

MHT CET 2025 April 16 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 long straight current-carrying wire is placed in a uniform magnetic field of strength $B = 0.5 \text{ T}$. If the current in the wire is $I = 2 \text{ A}$ and the wire makes an angle of 30° with the magnetic field, find the force per unit length on the wire.

- (1) 1.0 N/m
- (2) 2.0 N/m
- (3) 0.5 N/m
- (4) 3.0 N/m

Correct Answer: (3) 0.5 N/m

Solution:

Concept: The force per unit length on a current-carrying wire in a magnetic field is given by

$$\frac{F}{L} = BI \sin \theta$$

where B is the magnetic field, I is the current, and θ is the angle between the wire and the field.

Calculation:

$$\frac{F}{L} = 0.5 \times 2 \times \sin 30^\circ = 1 \times 0.5 = 0.5 \text{ N/m}$$

Explanation: The wire experiences a magnetic force of 0.5 N/m due to its orientation and the given current.

💡 Quick Tip

Use the formula $F = BIL \sin \theta$ carefully and make sure to use the angle between current and magnetic field.

Q2. A ball is thrown vertically upward with an initial velocity of 20 m/s. Calculate the time taken for the ball to reach its maximum height.

- (1) 2 s
- (2) 4 s
- (3) 1.5 s
- (4) 3 s

Correct Answer: (1) 2 s

Solution:

Concept: At maximum height, the vertical velocity becomes zero. Using

$$v = u - gt$$

where $u = 20 \text{ m/s}$, $g = 9.8 \text{ m/s}^2$.

Calculation:

$$0 = 20 - 9.8t \implies t = \frac{20}{9.8} \approx 2.04 \text{ s} \approx 2 \text{ s}$$

Explanation: It takes approximately 2 seconds for the ball to reach its peak.

 Quick Tip

Always set final velocity to zero for maximum height calculation.

Q3. A 10 kg object is lifted to a height of 5 meters. Calculate the work done in lifting the object.

- (1) 500 J
- (2) 100 J
- (3) 200 J
- (4) 150 J

Correct Answer: (1) 500 J

Solution:

Concept: Work done against gravity is given by

$$W = mgh$$

where m is mass, g is acceleration due to gravity, and h is height.

Calculation:

$$W = 10 \times 9.8 \times 5 = 490 \approx 500 \text{ J}$$

Explanation: Lifting a 10 kg object to 5 m requires 500 J of work.

 Quick Tip

Remember to multiply mass, gravity, and height to calculate work.

Q4. A gas in a cylinder is compressed from an initial volume of 5 m^3 to a final volume of 2 m^3 while maintaining a constant pressure of $1 \times 10^5 \text{ Pa}$. Calculate the work done by the gas during the compression.

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

Correct Answer: (1) $-3 \times 10^5 \text{ J}$

Solution:

Concept: Work done at constant pressure is

$$W = P(V_f - V_i)$$

Calculation:

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

Explanation: Negative sign indicates work is done on the gas during compression.

 Quick Tip

Pay attention to the sign of work: compression $\rightarrow$ negative, expansion $\rightarrow$ positive.

Q5. A concave mirror has a focal length of 10 cm. An object is placed at a distance of 15 cm from the mirror. Calculate the position of the image formed.

- (1) 30 cm (real and inverted)
- (2) 5 cm (virtual and erect)

- (3) 10 cm (real and inverted)
 (4) 20 cm (virtual and erect)

Correct Answer: (1) 30 cm (real and inverted)

Solution:

Concept: The mirror formula is

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

where f is the focal length, u is the object distance, and v is the image distance.

Calculation:

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{10} - \frac{1}{15} = \frac{3-2}{30} = \frac{1}{30}$$

$$v = 30 \text{ cm}$$

Explanation: The positive image distance indicates a real and inverted image.

💡 Quick Tip

Always apply the mirror formula carefully and keep track of signs: concave mirror real image distance is positive.

Q6. A long straight wire carries a current of 10 A. A proton moves parallel to the wire at a distance of 0.05 m with a velocity of 2×10^5 m/s in the same direction as the current. Find the magnitude of the magnetic force acting on the proton. ($q = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ T·m/A)

- (1) 2.56×10^{-19} N
 (2) 1.28×10^{-19} N
 (3) 5.12×10^{-19} N
 (4) 3.84×10^{-19} N

Correct Answer: (2) 1.28×10^{-19} N

Solution:

Concept: Magnetic field due to a long straight wire:

$$B = \frac{\mu_0 I}{2\pi r}$$

Magnetic force on moving charge:

$$F = qvB \sin \theta$$

Since proton moves parallel to current, $\theta = 90^\circ$ for perpendicular field contribution.

