MHT CET 2025 April 17 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 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: (3) 4 m/s^2, 40 m

Solution:
Concept: According to Newton's second law, the acceleration of a body is given by $a = F/m$ where F is the applied force and m is the mass. Once acceleration is known, we can use the kinematic equation $s = ut + \frac{1}{2}at^2$ to find the distance traveled, where u is the initial velocity.

Calculation:

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

$$s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \cdot 4 \cdot (10)^2 = 40 \text{ m}$$

Explanation: The body accelerates at 4 m/s^2, and over 10 seconds, it travels 40 meters on the smooth surface.

Quick Tip

Always identify the force, mass, and initial velocity first. Use Newton's law to find acceleration, then kinematic equations for distance. Check units for consistency.

Q2. 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·E·R^2
(2) K·E·$R^2/2$
(3) E·R^2/K
(4) E·R^2

Correct Answer: (1) K·E·R^2

Solution:
Concept: A dielectric placed in an external electric field becomes polarized. The surface of the dielectric acquires bound charges. The induced surface charge Q is proportional to the dielectric constant K, the electric field E, and the area, which scales as R^2 for a sphere.

Calculation:

$$Q = K \cdot E \cdot R^2$$

Explanation: The induced charge depends on the material property (K), the applied field, and the surface area (via radius squared).

Quick Tip

Remember: Induced charge arises from polarization. Dielectric constant K scales the effect of the external field. Surface area is important: bigger radius → more induced charge.

Q3. 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:
Concept: Electric power is related to current and voltage as $P = VI$ for a resistive load. Know-

ing power and voltage, we can calculate current using $I = P/V$.

Calculation:

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

Explanation: The current through the bulb is approximately 0.5 A. This demonstrates the relation between electrical power, voltage, and current.

> **Quick Tip**
>
> Always check whether the device is resistive before applying P = VI. Convert units if necessary. Approximate decimals correctly for MCQ options.

Q4. 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 m/s^2)

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

Correct Answer: (1) 5 m

Solution:
Concept: In vertical motion under gravity, the maximum height is reached when the vertical velocity becomes zero. Using the kinematic equation $v^2 = u^2 - 2gh$, where $v = 0$ at maximum height, u is initial velocity, and g is acceleration due to gravity.

Calculation:

$$0 = (10)^2 - 2 \cdot 9.8 \cdot h \quad \Rightarrow \quad h = \frac{100}{19.6} \approx 5.10 \text{ m}$$

Explanation: The ball rises to a maximum height of approximately 5 m before descending. This uses basic kinematics for uniformly accelerated motion.

> **Quick Tip**
>
> Always set final velocity to zero for maximum height in vertical motion problems. Use $v^2 = u^2 - 2gh$ to avoid time calculation if not required. Check units and round off properly for MCQs.

Q5. 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:
Concept: For uniform acceleration, the velocity after time t is given by $v = u + at$, where u is initial velocity and a is acceleration.

Calculation:

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

Explanation: The car reaches a velocity of 10 m/s after accelerating uniformly for 5 seconds. This illustrates direct application of first kinematic equation.

> Quick Tip
>
> Identify initial velocity, acceleration, and time first. Use $v = u + at$ for straight-line uniform acceleration. Always check for unit consistency in SI units.

Q6. A metal wire has a length of 2 meters and a resistance of 10 Ω. 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 Ω
(2) 20 Ω
(3) 40 Ω
(4) 5 Ω

Correct Answer: (2) 20 Ω

Solution:
Concept: Resistance of a wire is given by $R = \rho\frac{L}{A}$, where ρ is resistivity, L is length, and A is cross-sectional area. Doubling the length doubles the resistance if ρ and A remain constant.

Calculation:

$$R_{\text{new}} = \rho\frac{2L}{A} = 2 \cdot 10 = 20\Omega$$

Explanation: Doubling the length while keeping cross-section same doubles the resistance.

Quick Tip

Remember that resistance length / area. Only length or cross-section changes affect resistance. Material resistivity stays constant unless specified.

Q7. 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 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:
Concept: Free-fall motion uses $v^2 = u^2 + 2gh$. Initial velocity $u = 0$, acceleration $g = 9.8$ m/s^2, height $h = 5$ m.

Calculation:

$$v^2 = 0 + 2 \cdot 9.8 \cdot 5 = 98 \quad \Rightarrow \quad v \approx 9.9 \approx 10 \text{ m/s}$$

Explanation: The object accelerates due to gravity, reaching 10 m/s before hitting the ground.

