

MHT CET 23 April Shift 1 PCM Paper

Total Time Allowed : 3 hours	Maximum Marks : 200	Total Questions : 200
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General Instructions

Read the following instructions very carefully and strictly follow them:

This question paper is divided into three sections:

1. The total duration of the examination is 3 hours (180 minutes).
2. The total number of questions is **200**, carrying a maximum of **200 marks**.
3. The marking scheme is as follows:
 - (i) For Physics, Chemistry, and Mathematics, 1 mark will be awarded for every correct response.
 - (ii) There is **no negative marking** for any incorrect response.
4. No marks will be awarded for unanswered questions.
5. Follow the instructions provided during the exam for submitting your answers.

1. A car accelerates uniformly from rest to a velocity of 25 m/s in 10 seconds. What is the acceleration of the car?

- (A) 2.5 m/s^2
- (B) 5 m/s^2
- (C) 10 m/s^2
- (D) 15 m/s^2

2. A block of mass 5 kg is placed on a horizontal surface. The coefficient of friction between the block and the surface is 0.4. What is the force of friction acting on the block?

- (A) 10 N
- (B) 15 N
- (C) 20 N
- (D) 25 N

3. In a Young's double-slit experiment, the distance between the slits is 0.2 mm and the distance between the screen and the slits is 2 m. If the wave-

length of the light used is 600 nm, calculate the distance between the two adjacent bright fringes.

- (A) 0.3 mm
 - (B) 0.6 mm
 - (C) 1.2 mm
 - (D) 1.5 mm
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4. In an LC circuit, the inductance L is 2 H and the capacitance C is 4 μF . What is the frequency of oscillation of the circuit?

- (A) 100 Hz
 - (B) 50 Hz
 - (C) 25 Hz
 - (D) 200 Hz
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5. A thin spherical shell of radius 0.5 m and mass 2 kg is rotating about its axis of symmetry with an angular velocity of 10 rad/s. What is its moment of inertia?

- (A) 0.5 $\text{kg}\cdot\text{m}^2$
 - (B) 1.0 $\text{kg}\cdot\text{m}^2$
 - (C) 2.0 $\text{kg}\cdot\text{m}^2$
 - (D) 4.0 $\text{kg}\cdot\text{m}^2$
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6. A particle is moving with a constant velocity of 5 m/s in a circular path of radius 2 m. What is the centripetal acceleration of the particle?

- (A) 1.25 m/s^2
 - (B) 2.5 m/s^2
 - (C) 5 m/s^2
 - (D) 10 m/s^2
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7. A body of mass 5 kg is placed on a frictionless inclined plane of angle 30° . What is the component of the weight of the body along the plane?

- (A) 25 N
 - (B) 50 N
 - (C) 45 N
 - (D) 75 N
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8. The electric field at a point in space is $2 \times 10^3 \text{ N/C}$ and the potential at the same point is 100 V. What is the potential energy of a charge of 5 μC placed at that point?

- (A) 0.5 mJ
 - (B) 1.0 mJ
 - (C) 2.0 mJ
 - (D) 5.0 mJ
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9. A 0.5 m long solenoid has 400 turns and carries a current of 3 A. What is the magnetic field at the center of the solenoid?

- (A) $2 \times 10^{-2} \text{ T}$
 - (B) $4 \times 10^{-2} \text{ T}$
 - (C) $6 \times 10^{-2} \text{ T}$
 - (D) $8 \times 10^{-2} \text{ T}$
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10. A photon has an energy of $3.2 \times 10^{-19} \text{ J}$. What is the frequency of the photon?

- (A) $5.0 \times 10^{14} \text{ Hz}$
 - (B) $4.0 \times 10^{14} \text{ Hz}$
 - (C) $3.0 \times 10^{14} \text{ Hz}$
 - (D) $6.0 \times 10^{14} \text{ Hz}$
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11. A satellite is orbiting the Earth at a height of 10^4 km above the Earth's surface. If the radius of the Earth is $6.4 \times 10^6 \text{ m}$, calculate the orbital speed of the satellite. (Gravitational constant $G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$ and Earth's mass $M = 6 \times 10^{24} \text{ kg}$)

- (A) 7.0 km/s
 - (B) 8.0 km/s
 - (C) 9.0 km/s
 - (D) 10.0 km/s
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12. A coil of 100 turns, carrying a current of 5 A, is placed in a magnetic field of 2 T. The area of each turn is 0.01 m². What is the magnetic moment of the coil?

- (A) 0.5 A·m²
 - (B) 1.0 A·m²
 - (C) 2.0 A·m²
 - (D) 5.0 A·m²
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13. The pH of a solution is 3. What is the concentration of H ions in the solution?

- (A) 1×10^{-3} mol/L
 - (B) 3×10^{-3} mol/L
 - (C) 1×10^{-6} mol/L
 - (D) 3×10^{-6} mol/L
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14. What is the oxidation state of chromium in K₂Cr₂O₇?

- (A) +2
 - (B) +3
 - (C) +6
 - (D) +7
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15. What is the molecular geometry of SO₃?