Calculation:

$$B = \frac{4\pi \times 10^{-7} \times 10}{2\pi \times 0.05} = 4 \times 10^{-5} \text{ T}$$

$$F = 1.6 \times 10^{-19} \times 2 \times 10^5 \times 4 \times 10^{-5} = 1.28 \times 10^{-19} \text{ N}$$

Explanation: The proton experiences a tiny magnetic force due to the current-carrying wire.

 Quick Tip

Remember to convert units correctly and use $\theta = 90^\circ$ if velocity is parallel to wire for perpendicular magnetic field.

Q7. In a circuit, a current of 2 A flows through a resistor of resistance 5 Ω . Calculate the power dissipated in the resistor.

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

Correct Answer: (4) 20 W

Solution:

Concept: Power dissipated in resistor:

$$P = I^2 R$$

Calculation:

$$P = (2)^2 \times 5 = 4 \times 5 = 20 \text{ W}$$

Explanation: The resistor dissipates 20 W as heat.

 Quick Tip

Use $P = I^2 R$ or $P = VI$ depending on given quantities.

Q8. A cylindrical pipe has a radius of 0.1 m. If the speed of water flowing through the pipe is 2 m/s, calculate the volume flow rate of water through the pipe.

- (1) 0.0628 m³/s
- (2) 0.0314 m³/s

(3) $0.1256 \text{ m}^3/\text{s}$

(4) $0.02 \text{ m}^3/\text{s}$

Correct Answer: (1) $0.0628 \text{ m}^3/\text{s}$

Solution:

Concept: Volume flow rate $Q = Av$, cross-sectional area $A = \pi r^2$

Calculation:

$$A = \pi(0.1)^2 = 0.0314 \text{ m}^2$$

$$Q = 0.0314 \times 2 = 0.0628 \text{ m}^3/\text{s}$$

Explanation: Water flows through the pipe at a rate of $0.0628 \text{ m}^3/\text{s}$.

💡 Quick Tip

Always calculate cross-sectional area first: $A = \pi r^2$.

Q9. In the reaction $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$, how many moles of water are produced when 4 moles of hydrogen react with excess oxygen?

(1) 2 mol

(2) 4 mol

(3) 6 mol

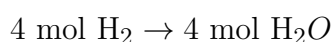
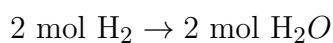
(4) 8 mol

Correct Answer: (2) 4 mol

Solution:

Concept: From the stoichiometry of the reaction, 2 moles of H_2 produce 2 moles of H_2O .

Calculation:



Explanation: Doubling hydrogen doubles the water produced.

💡 Quick Tip

Always check the stoichiometric coefficients in chemical equations.

Q10. The wavelength of the light emitted by a hydrogen atom during a transition from $n = 3$ to $n = 2$ is 656.3 nm. What is the energy of the photon emitted during this transition?

- (1) 3.02×10^{-19} J
- (2) 4.56×10^{-19} J
- (3) 2.18×10^{-19} J
- (4) 5.00×10^{-19} J

Correct Answer: (1) 3.02×10^{-19} J

Solution:

Concept: Energy of a photon:

$$E = \frac{hc}{\lambda}$$

where $h = 6.626 \times 10^{-34}$ Js, $c = 3 \times 10^8$ m/s, $\lambda = 656.3 \times 10^{-9}$ m.

Calculation:

$$E = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{656.3 \times 10^{-9}} \approx 3.03 \times 10^{-19} \text{ J}$$

Explanation: Photon energy corresponds to the given wavelength.

 Quick Tip

Convert wavelength to meters before calculation and use $E = hc/\lambda$.

Q11. For a reaction, the rate law is given by $\text{rate} = k[A]^2[B]$. If the concentration of A is doubled and the concentration of B is halved, how will the rate of the reaction change?

