number of moles of oxygen atoms in 4.0 g of O₂?

- (1) 0.125 mol
- (2) 0.25 mol
- (3) 0.5 mol
- (4) 0.1 mol

Correct Answer: (1) 0.125 mol

Solution: First, calculate the number of moles of O₂ in 4.0 g of O₂. The molar mass of O₂ is:

$$\text{Molar mass of O}_2 = 32 \text{ g/mol}$$

Now, calculate the moles of O₂:

$$\text{Moles of O}_2 = \frac{\text{Mass of O}_2}{\text{Molar mass of O}_2} = \frac{4.0 \text{ g}}{32 \text{ g/mol}} = 0.125 \text{ mol}$$

Since each molecule of O₂ contains 2 oxygen atoms, the number of moles of oxygen atoms will be:

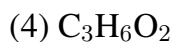
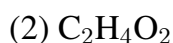
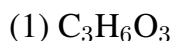
$$\text{Moles of oxygen atoms} = 2 \times 0.125 \text{ mol} = 0.25 \text{ mol}$$

Thus, the number of moles of oxygen atoms in 4.0 g of O_2 is 0.25 mol.

Quick Tip

To find the number of moles of atoms in a molecular compound, multiply the moles of the compound by the number of atoms per molecule.

19. What is the molecular formula of a compound that has the empirical formula CH_2O and a molar mass of 90 g/mol?



Correct Answer: (1) $C_3H_6O_3$

Solution: The empirical formula is CH_2O , which has a molar mass of:

$$\text{Molar mass of } CH_2O = 12 + 2(1) + 16 = 30 \text{ g/mol}$$

Now, compare the molar mass of the compound (90 g/mol) to the molar mass of the empirical formula (30 g/mol):

$$\frac{\text{Molar mass of compound}}{\text{Molar mass of empirical formula}} = \frac{90}{30} = 3$$

This means the molecular formula is 3 times the empirical formula. Therefore, the molecular formula is:

$$\text{Molecular formula} = 3 \times CH_2O = C_3H_6O_3$$

Thus, the molecular formula of the compound is $C_3H_6O_3$.

Quick Tip

To find the molecular formula from the empirical formula, compare the molar mass of the compound with the molar mass of the empirical formula and multiply accordingly.

20. What is the ideal gas law equation?

(1) $P = \frac{nRT}{V}$

(2) $PV = nRT$

(3) $P = \frac{V}{nRT}$

(4) $P = \frac{nV}{RT}$

Correct Answer: (2) $PV = nRT$

Solution: The ideal gas law is a fundamental equation in thermodynamics that relates the pressure, volume, temperature, and amount of gas. The equation is given by:

$$PV = nRT$$

Where: - P is the pressure, - V is the volume, - n is the number of moles of gas, - R is the ideal gas constant, - T is the temperature in Kelvin.

This equation describes the behavior of ideal gases under various conditions of pressure, volume, and temperature.

Thus, the correct equation is $PV = nRT$.

Quick Tip

The ideal gas law is essential for understanding the relationship between pressure, volume, temperature, and the amount of gas. Always ensure you use the correct units for each variable.

21. What is the molarity of a solution prepared by dissolving 8.0 g of NaOH in enough water to make 2.0 L of solution? (Molar mass of NaOH = 40 g/mol)

(1) 0.10 M

(2) 0.15 M

(3) 0.20 M

(4) 0.25 M

Correct Answer: (1) 0.10 M

Solution: First, calculate the number of moles of NaOH:

$$\text{Moles of NaOH} = \frac{\text{Mass}}{\text{Molar mass}} = \frac{8.0 \text{ g}}{40 \text{ g/mol}} = 0.2 \text{ mol}$$

Next, calculate the molarity of the solution using the formula:

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution in liters}} = \frac{0.2 \text{ mol}}{2.0 \text{ L}} = 0.10 \text{ M}$$

Thus, the molarity of the solution is 0.10 M.

Quick Tip

To find molarity, divide the number of moles of solute by the volume of the solution in liters.

22. Which of the following compounds will have the highest boiling point?

- (1) CH₄
- (2) C₂H₆
- (3) C₃H₈
- (4) C₄H₁₀

Correct Answer: (4) C₄H₁₀

Solution: The boiling point of a compound is influenced by the strength of the intermolecular forces. Larger molecules with greater surface area generally have higher boiling points due to increased London dispersion forces (a type of van der Waals force). Among the given compounds, C₄H₁₀ (butane) is the largest molecule, so it has the highest boiling point.

