



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. A wire of length L and cross-sectional area A is made of a material of Young's modulus Y . If it is stretched by an amount x , the elastic potential energy stored in the wire is:

- (A) $\frac{YAx^2}{L}$
(B) $\frac{YAx^2}{2L}$
(C) $\frac{2YAx^2}{L}$
(D) $\frac{YAx}{L}$
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2. A particle moves in a circle of radius R such that its linear speed varies with time t as $v = kt$, where k is a positive constant. The angle θ between the net acceleration vector and the velocity vector at time t is given by:

- (A) $\tan^{-1} \left(\frac{k^2 t^2}{R} \right)$
(B) $\tan^{-1} \left(\frac{kt^2}{R} \right)$
(C) $\tan^{-1} \left(\frac{kt}{R} \right)$
(D) $\tan^{-1} \left(\frac{R}{k^2 t^2} \right)$
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3. Two wires X and Y of the same material have lengths in the ratio $1 : 2$ and diameters in the ratio $2 : 1$. If they are subjected to the same stretching force, the ratio of the elongation produced in wire X to that in wire Y ($\Delta L_X : \Delta L_Y$) is:

- (A) $1 : 4$
(B) $1 : 8$
(C) $1 : 2$
(D) $8 : 1$
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4. The elastic potential energy stored per unit volume (energy density) in a stretched string under a longitudinal tension stress σ and material Young's modulus Y is expressed as:

- (A) $\frac{\sigma^2}{2Y}$
(B) $\frac{2Y}{\sigma^2}$
(C) $\frac{Y\sigma^2}{2}$
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(D) $\frac{\sigma^2}{Y}$

CHEMISTRY

5. An octahedral coordination complex with the electronic configuration $t_{2g}^4 e_g^0$ is expected to exhibit which of the following magnetic properties and d-d transition characteristics?

- (A) Paramagnetic with 4 unpaired electrons; spin-allowed transitions
 - (B) Paramagnetic with 2 unpaired electrons; spin-allowed transitions
 - (C) Diamagnetic; spin-forbidden transitions
 - (D) Paramagnetic with 2 unpaired electrons; spin-forbidden transitions
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6. During the structural analysis of an unknown aldohexose, a chemist treats a sample with periodic acid (HIO_4). If the carbohydrate is completely cleaved to yield five molecules of formic acid (HCOOH) and one molecule of formaldehyde (HCHO), this diagnostic breakdown directly proves the presence of:

- (A) A ketohexose structure with a carbonyl at C-2
 - (B) A cyclic pyranose ring configuration
 - (C) A continuous straight-chain structure containing five $-\text{CHOH}$ groups and one $-\text{CH}_2\text{OH}$ group
 - (D) Three isolated, non-adjacent primary alcohol branches
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7. In an analytical laboratory, a 20.0 mL sample of an aqueous solution containing oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$) requires exactly 16.0 mL of a 0.05 M potassium permanganate (KMnO_4) solution for complete oxidation in a hot, acidic medium (H_2SO_4). Calculate the molarity of the oxalic acid solution.

- (A) 0.010 M
- (B) 0.040 M

- (C) 0.100 M
(D) 0.250 M
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8. A current of 2.0 A is passed for 5 hours through an electrolytic cell containing an aqueous solution of a metal salt, depositing 12.0 g of the metal at the cathode. If the atomic mass of the metal is 193 g mol^{-1} , find the oxidation state of the metal ion in the solution. (Take Faraday's constant $F = 96500 \text{ C mol}^{-1}$).

- (A) +1
(B) +2
(C) +3
(D) +6
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MATHEMATICS

9. In how many ways can the letters of the word COCHIN be arranged such that the two 'C's are never separated by any other letter?

- (A) 360
(B) 120
(C) 240
(D) 720
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10. Evaluate the definite integral: $\int_0^{2026} \frac{x^5}{x^5 + (2026-x)^5} dx$

- (A) 2026
(B) 1013
(C) 506.5
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(D) 0

11. If the vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$, and $\vec{c} = 3\hat{i} + \lambda\hat{j} + 5\hat{k}$ represent the concurrent coterminal edges of a parallelepiped whose volume is 0 (i.e., the vectors are coplanar), find the value of the scalar parameter λ .

(A) 4

(B) -4

(C) 2

(D) -2

12. A pair of fair dice is thrown simultaneously. What is the probability that the sum of the numbers appearing on the top faces is at least 10?

(A) $\frac{1}{6}$

(B) $\frac{1}{12}$

(C) $\frac{5}{36}$

(D) $\frac{1}{4}$
