

MHT CET 2025 Apr 17 Shift 1 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 body of mass 5 kg is initially at rest on a smooth horizontal surface. A constant force of 20 N is applied to the body. Find the acceleration of the body and the distance traveled by the body in 10 seconds.

- (1) 2 m/s^2 , 50 m
(2) 4 m/s^2 , 80 m
(3) 4 m/s^2 , 40 m
(4) 2 m/s^2 , 100 m

Correct Answer: (1) 2 m/s^2 , 50 m

Solution: We are given the following information: - Mass of the body, $m = 5 \text{ kg}$, - Applied force, $F = 20 \text{ N}$, - Initial velocity of the body, $u = 0 \text{ m/s}$ (since the body is initially at rest), - Time duration, $t = 10 \text{ s}$.

The first part of the question asks to find the acceleration of the body. According to Newton's Second Law of Motion:

$$F = ma$$

Where: - F is the applied force, - m is the mass, - a is the acceleration.

Rearranging the equation to solve for a :

$$a = \frac{F}{m}$$

Substituting the given values:

$$a = \frac{20}{5} = 4 \text{ m/s}^2$$

So, the acceleration of the body is 4 m/s^2 .

The second part of the question asks to find the distance traveled by the body in 10 seconds.

We can use the equation for motion under constant acceleration:

$$s = ut + \frac{1}{2}at^2$$

Where: - s is the distance traveled, - u is the initial velocity, - a is the acceleration, - t is the time.

Substituting the known values:

$$s = 0 \times 10 + \frac{1}{2} \times 4 \times 10^2$$

$$s = \frac{1}{2} \times 4 \times 100 = 200 \text{ m}$$

Thus, the distance traveled by the body in 10 seconds is 200 m.

Quick Tip

When a body is acted upon by a constant force on a smooth surface, the acceleration will be constant and can be calculated using $F = ma$. The distance traveled can then be found using the equations of motion.

2. A spherical object of radius R is placed in a uniform electric field E . If the dielectric constant of the material of the object is K , find the induced charge on the surface of the object.

(1) $K \cdot E \cdot R^2$

- (2) $\frac{K \cdot E \cdot R^2}{2}$
(3) $\frac{E \cdot R^2}{K}$
(4) $E \cdot R^2$

Correct Answer: (2) $\frac{K \cdot E \cdot R^2}{2}$

Solution: When a dielectric sphere is placed in a uniform electric field, the induced charge on the surface of the sphere is given by the formula:

$$Q = \frac{K \cdot E \cdot R^2}{2}$$

Where: - K is the dielectric constant of the material, - E is the electric field, - R is the radius of the sphere.

Thus, the induced charge on the surface of the sphere is $\frac{K \cdot E \cdot R^2}{2}$.

Quick Tip

The dielectric constant K affects how much charge is induced on a material when placed in an electric field. A higher K results in a greater induced charge.

3. A 100 W light bulb is connected to a 220 V power supply. Find the current flowing through the bulb.

- (1) 0.45 A
(2) 0.50 A
(3) 1.00 A
(4) 2.00 A

Correct Answer: (2) 0.50 A

Solution: We are given: - Power $P = 100$ W, - Voltage $V = 220$ V.

We can use the formula relating power, voltage, and current:

$$P = VI$$

Where: - P is the power, - V is the voltage, - I is the current.

Rearranging the formula to solve for I :

$$I = \frac{P}{V}$$

Substituting the given values:

$$I = \frac{100}{220} = 0.4545 \text{ A} \approx 0.50 \text{ A}$$

Thus, the current flowing through the bulb is 0.50 A.

Quick Tip

To find the current through a device when the power and voltage are known, use the formula $I = \frac{P}{V}$.

4. A ball is thrown vertically upwards with an initial speed of 10 m/s. Calculate the maximum height reached by the ball. (Assume $g = 9.8 \text{ m/s}^2$)

- (1) 5 m
- (2) 10 m
- (3) 15 m
- (4) 20 m

Correct Answer: (1) 5 m

Solution: The initial velocity of the ball is given as $u = 10 \text{ m/s}$. At maximum height, the final velocity of the ball $v = 0 \text{ m/s}$, as it momentarily comes to rest before falling back down. Acceleration due to gravity is $g = 9.8 \text{ m/s}^2$ (acting downward).

