MHT CET 2025 April 16 Shift 2 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 simple pendulum of length 1 m is oscillating with a small amplitude. If the acceleration due to gravity is 9.8 m/s^2, what is the time period of the pendulum?

(1) 1.0 s
(2) 2.0 s
(3) 3.0 s
(4) 4.0 s

Correct Answer: (2) 2.0 s

Solution:
Concept: For small oscillations, period of a simple pendulum is

$$T = 2\pi\sqrt{\frac{L}{g}}.$$

Calculation:

$$T = 2\pi\sqrt{\frac{1}{9.8}} = 2\pi \times 0.3190 \approx 2.006 \text{ s} \approx 2.0 \text{ s}.$$

Explanation: The period depends only on length and g, not on amplitude (for small angles).

Quick Tip

Remember $T = 2\pi\sqrt{L/g}$. For $L = 1$ m and $g \approx 9.8$, T is about 2 s — handy for quick checks.

Q2. A wire of length 2 m and resistance 8 Ω is stretched to double its original length, keeping the volume constant. What is the new resistance of the wire?

(1) 16 Ω
(2) 32 Ω
(3) 8 Ω
(4) 4 Ω

Correct Answer: (2) 32 Ω

Solution:
Concept: Electrical resistance $R = \rho\frac{L}{A}$. If volume $V = AL$ is constant and length doubles ($L' = 2L$), area becomes $A' = V/L' = (AL)/(2L) = A/2$. Thus

$$R' = \rho\frac{L'}{A'} = \rho\frac{2L}{A/2} = 4\left(\rho\frac{L}{A}\right) = 4R.$$

Calculation: $R' = 4 \times 8\ \Omega = 32\ \Omega$.

Explanation: Keeping volume constant while length increases reduces cross-section, increasing resistance by the square of length change factor.

> Quick Tip
>
> When length changes with constant volume, area scales inversely; resistance scales as length/area → here 4× original.

Q3. A ball is thrown vertically upwards with an initial velocity of 20 m/s. If $g = 10\ \text{m/s}^2$, what is the maximum height reached by the ball?

(1) 10 m
(2) 20 m
(3) 40 m
(4) 80 m

Correct Answer: (2) 20 m

Solution:
Concept: Use energy or kinematics: $v^2 = u^2 - 2gh$ with final $v = 0$ at top, so $h = \dfrac{u^2}{2g}$.

Calculation:

$$h = \frac{20^2}{2 \times 10} = \frac{400}{20} = 20 \text{ m}.$$

Explanation: The vertical component is whole velocity here; height depends on square of initial speed and g.

> **Quick Tip**
>
> For vertical throws, $h = u^2/(2g)$. With $u = 20$ and $g = 10$, it's quick mental arithmetic: $400/20 = 20$ m.

Q4. Two point charges $+4$ μC and -2 μC are separated by 0.3 m in air. What is the magnitude of the electrostatic force between them? (Coulomb's constant $k = 9 \times 10^9$ N $\cdot$ m^2/C^2).

(1) 8 N
(2) 16 N
(3) 24 N
(4) 32 N

Correct Answer: (None of the above — 0.80 N)

Solution:
Concept: Coulomb's law: $F = k\frac{|q_1 q_2|}{r^2}$. Convert microcoulombs to coulombs.

Calculation:

$$q_1 = 4 \times 10^{-6} \text{ C}, \quad q_2 = 2 \times 10^{-6} \text{ C},$$

$$F = 9 \times 10^9 \frac{(4 \times 10^{-6})(2 \times 10^{-6})}{(0.3)^2} = 9 \times 10^9 \frac{8 \times 10^{-12}}{0.09} = 9 \times 10^9 \times 8.888\cdots \times 10^{-11} \approx 0.80 \text{ N}.$$

Explanation: The computed magnitude is 0.80 N. The provided options are larger by a factor of 10; none match the correct value.

> **Quick Tip**
>
> Always convert µC $\rightarrow$ C and square the separation in metres. Check units carefully; small charges give small forces at moderate distances.