Quick Tip

For free-fall problems, initial velocity matters. Use $v^2 = u^2 + 2ghfordirectcalculation.Convertunitsconsistently.$

Q8. 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:
Concept: Forward-biased diode current is described by Shockley's equation: $I = I_0(e^{V/V_T} - 1)$, where I_0 is reverse saturation current and V_T is thermal voltage. Current increases exponentially with voltage.

Explanation: As forward voltage rises, more charge carriers cross the junction, increasing current exponentially.

Quick Tip

Forward bias → current rises exponentially. Reverse bias → small leakage current only. Use Shockley equation to visualize exponential behavior.

Q9. 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° = 0.5)

(1) 20°
(2) 25°
(3) 18°
(4) 15°

Correct Answer: (1) 20°

Solution:
Concept: Snell's law: $n_1 \sin i = n_2 \sin r$. Air n1 = 1, glass n2 = 1.5, i = 30°.

Calculation:

$$\sin r = \frac{1}{1.5} \cdot 0.5 \approx 0.333 \quad \Rightarrow \quad r \approx 19.5^\circ \approx 20^\circ$$

Explanation: Light bends towards the normal in higher refractive index medium.

Quick Tip

Snell's law is key: n1 sin i = n2 sin r. Higher n → ray bends toward normal. Use arcsin carefully to match MCQ options.

Q10. 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) 0.031 m/s
(4) 2.0 m/s

Correct Answer: (3) 0.031 m/s

Solution:
Concept: In SHM, $v_{\max} = \omega A$, where $\omega = 2\pi/T$, $A = 0.02$ m, $T = 4$ s.

Calculation:

$$\omega = \frac{2\pi}{4} = \frac{\pi}{2} \quad \Rightarrow \quad v_{\max} = \frac{\pi}{2} \cdot 0.02 \approx 0.031 \text{ m/s}$$

Explanation: Maximum speed occurs at equilibrium; amplitude and period determine ω.

Quick Tip

Convert amplitude to meters. Use $\omega = 2\pi/T$ for SHM.
$\mathrm{v}_{max}occursatequilibrium, notatamplitude.$

Q11. A magnetic field of strength B = 2 T is applied perpendicular to a current-carrying conductor. If the current in the conductor is I = 3 A and the length of the conductor within the magnetic field is L = 1.5 m, calculate the force acting on the conductor.

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

Correct Answer: (1) 9 N

Solution:
Concept: The force on a current-carrying conductor in a magnetic field is given by $F = BIL\sin\theta$, where θ is the angle between current and field. Here, $\theta = 90^\circ \Rightarrow \sin\theta = 1$.

Calculation:

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

Explanation: The conductor experiences a force perpendicular to both the current and magnetic field of magnitude 9 N. This illustrates the application of Lorentz force in conductors.

Quick Tip

Always identify the angle between current and magnetic field. Maximum force occurs at $\theta = 90°$. Use F = BIL sin formula for straight conductor in uniform field.

Q12. The reaction between hydrogen and oxygen to form water is given as: 2H2 + O2 → 2H2O. 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:
Concept: From the balanced equation, 2 moles of H2 react with 1 mole O2 to form 2 moles of H2O. This is a stoichiometry problem.

Calculation:

$$4 \text{ moles H2} \Rightarrow \frac{4}{2} \cdot 2 = 4 \text{ moles H2O}$$

Explanation: With excess O2, 4 moles of H2 produce exactly 4 moles of water.

Quick Tip

Use mole ratios from the balanced equation. Always check limiting reagent. Convert moles to required substance using simple proportion.

Q13. What is the oxidation state of chromium in the compound Cr2O3?

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

Correct Answer: (2) +3

Solution:
Concept: Sum of oxidation states in a neutral compound is zero. Oxygen = -2. Cr2O3 has 3 oxygens: total -6. 2 Cr atoms → each Cr = +3.

Calculation:

$$2x + 3(-2) = 0 \quad \Rightarrow \quad 2x - 6 = 0 \quad \Rightarrow \quad x = +3$$

Explanation: Each chromium has oxidation state +3.

Quick Tip

Assign known oxidation numbers first. Sum must equal overall charge of compound. Use simple algebra to solve for unknown.

Q14. Which of the following gases is most likely to exhibit ideal gas behavior?