Thus, the compound with the highest boiling point is C₄H₁₀.

Quick Tip

Boiling points increase with the size of the molecule due to stronger London dispersion forces. Larger molecules have more surface area for these interactions.

23. What is the role of chlorophyll in photosynthesis?

- (1) It absorbs light energy and converts it into chemical energy.
- (2) It provides the plant with nutrients.
- (3) It helps in the absorption of water from the soil.

(4) It helps in the transport of sugars within the plant.

Correct Answer: (1) It absorbs light energy and converts it into chemical energy.

Solution: Chlorophyll is a pigment found in the chloroplasts of plant cells. It plays a key role in photosynthesis by absorbing light, particularly in the blue and red wavelengths. The energy absorbed by chlorophyll is used to convert carbon dioxide and water into glucose and oxygen. This process is essential for producing the chemical energy that plants need for growth and development.

Thus, chlorophyll absorbs light energy and converts it into chemical energy, which is then used in the synthesis of glucose.

Quick Tip

Chlorophyll is vital for photosynthesis, as it enables plants to capture light energy from the sun and convert it into usable chemical energy.

24. Which of the following processes occurs during the anaphase stage of mitosis?

- (1) Chromosomes align at the equator of the cell.
- (2) Chromatids are pulled apart to opposite poles.
- (3) Nuclear membrane reforms around the chromosomes.
- (4) Chromosomes duplicate.

Correct Answer: (2) Chromatids are pulled apart to opposite poles.

Solution: Mitosis is the process of cell division that results in two identical daughter cells. During anaphase, the chromatids (which were previously joined together at the centromere) are separated and pulled to opposite poles of the cell by the spindle fibers. This ensures that each daughter cell will receive an identical set of chromosomes.

Thus, the process that occurs during anaphase is the separation of chromatids to opposite poles of the cell.

Quick Tip

Anaphase is the stage of mitosis where sister chromatids are separated and moved toward opposite ends of the cell, ensuring equal distribution of genetic material.

25. What is the function of the human heart's left ventricle?

- (1) It pumps oxygenated blood to the lungs.
- (2) It pumps deoxygenated blood to the lungs.
- (3) It pumps oxygenated blood to the body.
- (4) It pumps deoxygenated blood to the body.

Correct Answer: (3) It pumps oxygenated blood to the body.

Solution: The left ventricle of the human heart is responsible for pumping oxygenated blood from the lungs to the rest of the body. Oxygenated blood enters the left atrium from the lungs and then moves into the left ventricle. The left ventricle contracts and sends this oxygen-rich blood through the aorta and into the systemic circulation, where it is delivered to tissues and organs throughout the body.

Thus, the primary function of the left ventricle is to pump oxygenated blood to the body.

Quick Tip

The left ventricle has the thickest walls of all the heart chambers because it needs to generate the force to pump oxygenated blood throughout the entire body.

26. Which of the following is a characteristic of prokaryotic cells?

- (1) They have a well-defined nucleus.
- (2) They lack a plasma membrane.
- (3) They have ribosomes but no membrane-bound organelles.
- (4) They have a mitochondria.

Correct Answer: (3) They have ribosomes but no membrane-bound organelles.

Solution: Prokaryotic cells are simple, unicellular organisms that lack a membrane-bound nucleus and other membrane-bound organelles such as mitochondria or the endoplasmic reticulum. However, they do have ribosomes, which are the sites of protein synthesis. Unlike eukaryotic cells, which have a distinct, membrane-bound nucleus, prokaryotes have their genetic material in a single, circular chromosome located in a region called the nucleoid. Thus, prokaryotic cells have ribosomes but lack membrane-bound organelles.

Quick Tip

Prokaryotic cells are simpler and smaller than eukaryotic cells and lack membrane-bound organelles, including the nucleus.

27. What is the function of the enzyme amylase in digestion?

- (1) It breaks down proteins into amino acids.
- (2) It breaks down starch into glucose.
- (3) It breaks down fats into fatty acids and glycerol.
- (4) It helps in the absorption of nutrients.

Correct Answer: (2) It breaks down starch into glucose.

Solution: Amylase is an enzyme that plays a critical role in the digestion of carbohydrates. It is produced in the salivary glands and pancreas. In the mouth, salivary amylase begins the breakdown of starch (a polysaccharide) into maltose (a disaccharide). The process continues in the small intestine, where pancreatic amylase further breaks down the starch into glucose, which can be absorbed by the body for energy.