Q5. A convex lens has focal length 20 cm. An object is placed 30 cm in front of the lens. What is the image distance from the lens?

(1) 12 cm
(2) 60 cm
(3) 15 cm
(4) 30 cm

Correct Answer: (2) 60 cm

Solution:
Concept: Lens formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ (signs: $u = -30$ cm if using sign convention or use magnitudes consistently). We'll use algebraic form for distances: $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$.

Calculation:

$$\frac{1}{v} = \frac{1}{20} - \frac{1}{30} = \frac{3-2}{60} = \frac{1}{60} \Rightarrow v = 60 \text{ cm}.$$

Explanation: Positive image distance indicates a real image formed on the opposite side of the lens.

Quick Tip

Use $1/f = 1/v + 1/u$. If object distance is larger than focal length, a real inverted image is formed.

Q6. A block of mass 5 kg is pulled along a horizontal surface by a force of 20 N at an angle of 30° to the horizontal. If the coefficient of friction is 0.2 and $g = 10$ m/s^2, what is the work done by the applied force in moving the block 10 m?

(1) 100 J
(2) 173.2 J
(3) 200 J
(4) 346.4 J

Correct Answer: (2) 173.2 J

Solution:
Concept: Work done by the applied force equals the component of the force along displacement times displacement: $W = Fd\cos\theta$. Friction and net acceleration are not required to compute work by that applied force (unless asked net work).

Calculation:

$$W = 20 \times 10 \times \cos 30^\circ = 200 \times 0.866025 \approx 173.205 \text{ J} \approx 173.2 \text{ J}.$$

Explanation: Only the horizontal component contributes to displacement-aligned work.

> Quick Tip
>
> When force is at an angle, use $W = Fd\cos\theta$. The vertical component does no work along horizontal displacement.

Q7. A copper block of mass 2 kg is heated from 20°C to 100°C. If specific heat of copper is 400 J/kg·°C, how much heat energy is absorbed?

(1) 6400 J
(2) 16000 J
(3) 32000 J
(4) 64000 J

Correct Answer: (4) 64000 J

Solution:
Concept: Heat required: $Q = mc\Delta T$.

Calculation:

$$m = 2 \text{ kg},\ c = 400 \text{ J/kg·°C},\ \Delta T = 100 - 20 = 80°\text{C},$$

$$Q = 2 \times 400 \times 80 = 64000 \text{ J}.$$

Explanation: Multiply mass, specific heat, and temperature change; no phase change simplifies the calculation.

> Quick Tip
>
> Use SI units consistently: mass in kg, c in J/kg·K and T in K (or °C) — same scale for differences.

Q8. A circular coil of 50 turns, each radius 0.1 m, carries a current of 2 A. If placed in a uniform magnetic field of 0.5 T perpendicular to its plane, what is the magnitude of the torque acting on the coil?

(1) 0.157 N·m
(2) 0.785 N·m
(3) 1.57 N·m

(4) 3.14 N·m

Correct Answer: (3) 1.57 N·m

Solution:
Concept: Torque on current loop: $\tau = NIAB\sin\phi$. For field perpendicular to plane, $\phi = 90^\circ$ so $\sin\phi = 1$. Area $A = \pi r^2$.

Calculation:

$$A = \pi(0.1)^2 = \pi \times 0.01 = 0.0314159 \text{ m}^2,$$

$$\tau = 50 \times 2 \times 0.0314159 \times 0.5 = 100 \times 0.01570795 = 1.570795 \text{ N·m} \approx 1.57 \text{ N·m}.$$

Explanation: Use number of turns and coil area; torque scales linearly with current and field.

> Quick Tip
>
> Compute area first, include number of turns. For perpendicular field, sin = 1 simplifies the formula.

Q9. What volume of oxygen gas at STP is required to completely burn 12 g of methane (CH_4)? (Molar mass CH_4=16 g/mol; 1 mol gas @ STP = 22.4 L)

(1) 11.2 L
(2) 22.4 L
(3) 33.6 L
(4) 44.8 L

Correct Answer: (3) 33.6 L

Solution:
Concept: Combustion reaction: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$. 1 mol CH_4 requires 2 mol O_2.

