

MHT CET 2025 April 15 Shift 1 Question Paper with Solutions

Time Allowed :3 Hours

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.

Q1. A car of mass 1000 kg is moving with a velocity of 20 m/s. The driver applies the brakes, and the car comes to rest in 10 seconds. Find the average force exerted by the brakes to stop the car.

- (1) 5000 N
- (2) 2000 N
- (3) 10000 N
- (4) 4000 N

Correct Answer: (2) 2000 N

Solution:

Concept: According to Newton's second law of motion, the net force acting on a body is equal to the product of its mass and acceleration:

$$F = ma$$

To find the acceleration, we use the definition of acceleration as the rate of change of velocity:

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

where v is the final velocity, u is the initial velocity, and t is the time. Here, the car comes to rest, so $v = 0$, $u = 20$ m/s, $t = 10$ s.

Calculation:

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

The negative sign indicates that the acceleration is opposite to the direction of motion (deceleration). Using $F = ma$:

$$F = 1000 \times (-2) = -2000 \text{ N}$$

The magnitude of the force is 2000 N. This is the average braking force needed to stop the car over 10 seconds.

Explanation: The car decelerates uniformly under the action of the brakes. The negative sign shows the force acts opposite to motion. Using Newton's law ensures the correct force magnitude is obtained regardless of the vehicle's mass.

 Quick Tip

Always calculate acceleration first, considering the direction of motion. Then apply $F = ma$. The magnitude of the force is what matters when reporting results. Keep units consistent throughout the calculation.

Q2. A 50 kg person climbs a staircase of height 10 m. Calculate the work done by the person against gravity.

- (1) 5000 J
- (2) 1000 J
- (3) 1500 J
- (4) 3000 J

Correct Answer: (1) 5000 J

Solution:

Concept: Work done against gravity is the product of the weight of the person and the vertical height climbed:

$$W = mgh$$

where m is mass, g is gravitational acceleration (9.8 m/s^2), and h is height. This formula comes from the general definition of work $W = F \cdot d \cdot \cos \theta$, where force F is along the displacement ($\theta = 0$ for vertical climb).

Calculation:

$$W = 50 \times 9.8 \times 10 = 4900 \text{ J} \approx 5000 \text{ J}$$

Explanation: The person's weight acts downward, and the person moves upward against gravity. Therefore, the work done is stored as gravitational potential energy. The calculation assumes no energy losses due to friction or air resistance.

 Quick Tip

Work against gravity is equivalent to the gain in potential energy. Multiply the weight of the person by the vertical height climbed to find the work done. Ensure consistent units for mass and height.

Q3. A car of mass 800 kg is moving in a circular path with a radius of 50 m at a speed of 20 m/s. Calculate the centripetal force acting on the car.

- (1) 6400 N
- (2) 3200 N
- (3) 8000 N
- (4) 4000 N

Correct Answer: (1) 6400 N

Solution:

Concept: An object moving in a circular path experiences a centripetal force directed toward the center. The magnitude of this force is:

$$F_c = \frac{mv^2}{r}$$

where m is mass, v is speed, and r is radius of the circle. This formula comes from equating centripetal acceleration $a_c = v^2/r$ to $F = ma$.

Calculation:

$$F_c = \frac{800 \times 20^2}{50} = \frac{800 \times 400}{50} = 6400 \text{ N}$$

Explanation: The car must constantly change direction to follow the circular path. The required inward force is supplied by friction between tires and road. If the centripetal force exceeds friction, the car skids outward.

 Quick Tip

Centripetal force depends on mass, speed squared, and radius. It always acts toward the center of the circle. Ensure correct units and use this formula only for uniform circular motion.

Q4. A pipe has a radius of 2 cm at one end and 1 cm at the other end. The velocity of the water at the wider end is 5 m/s. What is the velocity of the water at the narrower end, assuming incompressible flow?