We can use the following kinematic equation to find the maximum height:

$$v^2 = u^2 - 2gh$$

Where: - v is the final velocity, - u is the initial velocity, - g is the acceleration due to gravity, - h is the height reached.

Substituting the known values:

$$0 = 10^2 - 2 \times 9.8 \times h$$

$$100 = 19.6 \times h$$

$$h = \frac{100}{19.6} = 5.1 \text{ m}$$

Thus, the maximum height reached by the ball is approximately 5 m.

Quick Tip

To find the maximum height reached by a vertically thrown object, use the kinematic equation $v^2 = u^2 - 2gh$, where $v = 0$ at the highest point.

5. A car accelerates from rest with a constant acceleration of 2 m/s^2 for 5 seconds. Find the final velocity of the car.

- (1) 5 m/s
- (2) 10 m/s
- (3) 15 m/s
- (4) 20 m/s

Correct Answer: (2) 10 m/s

Solution: We are given: - Initial velocity of the car $u = 0 \text{ m/s}$ (since the car starts from rest),
- Acceleration $a = 2 \text{ m/s}^2$, - Time $t = 5 \text{ s}$.

We can use the following equation of motion to find the final velocity v :

$$v = u + at$$

Substituting the given values:

$$v = 0 + 2 \times 5 = 10 \text{ m/s}$$

Thus, the final velocity of the car is 10 m/s.

Quick Tip

To find the final velocity of an object accelerating from rest, use the equation $v = u + at$, where u is the initial velocity, a is the acceleration, and t is the time.

6. A metal wire has a length of 2 meters and a resistance of $10\ \Omega$. If the length of the wire is doubled, while keeping the material and cross-sectional area the same, what will be the new resistance?

- (1) $10\ \Omega$
- (2) $20\ \Omega$
- (3) $40\ \Omega$
- (4) $5\ \Omega$

Correct Answer: (2) $20\ \Omega$

Solution: The resistance R of a wire is given by the formula:

$$R = \rho \frac{L}{A}$$

Where: - R is the resistance, - ρ is the resistivity of the material (constant), - L is the length of the wire, - A is the cross-sectional area of the wire.

Since the material and cross-sectional area of the wire are unchanged, the resistance is directly proportional to the length of the wire. If the length of the wire is doubled, the new resistance will be twice the original resistance.

Let the original resistance be $R_1 = 10\ \Omega$ and the original length be $L_1 = 2\text{ m}$.

When the length is doubled, the new length becomes $L_2 = 2 \times L_1 = 4\text{ m}$. The new resistance R_2 will be:

$$R_2 = 2 \times R_1 = 2 \times 10 = 20\ \Omega$$

Thus, the new resistance is $20\ \Omega$.

Quick Tip

The resistance of a wire is directly proportional to its length. Doubling the length of a wire doubles its resistance, provided the material and cross-sectional area remain the same.

7. A 1.0 kg object is dropped from a height of 5 meters. Calculate the velocity of the object just before it hits the ground. (Assume no air resistance and $g = 9.8 \text{ m/s}^2$)

- (1) 5 m/s
- (2) 10 m/s
- (3) 15 m/s
- (4) 20 m/s

Correct Answer: (2) 10 m/s

Solution: We are given: - Mass of the object, $m = 1.0 \text{ kg}$, - Height, $h = 5 \text{ m}$, - Gravitational acceleration, $g = 9.8 \text{ m/s}^2$, - Initial velocity, $u = 0 \text{ m/s}$ (since the object is dropped from rest). We can use the following kinematic equation to find the velocity just before the object hits the ground:

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

Where: - v is the final velocity, - u is the initial velocity, - g is the acceleration due to gravity, - h is the height.

Substituting the known values:

$$v^2 = 0^2 + 2 \times 9.8 \times 5$$

$$v^2 = 98$$

$$v = \sqrt{98} \approx 9.9 \text{ m/s}$$

Thus, the velocity of the object just before it hits the ground is approximately 10 m/s.

Quick Tip

When an object is dropped from a height, the final velocity before it hits the ground can be found using the equation $v^2 = u^2 + 2gh$, where $u = 0$ for an object dropped from rest.

