



General Instructions

- (i) **Duration:** The total duration of the examination is 3 hours (180 minutes).
- (ii) **Total Marks:** The complete paper carries a maximum of 390 marks.
- (iii) **Structure:** The paper has 4 Sections:
 - **Part 1:** 30 Multiple Choice Questions (Physics).
 - **Part 2:** 30 Multiple Choice Questions (Chemistry).
 - **Part 3:** 10 Multiple Choice Questions (English Proficiency),
20 Multiple Choice Questions (Logical Reasoning)
 - **Part 4:** 40 Multiple Choice Questions (Mathematics/Biology)
- (iv) **Compulsory Questions:** All 130 questions are compulsory, and +12 Questions (Optional Extra Questions)
- (v) Each question has four options. Only **one** option is correct.
- (vi) **Correct Answer:** +3 marks.
- (vii) **Incorrect Answer:** -1 (Negative marking).
- (viii) **Unanswered/Marked for Review:** 0 marks.

PHYSICS

1. Two point charges $+q$ and $-q$ are held fixed at a distance d apart. The net electric potential at a point midway between the two charges and its net field are?

- (A) $E = 0$ $V = 0$
(B) $E \neq 0$ $V \neq 0$
(C) $E = 0$ $V \neq 0$
(D) $E \neq 0$ $V = 0$
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2. A charge Q is placed at the center of an uncharged conducting spherical shell of inner radius R_1 and outer radius R_2 . The surface charge density on the outer surface of the shell is:

- (A) $\frac{Q}{(4\pi R_1^2)}$
(B) $\frac{Q}{(4\pi R_2^2)}$
(C) $\frac{-Q}{(4\pi R_1^2)}$
(D) Zero
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3. A parallel plate capacitor is charged and then disconnected from the charging battery. If the plates are now pulled further apart using insulating handles:

- (A) The charge increases
(B) The voltage decreases
(C) The capacitance increases
(D) The electrostatic energy stored increases
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4. The magnetic field at the center of a circular current-carrying loop of radius R is B_0 . The magnetic field at an axial point at a distance $x = R$ from the center of the loop is:

- (A) $B_0/2$
(B) $B_0/2\sqrt{2}$
(C) $B_0/4$
(D) $B_0\sqrt{2}$
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CHEMISTRY

5. The value of enthalpy change (ΔH) for the reaction $\text{C}_2\text{H}_5\text{OH}(l) + 3\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 3\text{H}_2\text{O}(l)$, at 27°C is $-1366.5 \text{ kJ mol}^{-1}$. The value of internal energy change for the above reaction at this temperature will be

- (A) $-1371.5 \text{ kJ mol}^{-1}$
(B) $-1369.0 \text{ kJ mol}^{-1}$
(C) $-1364.0 \text{ kJ mol}^{-1}$
(D) $-1361.5 \text{ kJ mol}^{-1}$
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6. For the complete combustion of ethanol, $\text{C}_2\text{H}_5\text{OH}(l) + 3\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 3\text{H}_2\text{O}(l)$, the amount of heat produced as measured in bomb calorimeter is $1364.47 \text{ kJ mol}^{-1}$ at 25°C . Assuming ideality the enthalpy of combustion, ΔH_C , for the reaction will be ($R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$)

- (A) $-1366.95 \text{ kJ mol}^{-1}$
(B) $-1361.95 \text{ kJ mol}^{-1}$
(C) $-1460.50 \text{ kJ mol}^{-1}$
(D) $-1350.50 \text{ kJ mol}^{-1}$
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7. What is $[\text{NH}_4^+]$ in a solution that is 0.02M NH_3 and 0.01 M KOH ? [$K_b(\text{NH}_3) = 1.8 \times 10^{-5}$]

- (A) $3.6 \times 10^{-5} \text{ M}$
(B) $1.8 \times 10^{-5} \text{ M}$
(C) $0.9 \times 10^{-5} \text{ M}$
(D) $7.2 \times 10^{-5} \text{ M}$
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8. 1.1 mole of A mixed with 2.2 moles of B and the mixture is kept in a 1 L flask and the equilibrium, $\text{A} + 2\text{B} \rightleftharpoons 2\text{C} + \text{D}$ is reached. If at equilibrium 0.2 mole of C is formed then the value of K_c will be

- (A) 0.1
(B) 0.01
(C) 0.001
(D) 1
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MATHEMATICS

9. If $y^x = e^{y-x}$, then $\frac{dy}{dx}$ is equal to

- (A) $\frac{1+\log y}{y \log y}$
(B) $\frac{(1+\log y)^2}{y \log y}$
(C) $\frac{1+\log y}{(\log y)^2}$
(D) $\frac{(1+\log y)^2}{\log y}$
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10. The domain of the function $f(x) = \sqrt{x - \sqrt{1 - x^2}}$ is

- (A) $\left[-1, -\frac{1}{\sqrt{2}}\right] \cup \left[\frac{1}{\sqrt{2}}, 1\right]$
(B) $[-1, 1]$
(C) $\left(-\infty, -\frac{1}{\sqrt{2}}\right] \cup \left[\frac{1}{\sqrt{2}}, +\infty\right]$
(D) $\left[\frac{1}{\sqrt{2}}, 1\right]$
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11. Let $A = \{1, 2, 3, 4, 5\}$ and R be a relation defined by $R = \{(x, y) : x, y \in A, x + y = 5\}$. Then, R is

- (A) reflexive and symmetric but not transitive
(B) an equivalence relation
(C) neither reflexive nor transitive
(D) neither reflexive nor symmetric but transitive
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12. If A and B are symmetric matrices of same order such that $AB + BA = X$ and $AB - BA = Y$, then $(XY)^T =$

- (A) XY
(B) $X^T Y^T$
(C) $-YX$
(D) $-Y^T X^T$
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