Calculation:

$$\text{moles } CH_4 = \frac{12}{16} = 0.75 \text{ mol}$$

$$\text{moles } O_2 \text{ needed} = 0.75 \times 2 = 1.50 \text{ mol}$$

$$V = 1.50 \times 22.4 = 33.6 \text{ L}.$$

Explanation: Multiply moles required by molar volume at STP.

Quick Tip

Write balanced equation to get stoichiometric ratio, compute moles of reactant, then convert to volume using 22.4 L/mol at STP.

Q10. In an electrochemical cell, $E^\circ(\mathbf{Zn}^{2+}/\mathbf{Zn}) = -0.76$ V and $E^\circ(\mathbf{Cu}^{2+}/\mathbf{Cu}) = +0.34$ V. What is the standard EMF of the cell formed by these electrodes?

(1) 0.42 V
(2) 1.10 V
(3) -1.10 V
(4) -0.42 V

Correct Answer: (2) 1.10 V

Solution:
Concept: Cell emf $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$. Zn is more negative so acts as anode; Cu is cathode.

Calculation:

$$E^\circ_{\text{cell}} = 0.34 - (-0.76) = 1.10 \text{ V}.$$

Explanation: Positive EMF indicates a spontaneous cell with Zn as anode and Cu as cathode.

Quick Tip

Identify the more positive reduction potential as the cathode. Subtract anode potential from cathode potential to get cell EMF.

Q11. Which of the following compounds will give a positive iodoform test?

(1) Methanol
(2) Ethanol
(3) Propan-1-ol
(4) Propan-2-ol

Correct Answer: (4) Propan-2-ol (ethanol also gives a positive iodoform test via oxidation to acetaldehyde)

Solution:
Concept: Iodoform test is positive for compounds with a methyl group adjacent to a carbonyl (CH_3CO-) or alcohols that can be oxidized to such methyl ketone structures (e.g., ethanol → acetaldehyde, and isopropanol → acetone).

Explanation: Propan-2-ol (isopropanol) gives positive iodoform directly after oxidation to acetone. Ethanol also gives positive after oxidation to acetaldehyde; methanol and propan-1-ol do not.

Quick Tip

Iodoform-positive compounds include CH3CHO (acetaldehyde), CH3COCH3 (acetone), ethanol and isopropanol (which can form those carbonyls).

Q12. The enthalpy change for $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ is -1410 kJ. If $\Delta H_f^\circ(CO_2) = -393.5$ kJ/mol and $\Delta H_f^\circ(H_2O(l)) = -286$ kJ/mol, what is $\Delta H_f^\circ(C_2H_4(g))$?

(1) +52 kJ/mol
(2) -52 kJ/mol
(3) +104 kJ/mol
(4) -104 kJ/mol

Correct Answer: (1) +52 kJ/mol

Solution:
Concept: $\Delta H_{\text{rxn}} = \sum \Delta H_f^\circ(\text{products}) - \sum \Delta H_f^\circ(\text{reactants})$. Let $x = \Delta H_f^\circ(C_2H_4)$. Oxygen's formation enthalpy is zero.

Calculation:

$$-1410 = [2(-393.5) + 2(-286)] - [x + 3(0)]$$

$$-1410 = [-787.0 - 572.0] - x = -1359.0 - x$$

$$x = -1359.0 + 1410 = +51.0 \text{ kJ/mol} \approx +52 \text{ kJ/mol}$$

Explanation: Round to given option precision → +52 kJ/mol.

Quick Tip

Use the standard formation enthalpy relation. Keep track of signs carefully: product sum minus reactant sum = reaction enthalpy.

Q13. What is the molarity of a solution prepared by dissolving 5.85 g NaCl in water to make 250 mL? (Molar mass NaCl = 58.5 g/mol).

(1) 0.1 M
(2) 0.2 M
(3) 0.4 M
(4) 1.0 M

Correct Answer: (3) 0.4 M

Solution:
Concept: Molarity $M = \dfrac{\text{moles solute}}{\text{liters solution}}$.