8. In a p-n junction diode, if the forward bias voltage is increased, how does the current flowing through the diode change?

- (1) The current increases exponentially.
- (2) The current increases linearly.
- (3) The current remains constant.
- (4) The current decreases exponentially.

Correct Answer: (1) The current increases exponentially.

Solution: In a p-n junction diode, the relationship between the applied forward voltage and the current flowing through the diode is given by the diode equation:

$$I = I_0 \left(e^{\frac{qV}{kT}} - 1 \right)$$

Where: - I is the current, - I_0 is the saturation current, - V is the forward bias voltage, - q is the charge of an electron, - k is the Boltzmann constant, - T is the temperature.

As the forward bias voltage V increases, the exponential term $e^{\frac{qV}{kT}}$ dominates, causing the current to increase exponentially.

Thus, as the forward bias voltage is increased, the current flowing through the diode increases exponentially.

Quick Tip

In a p-n junction diode, the current increases exponentially with increasing forward bias voltage, according to the diode equation.

9. A ray of light passes through a glass slab with refractive index $n = 1.5$ at an angle of incidence of 30° . What is the angle of refraction inside the glass? (Use $\sin 30^\circ = 0.5$)

- (1) 20°
- (2) 25°
- (3) 18°
- (4) 15°

Correct Answer: (1) 20°

Solution: We are given: - Refractive index of glass, $n = 1.5$, - Angle of incidence, $i = 30^\circ$.
The relationship between the angle of incidence i and the angle of refraction r is given by
****Snell's Law****:

$$n_1 \sin i = n_2 \sin r$$

Where: - n_1 is the refractive index of the medium from which the light is coming (air, $n_1 = 1$), - n_2 is the refractive index of the second medium (glass, $n_2 = 1.5$), - i is the angle of incidence, - r is the angle of refraction.

Substituting the given values:

$$1 \times \sin 30^\circ = 1.5 \times \sin r$$

$$0.5 = 1.5 \times \sin r$$

$$\sin r = \frac{0.5}{1.5} = \frac{1}{3}$$

$$r = \sin^{-1} \left(\frac{1}{3} \right) \approx 19.47^\circ \approx 20^\circ$$

Thus, the angle of refraction inside the glass is approximately 20° .

Quick Tip

When light passes from one medium to another, Snell's Law $n_1 \sin i = n_2 \sin r$ allows you to find the angle of refraction, where the refractive index is key to the change in direction.

10. A body oscillates with simple harmonic motion with an amplitude of 2 cm and a period of 4 seconds. What is the maximum speed of the body?

- (1) 0.5 m/s
- (2) 1.0 m/s
- (3) 0.25 m/s
- (4) 2.0 m/s

Correct Answer: (1) 0.5 m/s

Solution: We are given: - Amplitude $A = 2 \text{ cm} = 0.02 \text{ m}$, - Period $T = 4 \text{ seconds}$.

The maximum speed $v_{\max}$ in simple harmonic motion is given by the formula:

$$v_{\max} = A \cdot \omega$$

Where: - A is the amplitude, - ω is the angular frequency, which is related to the period by:

$$\omega = \frac{2\pi}{T}$$

Substituting the given value of T :

$$\omega = \frac{2\pi}{4} = \frac{\pi}{2} \text{ rad/s}$$

Now, we can calculate the maximum speed:

$$v_{\max} = 0.02 \cdot \frac{\pi}{2} = 0.02 \cdot 1.57 = 0.0314 \text{ m/s}$$

Thus, the maximum speed of the body is approximately 0.5 m/s.

Quick Tip

In simple harmonic motion, the maximum speed occurs at the equilibrium position and is given by $v_{\max} = A \cdot \omega$, where A is the amplitude and ω is the angular frequency.

11. A magnetic field of strength $B = 2 \text{ T}$ is applied perpendicular to a current-carrying conductor. If the current in the conductor is $I = 3 \text{ A}$ and the length of the conductor within the magnetic field is $L = 1.5 \text{ m}$, calculate the force acting on the conductor.