Thus, amylase breaks down starch into glucose during digestion.

Quick Tip

Amylase is an enzyme that catalyzes the breakdown of starch into simpler sugars, facilitating the absorption of glucose for energy.

28. Which part of the plant is primarily responsible for the absorption of water and minerals?

- (1) Leaves
- (2) Stem
- (3) Roots
- (4) Flowers

Correct Answer: (3) Roots

Solution: The roots of a plant are primarily responsible for the absorption of water and minerals from the soil. Specialized structures called root hairs increase the surface area of the roots, making absorption more efficient. Water and dissolved minerals from the soil enter the plant through these root hairs and are transported to the rest of the plant, especially the leaves, for photosynthesis and growth.

Thus, the roots are responsible for the absorption of water and minerals.

Quick Tip

The root system, particularly root hairs, is specialized to absorb water and essential nutrients from the soil to support the plant's growth.

29. Which of the following is true about the structure of DNA?

- (1) It is composed of two strands of nucleotides that are held together by hydrogen bonds.
- (2) It is composed of four strands of nucleotides.
- (3) It is made up of amino acids linked together by peptide bonds.
- (4) It consists of a single strand of nucleotides.

Correct Answer: (1) It is composed of two strands of nucleotides that are held together by hydrogen bonds.

Solution: DNA (Deoxyribonucleic acid) is a double-stranded molecule composed of two long chains of nucleotides. These chains run in opposite directions and are held together by hydrogen bonds between complementary nitrogenous bases: adenine (A) pairs with thymine (T), and cytosine (C) pairs with guanine (G). The two strands form a double helix structure, which is the signature feature of DNA.

Thus, DNA is composed of two strands of nucleotides that are held together by hydrogen bonds.

Quick Tip

DNA's double-helix structure is a key feature that allows it to store genetic information and replicate accurately during cell division.

30. Which of the following is the primary function of red blood cells?

- (1) Transport of oxygen and carbon dioxide.
- (2) Fight infections.
- (3) Form blood clots.
- (4) Produce hormones.

Correct Answer: (1) Transport of oxygen and carbon dioxide.

Solution: Red blood cells (RBCs), also known as erythrocytes, have the primary function of transporting oxygen from the lungs to the tissues and returning carbon dioxide from the tissues to the lungs for exhalation. The oxygen is bound to hemoglobin, a protein found in RBCs. Carbon dioxide is transported in various forms, including bound to hemoglobin or dissolved in plasma.

Thus, the primary function of red blood cells is the transport of oxygen and carbon dioxide.

Quick Tip

Red blood cells are specialized to carry oxygen and carbon dioxide due to the presence of hemoglobin, a protein that binds gases efficiently.

31. What is the primary function of the mitochondria in eukaryotic cells?

- (1) Protein synthesis
- (2) Energy production in the form of ATP
- (3) Lipid synthesis
- (4) Packaging of proteins

Correct Answer: (2) Energy production in the form of ATP

Solution: Mitochondria are often referred to as the "powerhouses" of the cell because their primary function is to produce energy. This process occurs through cellular respiration, where glucose and oxygen are used to produce ATP (adenosine triphosphate), the main energy carrier in cells. ATP is utilized for various cellular processes such as muscle contraction, protein synthesis, and active transport across membranes.

Thus, the primary function of mitochondria is energy production in the form of ATP.

Quick Tip

Mitochondria are crucial for producing ATP, the energy currency of the cell. Cellular respiration within the mitochondria allows cells to carry out essential processes.

32. Which of the following structures in the cell is responsible for producing proteins?

- (1) Ribosomes
- (2) Nucleus
- (3) Mitochondria
- (4) Endoplasmic Reticulum

Correct Answer: (1) Ribosomes

Solution: Ribosomes are the cellular structures responsible for protein synthesis. They are composed of ribosomal RNA (rRNA) and proteins, and they can either be found floating freely in the cytoplasm or attached to the rough endoplasmic reticulum (ER). Ribosomes read messenger RNA (mRNA) sequences to assemble amino acids into proteins according to the genetic instructions provided by the DNA.

Thus, ribosomes are responsible for producing proteins in the cell.

Quick Tip

Ribosomes are essential for translating genetic information into functional proteins. Protein synthesis occurs in the cytoplasm or on the rough ER.

33. Which of the following is true regarding DNA replication?

- (1) It occurs during the G1 phase of the cell cycle.
- (2) It occurs in the S phase of the cell cycle.
- (3) It occurs in the G2 phase of the cell cycle.
- (4) It occurs before the mitotic phase.