- (1) 10 m/s
- (2) 20 m/s
- (3) 15 m/s
- (4) 25 m/s

Correct Answer: (2) 20 m/s

Solution:

Concept: For incompressible fluids, the volume flow rate is constant along the pipe:

$$A_1 v_1 = A_2 v_2$$

where $A = \pi r^2$ is the cross-sectional area. This is the continuity equation.

Calculation:

$$A_1 = \pi(0.02)^2 = 1.256 \times 10^{-3} \text{ m}^2, \quad A_2 = \pi(0.01)^2 = 3.14 \times 10^{-4} \text{ m}^2$$

$$v_2 = \frac{A_1}{A_2} v_1 = \frac{1.256 \times 10^{-3}}{3.14 \times 10^{-4}} \times 5 \approx 20 \text{ m/s}$$

Explanation: As the pipe narrows, the velocity must increase to maintain constant flow. This principle applies to incompressible, non-viscous fluids.

 Quick Tip

Use the continuity equation $Av = \text{constant}$. A smaller cross-section means higher velocity. Always convert radii to meters for consistency.

Q5. A 200 g sample of water at 80°C is mixed with 100 g of water at 20°C. Assuming no heat loss to surroundings, what is the final temperature of the mixture?

- (1) 50°C
- (2) 60°C
- (3) 55°C
- (4) 45°C

Correct Answer: (2) 60°C

Solution:

Concept: The heat lost by hot water equals heat gained by cold water (conservation of energy):

$$m_1 c (T_1 - T_f) = m_2 c (T_f - T_2)$$

Here, c is specific heat of water, which cancels out.

Calculation:

$$\begin{aligned}200(80 - T_f) &= 100(T_f - 20) \\16000 - 200T_f &= 100T_f - 2000 \\18000 &= 300T_f \implies T_f = 60\text{ }^\circ\text{C}\end{aligned}$$

Explanation: The final temperature is closer to the hot water temperature because the mass of hot water is greater. This is an example of mixing with no heat loss.

 Quick Tip

Heat lost by hot water equals heat gained by cold water. The larger mass influences the final temperature. Ensure that the final temperature is between initial temperatures.

Q6. A 5-ohm resistor is connected to a 10 V battery. Calculate the current flowing through the resistor.

- (1) 1.0 A
- (2) 2.0 A
- (3) 0.5 A
- (4) 0.2 A

Correct Answer: (2) 2.0 A

Solution:

Concept: According to Ohm's law,

$$V = IR \implies I = \frac{V}{R}$$

where V is voltage, R is resistance, and I is current.

Calculation:

$$I = \frac{10}{5} = 2\text{ A}$$

Explanation: The resistor allows 2 A of current to flow. Ohm's law shows the direct relationship between voltage, current, and resistance. This assumes ideal resistor with no temperature change.

 Quick Tip

Use Ohm's law $I = V/R$ with consistent units. Current flows from positive to negative terminal. Always verify voltage and resistance values before calculating.

Q7. What is the pH of a 0.001 M hydrochloric acid (HCl) solution?

- (1) 3
- (2) 4
- (3) 7
- (4) 10

Correct Answer: (1) 3

Solution:

Concept: pH is calculated using the formula $\text{pH} = -\log_{10}[H^+]$. HCl is a strong acid, so it dissociates completely, and $[H^+] = [\text{HCl}]$.

Calculation:

$$\text{pH} = -\log_{10}(0.001) = -\log_{10}(10^{-3}) = 3$$

Explanation: The pH value represents the concentration of hydrogen ions. A 0.001 M HCl solution is acidic, and its pH is 3.

 Quick Tip

For strong acids and bases, assume complete dissociation. Use $\text{pH} = -\log[H^+]$. Double-check units and use base-10 logarithms for pH calculations.