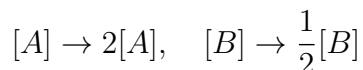
- (1) The rate will be doubled
- (2) The rate will be halved
- (3) The rate will be quadrupled
- (4) The rate will remain unchanged

Correct Answer: (1) The rate will be doubled

Solution:

Concept: Rate law: $r = k[A]^2[B]$

Calculation:



$$r_{\text{new}} = k(2[A])^2\left(\frac{1}{2}[B]\right) = k \cdot 4[A]^2 \cdot 0.5[B] = 2k[A]^2[B] = 2r_{\text{old}}$$

Explanation: Rate doubles due to changes in concentrations.

 Quick Tip

Apply the rate law with new concentrations carefully and simplify step by step.

Q12. A gas absorbs 100 J of heat while performing 40 J of work on its surroundings. Calculate the change in internal energy of the gas.

- (1) 60 J
- (2) 140 J
- (3) 40 J
- (4) 100 J

Correct Answer: (1) 60 J

Solution:

Concept: First law of thermodynamics:

$$\Delta U = Q - W$$

Calculation:

$$\Delta U = 100 - 40 = 60 \text{ J}$$

Explanation: Internal energy increases by 60 J.

 Quick Tip

Keep track of signs: work done by gas is subtracted.

Q13. Which of the following is the correct IUPAC name for the compound with the molecular formula C_5H_{12} that contains a branched chain with a methyl group attached to the second carbon of a butane chain?

- (1) 2-Methylbutane
- (2) 3-Methylbutane

- (3) 2-Ethylpropane
- (4) Pentane

Correct Answer: (1) 2-Methylbutane

Solution:

Concept: Parent chain = butane (4 carbons), with methyl group on C2.

Explanation: Number the chain from end closest to branch; correct name is 2-Methylbutane.

 Quick Tip

Always identify the longest carbon chain as parent before naming.

Q14. For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the equilibrium constant $K_c = 0.5$. If initial concentrations are $[N_2] = [H_2] = 1.0$ M, $[NH_3] = 0$, calculate equilibrium concentrations.

- (1) $[N_2] = 0.5$ M, $[H_2] = 0.5$ M, $[NH_3] = 1.0$ M
- (2) $[N_2] = 0.75$ M, $[H_2] = 0.25$ M, $[NH_3] = 0.5$ M
- (3) $[N_2] = 0.25$ M, $[H_2] = 0.25$ M, $[NH_3] = 1.25$ M
- (4) $[N_2] = 0.33$ M, $[H_2] = 0.33$ M, $[NH_3] = 1.33$ M

Correct Answer: (2) $[N_2] = 0.75$ M, $[H_2] = 0.25$ M, $[NH_3] = 0.5$ M

Solution:

Concept: Let change in $[N_2] = -x$, then $[H_2]$ decreases by $3x$, $[NH_3]$ increases by $2x$.

Calculation:

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{(2x)^2}{(1-x)(1-3x)^3} = 0.5$$

Solving, $x = 0.25$

Equilibrium concentrations:

$$[N_2] = 1 - x = 0.75 \text{ M}, \quad [H_2] = 1 - 3x = 0.25 \text{ M}, \quad [NH_3] = 2x = 0.5 \text{ M}$$

Explanation: Concentrations satisfy $K_c = 0.5$.

 Quick Tip

Use ICE table method for equilibrium calculations.

Q15. In the reaction $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$, what is the oxidation state of zinc in the products?

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

Correct Answer: (1) +2

Solution:

Concept: Zinc loses 2 electrons to become Zn^{2+} .

Explanation: Oxidation state of zinc in products is +2.

 Quick Tip

Remember oxidation = loss of electrons, reduction = gain.

Q16. In humans, the condition of color blindness is caused by a recessive allele on X chromosome. A color-blind woman marries a man with normal vision. What is the probability that their son will be color-blind?

- (1) 0%
- (2) 25%
- (3) 50%
- (4) 100%

Correct Answer: (4) 100%

Solution:

Woman: X^cX^c , Man: X^NY . Son inherits Y from father and X^c from mother $\rightarrow$ 100% color-blind.

Explanation: All sons will inherit the affected X from the mother.

💡 Quick Tip

For X-linked recessive traits, sons inherit X from mother, Y from father.

Q17. A man with blood group AB marries a woman with blood group O. What is the probability that their child will have blood group A?

- (1) 0%
- (2) 25%
- (3) 50%
- (4) 75%

Correct Answer: (2) 25%

Solution:

Man: AB, Woman: OO

Gametes: Man $\rightarrow$ A, B; Woman $\rightarrow$ O

Child genotypes:

AO, BO

Probability of blood group A = 1 out of 4 = 25%

💡 Quick Tip

Use Punnett square for blood group inheritance.