- (A) Linear
- (B) Trigonal planar
- (C) Tetrahedral
- (D) Octahedral

16. What is the mass of sodium chloride (NaCl) formed when 0.5 moles of sodium (Na) reacts with excess chlorine (Cl₂)?

- (A) 29 g
- (B) 35.5 g
- (C) 58 g
- (D) 70 g

17. Calculate the oxidation number of sulfur in H₂SO₄.

- (A) +4
- (B) +6
- (C) +2
- (D) 0

18. A sample of an ideal gas occupies 10 liters at a pressure of 2 atm and a temperature of 300 K. What is the volume of the gas at 1 atm pressure and 300 K temperature?

- (A) 5 L
- (B) 10 L
- (C) 20 L
- (D) 40 L

19. What is the total number of orbitals in the third energy level ($n = 3$)?

- (A) 9
- (B) 16
- (C) 4
- (D) 3

20. What is the value of the ionization energy of hydrogen in joules? (Given that the ionization energy of hydrogen is 13.6 eV)

- (A) 2.18×10^{-18} J
 - (B) 1.6×10^{-18} J
 - (C) 3.2×10^{-19} J
 - (D) 1.0×10^{-19} J
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21. What is the empirical formula of a compound containing 40% sulfur and 60% oxygen by mass?

- (A) SO₂
 - (B) SO₃
 - (C) S₂O₃
 - (D) SO
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22. What is the standard electrode potential for the half-reaction $\text{Cu}^{2+} + 2e^{-} \rightarrow \text{Cu}$?

- (A) +0.34 V
 - (B) -0.34 V
 - (C) +1.10 V
 - (D) 0 V
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23. What is the percentage composition of nitrogen in ammonium nitrate (NH₄NO₃)?

- (A) 18.5
 - (B) 28.0
 - (C) 35.0
 - (D) 42.5
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24. What is the total number of moles of gas in a 5 L container at 300 K and 2 atm pressure (Use the ideal gas law)?

- (A) 0.4 mol
- (B) 0.6 mol
- (C) 1.0 mol

(D) 2.0 mol

25. A solution contains 10 g of NaOH dissolved in 500 mL of water. What is the molarity of the NaOH solution?

- (A) 0.25 M
 - (B) 0.5 M
 - (C) 1.0 M
 - (D) 2.0 M
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26. The enthalpy change for the reaction $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ is -393.5 kJ/mol . What is the heat released when 2 moles of carbon react with excess oxygen?

- (A) -393.5 kJ
 - (B) -787 kJ
 - (C) -196.75 kJ
 - (D) 0 kJ
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27. Find the roots of the quadratic equation $2x^2 - 4x - 6 = 0$.

- (A) $x = 1$ or $x = -3$
 - (B) $x = -1$ or $x = 3$
 - (C) $x = 2$ or $x = -1$
 - (D) $x = 3$ or $x = -2$
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28. Find the area of a triangle with vertices A(2, 3), B(5, 11), and C(8, 7).

- (A) 15
 - (B) 18
 - (C) 20
 - (D) 25
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29. Solve for x : $\log_2(x - 1) = 3$.

- (A) $x = 9$
 - (B) $x = 7$
 - (C) $x = 8$
 - (D) $x = 6$
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30. Find the derivative of the function $f(x) = 3x^2 - 5x + 7$.

- (A) $6x - 5$
 - (B) $6x + 5$
 - (C) $3x^2 + 5$
 - (D) $3x^2 - 5$
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31. Find the value of the determinant $\begin{vmatrix} 2 & 3 \\ 4 & 5 \end{vmatrix}$.

- (A) 2
 - (B) 1
 - (C) 0
 - (D) -1
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32. Solve the system of equations:

$$x + y = 5$$

$$2x - y = 4$$

- (A) $x = 3, y = 2$
 - (B) $x = 2, y = 3$
 - (C) $x = 4, y = 1$
 - (D) $x = 1, y = 4$
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33. If $\log_2 x = 5$, what is the value of x ?

- (A) $x = 32$
- (B) $x = 25$
- (C) $x = 20$
- (D) $x = 16$

34. Find the length of the diagonal of a rectangle with length 6 cm and breadth 8 cm.

- (A) 10 cm
- (B) 12 cm
- (C) 14 cm
- (D) 8 cm

35. Solve the system of equations:

$$x + y = 10$$

$$3x - y = 5$$

- (A) $x = 5, y = 5$
- (B) $x = 4, y = 6$
- (C) $x = 3, y = 7$
- (D) $x = 6, y = 4$

36. Find the sum of the first 20 terms of the arithmetic progression: 2, 5, 8, 11, ...

- (A) 400
- (B) 420
- (C) 440
- (D) 460

37. Find the value of x if $\sin(2x) = 1$.

- (A) $\frac{\pi}{2}$
- (B) $\frac{\pi}{4}$
- (C) $\frac{\pi}{6}$
- (D) $\frac{\pi}{3}$

38. Find the value of $\log_3 81$.

- (A) 3
 - (B) 4
 - (C) 2
 - (D) 1
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