Q8. How many grams of sodium chloride (NaCl) are produced when 2.0 moles of sodium (Na) react with excess chlorine gas (Cl₂)? The balanced chemical equation is: $2 \text{Na(s)} + \text{Cl}_2(\text{g}) \rightarrow 2 \text{NaCl(s)}$.

- (1) 58.5 g
- (2) 116.9 g
- (3) 117.0 g
- (4) 231.5 g

Correct Answer: (3) 117.0 g

Solution:

Concept: From the balanced equation, 2 moles of Na produce 2 moles of NaCl, so mole ratio is 1:1. Use mass = moles $\times$ molar mass. Molar mass of NaCl = 58.5 g/mol.

Calculation:

$$\text{Mass of NaCl} = 2 \times 58.5 = 117.0 \text{ g}$$

Explanation: All 2 moles of sodium react completely with chlorine. Using molar mass and mole ratio, the total mass of NaCl formed is 117.0 g.

 Quick Tip

Always check the mole ratio from the balanced chemical equation. Multiply moles of product by molar mass to find the mass formed. Ensure units are consistent.

Q9. A gas occupies a volume of 5.0 L at 300 K and 1.0 atm pressure. What will be the volume if the pressure is increased to 2.0 atm while the temperature remains constant?

- (1) 2.5 L
- (2) 10.0 L
- (3) 5.0 L
- (4) 1.0 L

Correct Answer: (1) 2.5 L

Solution:

Concept: Use Boyle's Law for constant temperature: $P_1V_1 = P_2V_2$. Pressure and volume are inversely proportional.

Calculation:

$$V_2 = \frac{P_1V_1}{P_2} = \frac{1.0 \times 5.0}{2.0} = 2.5 \text{ L}$$

Explanation: Doubling the pressure halves the volume. This demonstrates the inverse relationship between pressure and volume at constant temperature.

 Quick Tip

Apply Boyle's Law $P_1V_1 = P_2V_2$ for isothermal conditions. Solve for unknown volume or pressure, keeping units consistent. This relationship is inversely proportional.

Q10. The standard electrode potential for $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$ is $+0.80 \text{ V}$. The cell potential for $\text{Cu}^{2+} + 2\text{Ag} \rightarrow \text{Cu} + 2\text{Ag}^+$ is 0.46 V . What is the standard electrode potential for $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$?

- (1) 0.34 V
- (2) 0.50 V
- (3) 0.46 V
- (4) 1.0 V

Correct Answer: (1) 0.34 V

Solution:

Concept: Cell potential $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$. Here, Ag is oxidized (anode) and Cu is reduced (cathode). Rearranging: $E_{\text{Cu}} = E_{\text{cell}} + E_{\text{Ag}} = 0.46 - 0.80 = -0.34 \text{ V}$. But standard reduction potential is positive for reduction: $E_{\text{Cu}} = +0.34 \text{ V}$.

Explanation: Using the relation between cell potential and electrode potentials, the standard reduction potential of Cu is determined to be 0.34 V .

 Quick Tip

Identify cathode and anode correctly. Use $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$. Sign conventions are crucial; check whether reduction or oxidation is considered.

Q11. For a reaction $\text{A} \rightarrow \text{B}$, the rate law is $\text{Rate} = k[\text{A}]^2$. If $[\text{A}]$ is increased by a factor of 3, by what factor does the rate increase?

- (1) 3
- (2) 9
- (3) 27
- (4) 6

Correct Answer: (2) 9

Solution:

Concept: Rate law: $\text{Rate} = k[\text{A}]^2$. Changing $[\text{A}]$ by factor of 3, new rate $= k(3[\text{A}])^2 = 9k[\text{A}]^2 = 9 \times \text{original rate}$.

Explanation: The reaction is second order with respect to A, so the rate depends on the square of the concentration. Tripling $[\text{A}]$ increases rate 9-fold.

💡 Quick Tip

Always apply exponents in the rate law when concentration changes. Multiply the effects for each reactant to determine overall rate change.