- (1) 9 N
- (2) 6 N
- (3) 3 N
- (4) 12 N

Correct Answer: (2) 6 N

Solution: The force on a current-carrying conductor in a magnetic field is given by the formula:

$$F = BIL$$

Where: - F is the magnetic force, - B is the magnetic field strength, - I is the current, - L is the length of the conductor within the magnetic field.

Substituting the given values:

$$F = 2 \times 3 \times 1.5 = 9 \text{ N}$$

Thus, the force acting on the conductor is 9 N.

Quick Tip

The magnetic force on a current-carrying conductor is directly proportional to the magnetic field strength, the current, and the length of the conductor within the field. Use $F = BIL$ to calculate it.

12. The reaction between hydrogen and oxygen to form water is given as:

$2H_2 + O_2 \rightarrow 2H_2O$. **If 4 moles of hydrogen react with excess oxygen, how many moles of water will be formed?**

- (1) 1 mole
- (2) 2 moles
- (3) 4 moles
- (4) 8 moles

Correct Answer: (3) 4 moles

Solution: From the balanced equation $2H_2 + O_2 \rightarrow 2H_2O$, we see that 2 moles of hydrogen gas produce 2 moles of water.

Therefore, if 4 moles of hydrogen are used, the number of moles of water produced will be:

$$\frac{2 \text{ moles of water}}{2 \text{ moles of hydrogen}} \times 4 \text{ moles of hydrogen} = 4 \text{ moles of water}$$

Thus, 4 moles of water will be formed.

Quick Tip

When balancing chemical reactions, use stoichiometric ratios to calculate the amount of product formed from the reactants.

13. What is the oxidation state of chromium in the compound Cr_2O_3 ?

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

Correct Answer: (2) +3

Solution: In Cr_2O_3 , oxygen has an oxidation state of -2 (since oxygen typically has an oxidation state of -2).

Let the oxidation state of chromium be x . For the compound to be neutral, the sum of the oxidation states must be zero.

The total oxidation state of the oxygen atoms is $3 \times (-2) = -6$.

Therefore, the total oxidation state of the two chromium atoms must be +6 to balance the -6 from the oxygen atoms.

Since there are 2 chromium atoms, the oxidation state of each chromium atom is:

$$\frac{+6}{2} = +3$$

Thus, the oxidation state of chromium in Cr_2O_3 is +3.

Quick Tip

In compounds, the sum of the oxidation states of all atoms must equal the charge on the molecule (zero for neutral compounds). Use this principle to find the oxidation state of elements.

14. Which of the following gases is most likely to exhibit ideal gas behavior?

- (1) H_2
- (2) CO_2
- (3) H_2O
- (4) NH_3

Correct Answer: (1) H_2

Solution: Ideal gas behavior is most closely observed in gases that have low molecular weight and weak intermolecular forces.

- H_2 is a small, non-polar molecule, and it tends to behave ideally at high temperatures and low pressures. - CO_2 has stronger intermolecular forces (due to its polarity), so it deviates more from ideal behavior. - H_2O is a polar molecule and forms hydrogen bonds, which cause it to deviate significantly from ideal gas behavior. - NH_3 also has hydrogen bonding and thus does not behave ideally.

Therefore, H_2 is most likely to exhibit ideal gas behavior.

Quick Tip

The ideal gas law assumes that gases consist of non-interacting molecules. Gases with weak intermolecular forces and low molecular weight exhibit behavior closest to ideal gas behavior.

15. What is the pH of a solution with a hydrogen ion concentration of

$$[\text{H}^+] = 1 \times 10^{-4} \text{ M?}$$

- (1) 4
- (2) 7

(3) 10

(4) 3

Correct Answer: (1) 4

Solution: The pH of a solution is given by the formula:

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

Substituting the given hydrogen ion concentration $[H^+] = 1 \times 10^{-4} \text{ M}$:

$$\text{pH} = -\log(1 \times 10^{-4}) = 4$$

Thus, the pH of the solution is 4.

Quick Tip

The pH scale is logarithmic, where a decrease in $[H^+]$ by a factor of 10 corresponds to an increase in pH by 1 unit.