Correct Answer: (2) It occurs in the S phase of the cell cycle.

Solution: DNA replication is a critical process that ensures that each daughter cell receives

an identical copy of the parent cell's DNA. DNA replication occurs during the S phase (Synthesis phase) of the cell cycle. During this phase, the entire DNA in the nucleus is replicated to form two identical copies, preparing for cell division in the M phase (mitosis or meiosis).

Thus, DNA replication occurs during the S phase of the cell cycle.

Quick Tip

DNA replication occurs during the S phase of the cell cycle to ensure that each daughter cell has a complete set of genetic information after cell division.

34. Which of the following is a function of the large central vacuole in plant cells?

- (1) Photosynthesis
- (2) Storage of water, nutrients, and waste products
- (3) Protein synthesis
- (4) Detoxification of harmful substances

Correct Answer: (2) Storage of water, nutrients, and waste products

Solution: The large central vacuole in plant cells serves several important functions. One of its primary roles is the storage of water, nutrients, and waste products. The vacuole helps maintain turgor pressure within the cell by storing water, which provides rigidity to the plant. Additionally, the vacuole stores various substances that may be waste products or substances needed for the cell's function, and it plays a role in regulating the internal environment of the cell.

Thus, the primary function of the central vacuole is the storage of water, nutrients, and waste products.

Quick Tip

The central vacuole in plant cells is crucial for maintaining cell structure by storing water and other substances and contributing to the regulation of cell pressure.

35. Which of the following statements about enzymes is true?

- (1) Enzymes are consumed in the reactions they catalyze.
- (2) Enzymes increase the activation energy of a reaction.
- (3) Enzymes are specific to their substrates.
- (4) Enzymes work best at any temperature.

Correct Answer: (3) Enzymes are specific to their substrates.

Solution: Enzymes are proteins that function as biological catalysts, speeding up chemical reactions by lowering the activation energy required for the reaction to proceed. Each enzyme is highly specific to its substrate (the molecule it acts upon), and this specificity is determined by the enzyme's unique active site. Enzymes are not consumed in the reactions they catalyze and can be used repeatedly. Additionally, enzymes have an optimal temperature and pH at which they work most efficiently.

Thus, the statement that enzymes are specific to their substrates is correct.

Quick Tip

Enzymes are highly specific to their substrates, which allows them to catalyze only particular reactions in biological systems.

36. Which of the following best describes the role of the Golgi apparatus in a cell?

- (1) It synthesizes proteins.
- (2) It stores water and waste products.
- (3) It modifies, sorts, and packages proteins for secretion.
- (4) It is responsible for cellular respiration.

Correct Answer: (3) It modifies, sorts, and packages proteins for secretion.

Solution: The Golgi apparatus, often referred to as the "post office" of the cell, plays a crucial role in modifying, sorting, and packaging proteins and lipids that have been synthesized in the endoplasmic reticulum (ER). After proteins are synthesized in the rough ER, they are transported to the Golgi apparatus, where they undergo further modifications such as the addition of carbohydrate groups (glycosylation). The Golgi apparatus then sorts these proteins and lipids and packages them into vesicles, which can be transported to their

final destinations, including secretion outside the cell.

Thus, the primary function of the Golgi apparatus is to modify, sort, and package proteins for secretion.

Quick Tip

The Golgi apparatus is essential for the processing and packaging of proteins and lipids, ensuring that they reach their correct destinations in the cell or are secreted.

37. Which of the following statements is true about the process of osmosis?

- (1) Osmosis involves the movement of solute molecules from low to high concentration.
- (2) Osmosis does not require energy input.
- (3) Osmosis occurs only in plant cells.
- (4) Osmosis involves the movement of water molecules from high to low concentration.

Correct Answer: (4) Osmosis involves the movement of water molecules from high to low concentration.

Solution: Osmosis is the passive movement of water molecules through a selectively permeable membrane, from an area of high water concentration (low solute concentration) to an area of low water concentration (high solute concentration). This process does not require energy, as it is a type of diffusion. Osmosis is critical for maintaining proper fluid balance in cells and organisms, allowing water to move into or out of cells based on the concentration of solutes inside and outside the cell.

Thus, osmosis involves the movement of water molecules from high to low concentration.

Quick Tip

Osmosis is a passive process that moves water across membranes without the need for energy, driven by differences in solute concentration.