Q12. Which of the following is responsible for the production of oxygen during photosynthesis? A) Calvin cycle B) Photolysis of water C) Cyclic photophosphorylation D) Reduction of NADP^+

- (1) A Calvin cycle
- (2) B Photolysis of water
- (3) C Cyclic photophosphorylation
- (4) D Reduction of NADP^+

Correct Answer: (2) B Photolysis of water

Solution:

Concept: Oxygen in photosynthesis is produced when water molecules are split (photolysis) by light energy in photosystem II. Calvin cycle fixes CO_2 but does not release O_2 .

Explanation: Light energy splits H_2O into protons, electrons, and O_2 . Oxygen is released as a by-product during the light-dependent reaction.

💡 Quick Tip

Remember: O_2 comes from water photolysis, not CO_2 fixation. Calvin cycle produces glucose, while oxygen is generated in light reactions.

Q13. In a Mendelian cross between two heterozygous pea plants ($\text{Tt} \times \text{Tt}$), where "T" is the dominant allele for tall plants and "t" is the recessive allele for short plants, what is the probability of obtaining a short plant?

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

Correct Answer: (2) $1/4$

Solution:

Concept: This is a monohybrid cross. Use a Punnett square to determine offspring genotypes.

Genotypes: TT, Tt, tT, tt. Only tt results in short plants.

Calculation:

$$\text{Probability of short (tt)} = \frac{1}{4}$$

Explanation: Out of 4 possible genotypes, one (tt) is short. Hence, the probability is 1/4.

 Quick Tip

Draw a Punnett square for clarity. Dominant allele masks recessive in heterozygotes.
Probability = favorable outcomes / total outcomes.

Q14. Which part of the human brain is responsible for regulating the body's balance and coordination?

- (1) Cerebrum
- (2) Cerebellum
- (3) Medulla Oblongata
- (4) Thalamus

Correct Answer: (2) Cerebellum

Solution:

Concept: The cerebellum coordinates voluntary movements, posture, and balance. Cerebrum handles conscious thought, medulla controls involuntary actions, and thalamus acts as a relay.

Explanation: The cerebellum integrates sensory input and motor commands to maintain smooth, coordinated movement and equilibrium.

 Quick Tip

Remember: Cerebellum = balance coordination. Cerebrum = thinking, Medulla = involuntary functions, Thalamus = sensory relay. Focus on function rather than size.

Q15. Which of the following is true about transpiration in plants?

- (1) Transpiration helps in the absorption of minerals from the soil.
- (2) Transpiration cools the plant and helps in water regulation.
- (3) Transpiration decreases water absorption from the roots.

(4) Transpiration occurs only through the roots of the plant.

Correct Answer: (2) Transpiration cools the plant and helps in water regulation

Solution:

Concept: Transpiration is the loss of water vapor from plant leaves. It maintains water flow, nutrient transport, and helps in temperature regulation.

Explanation: Evaporation of water from stomata cools the plant and drives the ascent of sap. It does not occur only in roots; roots absorb water, leaves transpire.

 Quick Tip

Transpiration primarily occurs through leaves, not roots. It cools the plant, maintains water and nutrient flow. Always distinguish between absorption and loss.

Q16. Which hormone is primarily responsible for the development of secondary sexual characteristics in females?

- (1) Estrogen
- (2) Testosterone
- (3) Progesterone
- (4) Oxytocin

Correct Answer: (1) Estrogen

Solution:

Concept: Estrogen is the primary female sex hormone responsible for secondary sexual characteristics, such as breast development, body fat distribution, and menstrual cycle regulation. Progesterone aids in reproductive cycle but is not responsible for secondary sexual traits.

Explanation: Estrogen triggers physical changes at puberty in females, differentiating from male characteristics and preparing the body for reproduction.

 Quick Tip

Remember: Estrogen = female secondary sexual characteristics. Testosterone = male characteristics. Progesterone regulates pregnancy and menstrual cycle.