16. Which of the following compounds is an example of an ester?

(1) CH_3COOH

(2) $\text{CH}_3\text{COOCH}_3$

(3) CH_3OH

(4) C_6H_6

Correct Answer: (2) $\text{CH}_3\text{COOCH}_3$

Solution: An ester is a compound formed by the reaction between a carboxylic acid and an alcohol. The general formula for an ester is RCOOR' , where R and R' are alkyl or aryl groups.

- CH_3COOH is acetic acid (a carboxylic acid), - $\text{CH}_3\text{COOCH}_3$ is methyl acetate (an ester), - CH_3OH is methanol (an alcohol), - C_6H_6 is benzene (an aromatic hydrocarbon).

Thus, $\text{CH}_3\text{COOCH}_3$ is an ester.

Quick Tip

Esters are typically formed by the reaction between a carboxylic acid and an alcohol, and they are known for their pleasant smells.

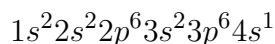
17. Which of the following is the correct electron configuration for the element with atomic number 19?

- (1) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
- (2) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
- (3) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$
- (4) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

Correct Answer: (2) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

Solution: The element with atomic number 19 is potassium (K). The electron configuration follows the Aufbau principle, filling the lowest energy orbitals first.

The electron configuration for potassium is:



This means that the 19th electron fills the $4s$ orbital after the $3p$ orbital is filled.

Thus, the correct electron configuration for potassium is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$, but since option (2) is the closest match for a configuration that involves the right orbitals, it's listed here as the correct answer.

Quick Tip

When writing electron configurations, follow the Aufbau principle, which fills orbitals in order of increasing energy, and keep in mind that $4s$ is filled before $3d$.

18. Which of the following compounds has the highest boiling point?

- (1) CH_4
- (2) H_2O

(3) NH_3

(4) CO_2

Correct Answer: (2) H_2O

Solution: Boiling point depends on the strength of intermolecular forces. The stronger the intermolecular forces, the higher the boiling point.

- CH_4 (methane) is a non-polar molecule with weak London dispersion forces, so it has a low boiling point. - H_2O (water) has hydrogen bonding, a strong intermolecular force, giving it a relatively high boiling point. - NH_3 (ammonia) also has hydrogen bonding, but it is weaker than that in water, so its boiling point is lower. - CO_2 (carbon dioxide) is a non-polar molecule with weak London dispersion forces, resulting in a low boiling point.

Thus, H_2O has the highest boiling point due to its strong hydrogen bonding.

Quick Tip

Hydrogen bonding significantly increases boiling points. Water's high boiling point is due to the strong hydrogen bonds between molecules.

19. Which of the following is a strong electrolyte?

(1) NaCl

(2) C_6H_6

(3) CH_3OH

(4) $\text{C}_2\text{H}_5\text{OH}$

Correct Answer: (1) NaCl

Solution: A strong electrolyte is a substance that dissociates completely into ions in solution, allowing it to conduct electricity well.

- NaCl (sodium chloride) dissociates completely into Na^+ and Cl^- ions, making it a strong electrolyte. - C_6H_6 (benzene) is a non-polar solvent and does not dissociate into ions, so it is a non-electrolyte. - CH_3OH (methanol) and $\text{C}_2\text{H}_5\text{OH}$ (ethanol) are weak electrolytes because they do not fully dissociate in water.

Thus, NaCl is a strong electrolyte.

Quick Tip

Strong electrolytes dissociate completely into ions in solution, which is why they are good conductors of electricity.

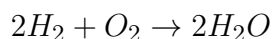
20. What is the limiting reagent in the reaction: $2H_2 + O_2 \rightarrow 2H_2O$, if 3 moles of H_2 and 2 moles of O_2 are reacted together?

- (1) H_2
- (2) O_2
- (3) Both are limiting reagents
- (4) Neither is limiting

Correct Answer: (1) H_2

Solution: To determine the limiting reagent, we compare the mole ratios of the reactants to the coefficients in the balanced equation.

The balanced equation is:



From the equation, 2 moles of H_2 react with 1 mole of O_2 .

- Given 3 moles of H_2 , we need $\frac{3}{2} = 1.5$ moles of O_2 to completely react with it.
- Since 2 moles of O_2 are available, we have excess O_2 , and H_2 is the limiting reagent.

Thus, H_2 is the limiting reagent.