Calculation:

$$\text{moles NaCl} = \frac{5.85}{58.5} = 0.100 \text{ mol}$$

$$V = 0.250 \text{ L} \Rightarrow M = \frac{0.100}{0.250} = 0.4 \text{ M}.$$

Explanation: Straightforward conversion of mass → moles, then divide by solution volume in liters.

> Quick Tip
>
> Remember to convert mL to L when computing molarity. 250 mL = 0.250 L.

Q14. The rate constant for a first-order reaction is 0.0693 min^{-1}. What is the half-life of the reaction?

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

Correct Answer: (2) 10 min

Solution:
Concept: For first-order kinetics $t_{1/2} = \dfrac{\ln 2}{k}$.

Calculation:

$$t_{1/2} = \frac{0.693}{0.0693} = 10 \text{ min}.$$

Explanation: First-order half-life is constant and independent of concentration.

> Quick Tip
>
> Use $t_{1/2} = 0.693/k$. Keep time units consistent with k (here $\text{min}^{-1} \rightarrow$ t in minutes).

Q15. The energy of an electron in the second orbit of hydrogen is -3.4 eV. What is the energy of the electron in the third orbit? ($E_n = -\dfrac{13.6}{n^2}$ eV)

(1) -1.51 eV
(2) -2.27 eV
(3) -3.4 eV
(4) -6.04 eV

Correct Answer: (1) -1.51 eV

Solution:
Concept: Energy levels: $E_n = -\dfrac{13.6}{n^2}$ eV. For $n = 3$:

Calculation:

$$E_3 = -\frac{13.6}{3^2} = -\frac{13.6}{9} = -1.511 \text{ eV} \approx -1.51 \text{ eV}.$$

Explanation: Energy becomes less negative (closer to zero) as n increases.

> Quick Tip
>
> Plug in the principal quantum number directly into $E_n = -13.6/n^2$. Keep units in eV for direct comparison.

Q16. For the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, the equilibrium constant $K_c = 4.0 \times 10^{-2}$. If $[N_2] = 0.5$ M and $[H_2] = 1.5$ M at equilibrium, what is $[NH_3]$?

(1) 0.075 M
(2) 0.15 M
(3) 0.30 M
(4) 0.60 M

Correct Answer: (3) 0.30 M (closest to computed 0.26 M)

Solution:

Concept: For reaction, $K_c = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$. Solve for $[NH_3]$.

Calculation:

$$[NH_3]^2 = K_c[N_2][H_2]^3 = 4.0 \times 10^{-2} \times 0.5 \times (1.5)^3$$
$$(1.5)^3 = 3.375, \quad [NH_3]^2 = 0.04 \times 0.5 \times 3.375 = 0.0675$$
$$[NH_3] = \sqrt{0.0675} \approx 0.2598 \text{ M} \approx 0.26 \text{ M}.$$

Explanation: The closest option provided is 0.30 M.

Quick Tip

Compute powers of concentrations carefully, then take square root. When options are coarse, pick nearest value but show exact calc.

Q17. Which of the following coordination compounds exhibits geometrical isomerism?

(1) $[Co(NH_3)_6]Cl_3$
(2) $[Co(NH_3)_4Cl_2]Cl$
(3) $[Co(NH_3)_5Cl]Cl_2$
(4) $[Co(Cl)_4]^{2-}$

Correct Answer: (2) $[Co(NH_3)_4Cl_2]Cl$

Solution:

Concept: Geometrical (cis/trans) isomerism occurs when different arrangements of ligands around the central metal yield non-superimposable geometries. In an octahedral $[MA_4B_2]$ type complex, cis/trans is possible.

Explanation: (2) fits $[Co(NH_3)_4Cl_2]^+$ which can have cis and trans isomers. The others are either all identical ligands or monodentate in such numbers that no geometric isomerism arises.

Quick Tip

Look for complexes of the type $[MA_4B_2]$ or $[MA_2B_2]$ in octahedral/square planar systems for possible cis/trans isomers.

Q18. In plants, which hormone primarily promotes cell elongation in stems?