(1) H2
(2) CO2
(3) H2O
(4) NH3

Correct Answer: (1) H2

Solution:
Concept: Ideal gases obey PV = nRT. Small, nonpolar, low-interaction gases behave closest to ideal. H2 is small, nonpolar, and weakly interacting. Water, NH3 show strong hydrogen bonding; CO2 has larger size.

Explanation: H2 will approximate ideal gas most closely.

Quick Tip

Small, light, nonpolar gases follow ideal gas laws best. Avoid polar or hydrogen-bonding gases for ideal behavior. Check conditions (high T, low P) for better ideality.

Q15. What is the pH of a solution with a hydrogen ion concentration of [H+] = 1 $\times$ 10^{-4} M?

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

Correct Answer: (1) 4

Solution:
Concept: pH is calculated by pH = -log[H+]. Here [H+] = 1×10^{-4} M.

Calculation:

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

Explanation: Solution is acidic since pH ¡ 7.

Quick Tip

Use pH = -log[H+] formula. Check whether [H+] or [OH-] is given. pH ¡7 acidic, pH=7 neutral, pH¿7 basic.

Q16. Which of the following compounds is an example of an ester?

(1) CH3COOH
(2) CH3COOCH3
(3) CH3OH
(4) C6H6

Correct Answer: (2) CH3COOCH3

Solution:
Concept: Esters have functional group -COO- (R-COO-R'). CH3COOCH3 contains -COO- linking two alkyl groups, thus is an ester. Others: CH3COOH (acid), CH3OH (alcohol), C6H6 (aromatic).

Explanation: CH3COOCH3 is a simple methyl ester.

Quick Tip

Identify functional group -COO- for esters. Distinguish alcohols, acids, and esters. Use structural formula recognition.

Q17. 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) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^1$
(4) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

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

Solution:
Concept: Atomic number 19 $\rightarrow$ 19 electrons. Fill shells according to Aufbau principle: 1s $\rightarrow$ 2s $\rightarrow$ 2p $\rightarrow$ 3s $\rightarrow$ 3p $\rightarrow$ 4s.

Calculation:

$$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$$

Explanation: The 19th electron enters 4s orbital; no electrons yet in 3d.

Quick Tip

Use Aufbau principle, Pauli exclusion, and Hund's rule. Count electrons carefully for correct configuration. 4s fills before 3d for first transition elements.

Q18. Which of the following compounds has the highest boiling point?

(1) CH4
(2) H2O
(3) NH3
(4) CO2

Correct Answer: (2) H2O

Solution:
Concept: Boiling point depends on intermolecular forces. H2O has strong hydrogen bonding, NH3 has moderate H-bonding, CH4 and CO2 have weak Van der Waals forces.

Explanation: Hydrogen bonding in H2O requires more energy to break, giving it the highest boiling point among these compounds.

Quick Tip

Compare intermolecular forces: H-bond ¿ dipole-dipole ¿ Van der Waals. Hydrogen bonding increases boiling point significantly. Identify molecules capable of H-bonding.

Q19. Which of the following is a strong electrolyte?

(1) NaCl
(2) C6H6
(3) CH3OH
(4) C2H5OH

Correct Answer: (1) NaCl

Solution:
Concept: Strong electrolytes dissociate completely in water to produce ions. NaCl dissolves completely into Na^+ and Cl^-. C6H6 and alcohols are covalent and poor conductors.

Explanation: NaCl conducts electricity well because it produces maximum ions in solution.

Quick Tip

Identify ionic compounds for strong electrolytes. Covalent compounds generally do not ionize completely. Check solubility and ionic dissociation.

Q20. What is the limiting reagent in the reaction: 2H2 + O2 $\rightarrow$ 2H2O, if 3 moles of H2 and 2 moles of O2 are reacted together?

(1) H2
(2) O2
(3) Both are limiting reagents
(4) Neither is limiting

Correct Answer: (1) H2

Solution:
Concept: Limiting reagent is the reactant that runs out first. Stoichiometry: 2 moles H2 react with 1 mole O2.

Calculation:

$$\text{Required O2 for 3 moles H2} = \frac{3}{2} = 1.5 \text{ moles} < 2 \text{ moles available}$$

Explanation: H2 will be exhausted first, making it the limiting reagent.

Quick Tip

Use mole ratios to compare reactants. The one with less required proportion is limiting. Check which reactant limits the product formation.

Q21. 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:
Concept: Ribosomes are cellular organelles where amino acids are linked to form proteins according to mRNA instructions. Ribosomes can be free or attached to ER.