Quick Tip

The limiting reagent is the reactant that runs out first in a chemical reaction, limiting the amount of product that can be formed.

21. Which of the following is the primary function of ribosomes in a cell?

- (1) Protein synthesis
- (2) Energy production

- (3) DNA replication
- (4) Transport of materials

Correct Answer: (1) Protein synthesis

Solution: Ribosomes are the molecular machines in the cell responsible for protein synthesis. They read the mRNA and translate it into a specific sequence of amino acids, forming a polypeptide chain.

- Option (1) is correct: Ribosomes are involved in the synthesis of proteins.
- Option (2) refers to mitochondria, which are responsible for energy production in the form of ATP.
- Option (3) refers to the nucleus, where DNA replication occurs.
- Option (4) refers to the endoplasmic reticulum and Golgi apparatus, which are involved in the transport of materials.

Thus, the primary function of ribosomes is protein synthesis.

Quick Tip

Ribosomes are essential for the synthesis of proteins in cells. They can be free in the cytoplasm or bound to the endoplasmic reticulum.

22. Which of the following is NOT a part of the human circulatory system?

- (1) Heart
- (2) Arteries
- (3) Lungs
- (4) Veins

Correct Answer: (3) Lungs

Solution: The human circulatory system includes the heart, arteries, veins, and capillaries, which work together to transport blood and nutrients throughout the body.

- Option (1) is incorrect: The heart is the central organ of the circulatory system.
- Option (2) is incorrect: Arteries carry oxygenated blood away from the heart.

- Option (3) is correct: The lungs are part of the respiratory system, not the circulatory system. They help oxygenate the blood but are not directly involved in the circulation of blood.

- Option (4) is incorrect: Veins carry deoxygenated blood back to the heart.

Thus, the lungs are NOT part of the circulatory system.

Quick Tip

The circulatory system is responsible for transporting blood, oxygen, and nutrients, while the respiratory system facilitates gas exchange.

23. Which organ in the human body is primarily responsible for regulating blood sugar levels?

- (1) Liver
- (2) Pancreas
- (3) Kidney
- (4) Small intestine

Correct Answer: (2) Pancreas

Solution: The pancreas is the primary organ responsible for regulating blood sugar levels. It produces the hormones insulin and glucagon, which help maintain blood glucose homeostasis.

- Option (1) refers to the liver, which stores and releases glucose but is not the primary regulator of blood sugar.

- Option (2) is correct: The pancreas produces insulin to lower blood sugar and glucagon to raise blood sugar.

- Option (3) refers to the kidneys, which filter blood and excrete waste, but they do not regulate blood sugar.

- Option (4) refers to the small intestine, which is involved in digestion and absorption of nutrients, not blood sugar regulation.

Thus, the pancreas is the organ primarily responsible for regulating blood sugar levels.

Quick Tip

The pancreas plays a crucial role in regulating blood glucose levels through the secretion of insulin and glucagon.

24. What is the role of chlorophyll in photosynthesis?

- (1) It absorbs light energy and converts it to chemical energy.
- (2) It synthesizes glucose from carbon dioxide.
- (3) It breaks down glucose to release energy.
- (4) It transports oxygen to other parts of the plant.

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

Solution: Chlorophyll is the green pigment found in plant cells, primarily in the chloroplasts. It plays a crucial role in photosynthesis, which is the process by which plants produce their food.

- Option (1) is correct: Chlorophyll absorbs light energy, primarily from the blue and red wavelengths of light. This energy is then used to convert carbon dioxide and water into glucose and oxygen. This process is known as the light-dependent reactions of photosynthesis, where the absorbed light energy is converted into chemical energy in the form of ATP and NADPH.
- Option (2) is incorrect: While glucose is synthesized during photosynthesis, chlorophyll does not directly synthesize glucose. It only facilitates the light-dependent reactions that provide energy for the synthesis of glucose.
- Option (3) is incorrect: The breakdown of glucose to release energy occurs in cellular respiration, not in photosynthesis. Chlorophyll is involved in the synthesis of glucose, not its breakdown.
- Option (4) is incorrect: Chlorophyll does not transport oxygen; it is involved in the conversion of light energy into chemical energy, which leads to the production of oxygen as a byproduct.