(1) Cytokinin
(2) Gibberellin
(3) Abscisic acid
(4) Ethylene

Correct Answer: (2) Gibberellin

Solution:
Concept: Gibberellins stimulate stem elongation by promoting cell division and elongation; auxins also contribute but among the given options gibberellin is primary for rapid stem elongation.

Explanation: Gibberellins are often associated with bolting and elongation in stems; cytokinins promote cell division, abscisic acid is inhibitory, ethylene influences ripening and stress responses.

Quick Tip

Gibberellins → stem elongation and bolting; remember auxin also causes cell elongation but is not listed here.

Q19. Which part of the human nephron is primarily responsible for reabsorption of glucose and amino acids?

(1) Bowman's capsule
(2) Proximal convoluted tubule
(3) Loop of Henle
(4) Distal convoluted tubule

Correct Answer: (2) Proximal convoluted tubule

Solution:
Concept: The proximal convoluted tubule (PCT) performs bulk reabsorption of filtrate: 65–70
Explanation: Bowman's capsule is the filtration site; Loop of Henle concentrates urine; distal tubule fine-tunes solute balance.

Quick Tip

PCT = major reabsorption site (glucose, amino acids, most ions). If glucose appears in urine, suspect PCT transport saturation.

Q20. In recombinant DNA technology, which enzyme cuts DNA at specific recognition sites to produce restriction fragments?

(1) DNA polymerase
(2) Restriction endonuclease
(3) Ligase
(4) Reverse transcriptase

Correct Answer: (2) Restriction endonuclease

Solution:
Concept: Restriction endonucleases (restriction enzymes) recognize specific palindromic DNA sequences and cleave DNA, generating fragments with blunt or sticky ends used in cloning.

Explanation: DNA polymerase synthesizes DNA, ligase joins fragments, reverse transcriptase makes cDNA from RNA; only restriction enzymes cut at specific sites.

Quick Tip

Remember: restriction enzymes → cut; ligase → paste. These are the basic tools of molecular cloning.

Q21. Which of the following is a pioneer species in the primary succession of a bare rock?

(1) Grasses
(2) Lichens
(3) Shrubs
(4) Trees

Correct Answer: (2) Lichens

Solution:
Concept: Pioneer species are first colonizers of bare substrates; lichens (symbiosis of algae + fungi) can grow on bare rock, secrete acids to break rock and accumulate organic matter, enabling later succession.

Explanation: Grasses, shrubs, and trees typically appear later as soil forms.

Quick Tip

Lichens and some algae/mosses are typical pioneers on bare rock; they initiate soil formation for subsequent plants.

Q22. In flowering plants, double fertilization results in formation of which two structures?

(1) Embryo and endosperm
(2) Embryo and seed coat
(3) Endosperm and pollen grain
(4) Seed coat and ovule

Correct Answer: (1) Embryo and endosperm

Solution:
Concept: Double fertilization: one sperm fertilizes egg → embryo (2n); the other sperm fuses with central cell (two polar nuclei) → primary endosperm nucleus → endosperm (nutritive tissue).

Explanation: This unique angiosperm feature yields embryo + endosperm inside the seed.

Quick Tip

Remember: double fertilization → embryo (from egg) + endosperm (from polar nuclei + sperm), providing nutrition for the embryo.

Q23. In a DNA molecule, if the percentage of adenine (A) is 30%, what is the percentage of cytosine (C)?

(1) 20%
(2) 30%
(3) 40%
(4) 50%

Correct Answer: (1) 20%

Solution:
Concept: Chargaff's rules: $A = T$ and $G = C$ in double-stranded DNA. If $A = 30\%$, then

$T = 30\%$. Total A+T = 60%, so G+C = 40%. Thus $C = G = 20\%$.

Explanation: Simple subtraction and pairing rules determine base percentages.

Quick Tip

Compute A and T first, subtract from 100

Q24. Which microorganism is used in production of curd from milk?

(1) Saccharomyces cerevisiae
(2) Lactobacillus acidophilus
(3) Aspergillus niger
(4) Penicillium notatum

Correct Answer: (2) Lactobacillus acidophilus

Solution:
Concept: Lactic acid bacteria (Lactobacillus spp., Streptococcus thermophilus) ferment lactose to lactic acid, causing milk proteins to coagulate and form curd.