Explanation: Ribosomes read mRNA and assemble polypeptides, essential for cell function. Other options represent mitochondria, nucleus, or vesicle functions.

Quick Tip

Remember ribosomes = protein factories. Free ribosomes → cytoplasmic proteins. ER-attached → secretory proteins.

Q22. 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:
Concept: Circulatory system includes heart, blood vessels (arteries, veins, capillaries). Lungs are part of the respiratory system, although they work closely with circulatory system for gas exchange.

Explanation: Lungs are not a structural component of circulation.

> Quick Tip
>
> Distinguish between circulatory and respiratory organs. Heart + vessels = circulatory system. Lungs facilitate oxygen exchange but are not part of vessels.

Q23. 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:
Concept: Pancreas regulates blood glucose via insulin (lowers) and glucagon (raises). Liver stores glycogen but is regulated by hormones from pancreas.

Explanation: Pancreas is central in endocrine regulation of sugar; dysfunction leads to diabetes.

> Quick Tip
>
> Insulin and glucagon from pancreas control sugar. Liver and muscles store glucose but don't secrete hormones. Link pancreas to blood glucose homeostasis.

Q24. 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:
Concept: Chlorophyll is a green pigment that captures sunlight. It excites electrons, driving ATP and NADPH formation in photosynthesis. Glucose synthesis occurs in Calvin cycle.

Explanation: Chlorophyll's main function is energy absorption, not direct glucose synthesis or transport.

Quick Tip

Photosynthesis: light reaction → ATP/NADPH. Chlorophyll = light absorber. Calvin cycle uses ATP/NADPH to make sugar.

Q25. 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:
Concept: Large intestine (colon) absorbs remaining water and electrolytes, forming solid feces. Nutrient absorption mainly occurs in small intestine.

Explanation: Function ensures dehydration of waste and formation of compact stool.

Quick Tip

Large intestine absorbs water, salts, vitamins. Small intestine handles nutrient absorption. Focus on main physiological roles for MCQs.

Q26. 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:
Concept: Mitochondria are the "powerhouse" of the cell. They convert glucose/fat into ATP via cellular respiration. Protein synthesis occurs in ribosomes, DNA storage in nucleus.

Explanation: Mitochondria generate energy for cellular processes.

Quick Tip

Energy = mitochondria, Protein = ribosome, DNA = nucleus. Look for "powerhouse" clues in MCQs. ATP is the main product of mitochondria.

Q27. 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:
Concept: Active transport moves molecules against concentration gradient using energy (ATP). Na+/K+ pump maintains ion gradients. Osmosis, diffusion, facilitated diffusion are passive.

Explanation: Sodium-potassium pump consumes ATP to transport 3 Na+ out, 2 K+ in.

Quick Tip

Active transport = requires ATP. Check gradient direction: against vs. along. Sodium-potassium pump is classical example.

Q28. 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:
Concept: Nucleolus is dense region in nucleus where rRNA is transcribed and combined with proteins to form ribosomal subunits. Other organelles do not synthesize rRNA.

Explanation: Ribosomal subunits assembled in nucleolus, then exported to cytoplasm.

Quick Tip

Remember nucleolus = ribosome factory. rRNA transcription occurs here. Other organelles have distinct functions (ER, Golgi, mitochondria).

Q29. 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:
Concept: Prokaryotes lack nucleus and membrane-bound organelles. They have ribosomes (70S) for protein synthesis, circular DNA, and a simple structure.

Explanation: Ribosomes are universal; others describe eukaryotes.

Quick Tip

Prokaryotes = bacteria, simple cells. Eukaryotes = complex, nucleus + organelles. Check for ribosomes as universal feature.

Q30. 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:
Concept: Cell cycle consists of G1, S, G2, M. S (synthesis) phase is when DNA replicates to ensure daughter cells have identical genomes. G1/G2 are growth/check phases, M is mitosis.

Explanation: DNA duplication occurs exclusively in S phase to prepare for cell division.

Quick Tip

S phase = synthesis of DNA. G1/G2 = growth and checkpoints. M phase = division; memorize standard cycle.

Q31. 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:
Concept: WBCs (leukocytes) are key components of the immune system. They detect, attack, and destroy pathogens like bacteria, viruses, and foreign bodies. RBCs carry oxygen, platelets aid clotting.

Explanation: WBCs' main role is defense; their activity is critical for immunity.

Quick Tip

Memorize WBC = immune defense, RBC = oxygen, platelets = clotting. Differentiate blood cell functions clearly. Immune response is central to WBC role.