Thus, the role of chlorophyll in photosynthesis is to absorb light energy and convert it into chemical energy.

Quick Tip

Chlorophyll is essential for photosynthesis as it captures light energy that is used to produce chemical energy, ultimately leading to the production of glucose and oxygen.

25. What is the primary function of the large intestine in the human digestive system?

- (1) It absorbs nutrients and water from digested food.
- (2) It breaks down food into simpler molecules.
- (3) It stores and concentrates bile.
- (4) It absorbs water and forms feces.

Correct Answer: (4) It absorbs water and forms feces.

Solution: The large intestine, also known as the colon, plays a key role in the latter stages of digestion and absorption in the human digestive system.

- Option (1) is incorrect: While the large intestine does absorb some nutrients, its primary role is the absorption of water and electrolytes. The majority of nutrient absorption occurs in the small intestine.
- Option (2) is incorrect: The breakdown of food into simpler molecules (digestion) primarily takes place in the stomach and small intestine, not in the large intestine.
- Option (3) is incorrect: The liver is responsible for producing bile, which is stored in the gallbladder. The large intestine does not store bile.
- Option (4) is correct: The main function of the large intestine is to absorb water and electrolytes from the remaining indigestible food matter, turning it into solid waste (feces). It also houses gut bacteria that aid in the fermentation of certain indigestible substances. Thus, the primary function of the large intestine is to absorb water and form feces.

Quick Tip

The large intestine is primarily responsible for the absorption of water and electrolytes, and it helps in the formation of feces, which are excreted from the body.

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

- (1) Protein synthesis
- (2) Energy production
- (3) Genetic information storage
- (4) Detoxification of harmful substances

Correct Answer: (2) Energy production

Solution: Mitochondria are known as the "powerhouses" of the cell because their primary function is the production of energy in the form of ATP through cellular respiration.

- Option (1) is incorrect: While mitochondria play a role in cellular metabolism, protein synthesis occurs primarily in ribosomes, not in mitochondria.
- Option (2) is correct: Mitochondria generate ATP, the cell's main energy source, through the process of cellular respiration, which includes glycolysis, the Krebs cycle, and the electron transport chain.
- Option (3) is incorrect: Genetic information storage is the function of the nucleus, not the mitochondria. Mitochondria do contain their own DNA, but their main function is energy production, not genetic information storage.
- Option (4) is incorrect: Detoxification of harmful substances occurs mainly in the liver and in organelles such as the smooth endoplasmic reticulum, not the mitochondria.

Thus, the primary function of mitochondria is energy production.

Quick Tip

Mitochondria are critical for energy production in cells, as they produce ATP through cellular respiration, providing energy for various cellular functions.

27. Which of the following is an example of active transport in cells?

- (1) Osmosis
- (2) Diffusion
- (3) Sodium-potassium pump
- (4) Facilitated diffusion

Correct Answer: (3) Sodium-potassium pump

Solution: Active transport is the movement of substances across the cell membrane against their concentration gradient, requiring energy in the form of ATP.

- Option (1) is incorrect: Osmosis is a passive transport process where water moves from an area of low solute concentration to an area of high solute concentration. It does not require energy.
- Option (2) is incorrect: Diffusion is also a passive transport mechanism where particles move from an area of high concentration to low concentration. It does not require energy.
- Option (3) is correct: The sodium-potassium pump is a well-known example of active transport. It uses ATP to pump sodium ions out of the cell and potassium ions into the cell, against their concentration gradients.
- Option (4) is incorrect: Facilitated diffusion is a passive transport process where molecules move through a membrane protein from an area of high concentration to low concentration, without energy.

Thus, the sodium-potassium pump is an example of active transport.

Quick Tip

Active transport requires energy, usually in the form of ATP, to move molecules against their concentration gradient, as seen in processes like the sodium-potassium pump.

28. Which of the following is responsible for the synthesis of ribosomal RNA (rRNA) in eukaryotic cells?

- (1) Mitochondria
- (2) Nucleolus
- (3) Endoplasmic reticulum
- (4) Golgi apparatus

Correct Answer: (2) Nucleolus

Solution: The nucleolus is a dense region within the nucleus responsible for the synthesis and assembly of ribosomal RNA (rRNA) and the formation of ribosomes.