Explanation: Saccharomyces is a yeast for fermentation (bread/beer), Aspergillus and Penicillium are molds used in other processes, not curd formation.

Quick Tip

Curd formation = lactic acid fermentation by Lactobacillus and related bacteria.
Think "lacto" $\rightarrow$ lactic acid producers.

Q25. Which is an example of homologous structures that provide evidence for evolution?

(1) Wings of a bird and wings of an insect
(2) Forelimbs of a human and wings of a bat
(3) Fins of a fish and flippers of a whale
(4) Stingers of a bee and spines of a porcupine

Correct Answer: (2) Forelimbs of a human and wings of a bat

Solution:
Concept: Homologous structures share a common ancestral origin but may have different functions (e.g., pentadactyl forelimb pattern in mammals: human arm, bat wing, whale flipper).

Explanation: Bird vs insect wings are analogous (convergent), fins and flippers may also be homologous in some contexts but classic textbook example is human forelimb vs bat wing.

> Quick Tip
>
> Homologous = same ancestry, different function (e.g., human arm and bat wing); analogous = same function, different ancestry.

Q26. In the human heart, which chamber receives oxygenated blood from the lungs?

(1) Right atrium
(2) Right ventricle
(3) Left atrium
(4) Left ventricle

Correct Answer: (3) Left atrium

Solution:
Concept: Pulmonary veins carry oxygenated blood from the lungs to the left atrium; left ventricle then pumps it into systemic circulation via the aorta.

Explanation: Right side receives deoxygenated blood (vena cavae $\rightarrow$ right atrium $\rightarrow$ right ventricle $\rightarrow$ pulmonary artery).

> Quick Tip
>
> Remember: lungs $\rightarrow$ left atrium (oxygenated); body $\rightarrow$ right atrium (deoxygenated). Right heart $\rightarrow$ pulmonary circuit; left heart $\rightarrow$ systemic.

Q27. Which organelle in a eukaryotic cell is primarily responsible for synthesizing proteins destined for secretion?

(1) Mitochondrion
(2) Rough endoplasmic reticulum

(3) Golgi apparatus
(4) Lysosome

Correct Answer: (2) Rough endoplasmic reticulum

Solution:
Concept: Ribosomes bound to the rough ER synthesize polypeptides destined for secretion or membrane insertion; these proteins enter the ER lumen for folding and modifications.

Explanation: Golgi modifies and packages secretory proteins; RER is the primary site of their synthesis.

Quick Tip

Secreted proteins are synthesized on RER-bound ribosomes → translocated into ER lumen → Golgi processing → secretion.

Q28. In a cross between a pea plant heterozygous for round seeds (Rr) and a plant with wrinkled seeds (rr), what is the expected phenotypic ratio of the offspring?

(1) 1 Round : 1 Wrinkled
(2) 3 Round : 1 Wrinkled
(3) All Round
(4) All Wrinkled

Correct Answer: (1) 1 Round : 1 Wrinkled

Solution:
Concept: Cross Rr × rr gives gametes R or r from heterozygote and r from homozygote. Punnett square yields genotypes Rr and rr in 1:1 ratio → phenotypes round (Rr) : wrinkled (rr) = 1:1.

Explanation: Half offspring inherit R (round) and half inherit r (wrinkled).

Quick Tip

Set up a 2×1 Punnett (R,r × r) to quickly see the 1:1 phenotypic outcome.

Q29. In flowering plants, which structure develops into the fruit after fertilization?

(1) Ovary
(2) Ovule
(3) Anther
(4) Stigma

Correct Answer: (1) Ovary

Solution:
Concept: After fertilization, the ovule develops into the seed while the ovary develops into the fruit, enclosing the seed(s).

Explanation: Anther produces pollen (male gametes), stigma is pollen-receptive; ovule → seed, ovary → fruit.

Quick Tip

Remember: ovule → seed; ovary → fruit. This distinction is key in plant reproductive morphology.