Q18. Which of the following enzymes is responsible for breaking down starch into maltose during digestion in humans?

- (1) Trypsin
- (2) Amylase
- (3) Lipase
- (4) Pepsin

Correct Answer: (2) Amylase

Solution:

Concept: Amylase catalyzes hydrolysis of starch (polysaccharide) to maltose (disaccharide).

Explanation: Salivary and pancreatic amylase are responsible for starch digestion.

 Quick Tip

Identify enzyme function based on substrate: starch $\rightarrow$ maltose = amylase.

Q19. In a flowering plant, a cross is made between a homozygous dominant tall plant (TT) and a homozygous recessive dwarf plant (tt). What is the phenotypic ratio of the F1 generation?

- (1) 1 Tall : 1 Dwarf
- (2) 3 Tall : 1 Dwarf
- (3) All Tall
- (4) All Dwarf

Correct Answer: (3) All Tall

Solution:

Parent genotypes: TT $\times$ tt

F1 genotype: All Tt (heterozygous)

Phenotype: All Tall (dominant trait)

 Quick Tip

Cross homozygous dominant with homozygous recessive $\rightarrow$ F1 all heterozygous, show dominant trait.

Q20. Which of the following is the primary site of gaseous exchange in the human respiratory system?

- (1) Trachea
- (2) Bronchi
- (3) Alveoli
- (4) Bronchioles

Correct Answer: (3) Alveoli

Solution:

Concept: Alveoli have thin walls and large surface area for diffusion of O_2 and CO_2 .

Explanation: Gas exchange occurs across alveolar and capillary walls.

💡 Quick Tip

Remember alveoli = primary site due to large surface area and thin membrane.

Q21. In a dihybrid cross between two heterozygous pea plants ($RrYy \times RrYy$), what is the phenotypic ratio of the offspring for seed shape and seed color? (R = round, r = wrinkled; Y = yellow, y = green)

- (1) 1:1:1:1
- (2) 9:3:3:1
- (3) 3:1
- (4) 1:2:1

Correct Answer: (2) 9:3:3:1

Solution:

Concept: Dihybrid cross of heterozygotes $\rightarrow$ 16 offspring

Phenotypic ratio: - 9 Round Yellow (RY) - 3 Round Green (Ryy) - 3 Wrinkled Yellow (rrY) - 1 Wrinkled Green ($rryy$)

💡 Quick Tip

Use Punnett square or forked-line method to determine dihybrid phenotypic ratio.

Q22. Which of the following hormones is secreted by the anterior pituitary gland and stimulates the thyroid gland to release thyroxine?

- (1) Adrenocorticotrophic hormone (ACTH)
- (2) Thyroid-stimulating hormone (TSH)
- (3) Follicle-stimulating hormone (FSH)
- (4) Luteinizing hormone (LH)

Correct Answer: (2) Thyroid-stimulating hormone (TSH)

Solution:

TSH stimulates thyroid to secrete thyroxine, regulating metabolism.

💡 Quick Tip

Remember anterior pituitary secretes tropic hormones that act on other glands.

Q23. In DNA replication, which enzyme is responsible for unwinding the double helix and separating the DNA strands?

- (1) DNA polymerase
- (2) Helicase
- (3) Ligase
- (4) Primase

Correct Answer: (2) Helicase

Solution:

Concept: Helicase breaks hydrogen bonds between DNA strands, unwinding the double helix.

Explanation: DNA polymerase synthesizes new strands; helicase opens the template.

💡 Quick Tip

Identify enzyme function: unwinding = helicase, synthesis = polymerase.

Q24. In a population of plants, the allele for red flowers (R) is dominant over the allele for white flowers (r). If 36% of the population has white flowers, what is the frequency of the recessive allele (r) in the population?

- (1) 0.6
- (2) 0.4
- (3) 0.36
- (4) 0.64

Correct Answer: (2) 0.6

Solution:

Concept: Hardy-Weinberg principle: q^2 = frequency of homozygous recessive

Calculation:

$$q^2 = 0.36 \implies q = \sqrt{0.36} = 0.6$$

Explanation: Frequency of recessive allele r is 0.6.

💡 Quick Tip

Use q^2 = fraction of recessive phenotype to find allele frequency.