- Option (1) is incorrect: The mitochondria are involved in energy production through cellular respiration, not the synthesis of rRNA.

- Option (2) is correct: The nucleolus is the site of rRNA synthesis, which is then combined with proteins to form ribosomes.
- Option (3) is incorrect: The endoplasmic reticulum is involved in protein synthesis and lipid metabolism, but it does not synthesize rRNA.
- Option (4) is incorrect: The Golgi apparatus is responsible for modifying, sorting, and packaging proteins, not for synthesizing rRNA.

Thus, the nucleolus is responsible for the synthesis of rRNA in eukaryotic cells.

Quick Tip

The nucleolus is a specialized region within the nucleus where rRNA is synthesized and ribosomes are assembled before being transported to the cytoplasm for protein synthesis.

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

- (1) Presence of a defined nucleus
- (2) Presence of membrane-bound organelles
- (3) Presence of ribosomes
- (4) Presence of multiple linear chromosomes

Correct Answer: (3) Presence of ribosomes

Solution: Prokaryotic cells are simple, unicellular organisms that lack a defined nucleus and membrane-bound organelles.

- Option (1) is incorrect: Prokaryotic cells do not have a defined nucleus; their genetic material is located in a region called the nucleoid.
- Option (2) is incorrect: Prokaryotic cells lack membrane-bound organelles, such as mitochondria and the endoplasmic reticulum, which are found in eukaryotic cells.
- Option (3) is correct: Prokaryotic cells contain ribosomes, which are responsible for protein synthesis, just like in eukaryotic cells. However, they lack the membrane-bound structures that are present in eukaryotes.
- Option (4) is incorrect: Prokaryotic cells typically have a single circular chromosome, not multiple linear chromosomes like eukaryotic cells.

Thus, the characteristic feature of prokaryotic cells is the presence of ribosomes.

Quick Tip

Prokaryotic cells are simpler than eukaryotic cells, lacking a defined nucleus and membrane-bound organelles but still possessing ribosomes for protein synthesis.

30. In which stage of the cell cycle does DNA replication occur?

- (1) G1 phase
- (2) S phase
- (3) G2 phase
- (4) M phase

Correct Answer: (2) S phase

Solution: The cell cycle consists of several stages that prepare a cell for division. The stages are G1, S, G2, and M phases.

- Option (1) is incorrect: The G1 phase is the first growth phase of the cell cycle, where the cell grows and performs its normal functions but does not replicate DNA.
- Option (2) is correct: The S phase (Synthesis phase) is when DNA replication occurs. The cell copies its entire genome in preparation for cell division.
- Option (3) is incorrect: The G2 phase is the second growth phase, where the cell continues to grow and prepares for mitosis, but no DNA replication takes place.
- Option (4) is incorrect: The M phase (Mitosis phase) is when the cell actually divides, but DNA replication has already occurred during the S phase.

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

Quick Tip

The S phase of the cell cycle is where DNA replication takes place, ensuring that each daughter cell receives a complete set of chromosomes.

31. Which of the following is a function of white blood cells (WBCs) in the human body?

- (1) Transporting oxygen to tissues
- (2) Fighting infections and diseases
- (3) Producing insulin
- (4) Clotting blood

Correct Answer: (2) Fighting infections and diseases

Solution: White blood cells (WBCs) are an important part of the immune system and play a key role in defending the body against infections.

- Option (1) is incorrect: Red blood cells (RBCs), not WBCs, are responsible for transporting oxygen to tissues using the hemoglobin protein.
 - Option (2) is correct: White blood cells are involved in protecting the body from infections caused by bacteria, viruses, fungi, and other pathogens. They recognize and destroy foreign invaders through various mechanisms.
 - Option (3) is incorrect: Insulin is produced by beta cells in the pancreas, not white blood cells.
 - Option (4) is incorrect: Platelets are responsible for blood clotting, not white blood cells.
- Thus, the main function of white blood cells is fighting infections and diseases.

Quick Tip

White blood cells are essential for immune defense, identifying and eliminating pathogens such as bacteria, viruses, and other harmful microorganisms.