



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. In a Wheatstone Bridge, all four arms have equal resistance of $1\ \Omega$ each. A battery is connected across the bridge, and a galvanometer is connected between the middle junctions.

What is the current flowing through the galvanometer?

- (A) Zero
 - (B) Depends on battery voltage
 - (C) Maximum current flows
 - (D) Cannot be determined
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2. A satellite is orbiting the Earth and dissipates energy due to some resistive forces. Its initial total mechanical energy is E (negative). If the radius of its orbit becomes half of the original value, what is the new total mechanical energy of the satellite?

- (A) $E/2$
 - (B) $E/4$
 - (C) $2E$
 - (D) $4E$
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3. Find the total mechanical energy of a satellite of mass m revolving in a circular orbit of radius a around the Earth (mass M).

- (A) $-\frac{GMm}{a}$
 - (B) $-\frac{GMm}{2a}$
 - (C) $\frac{GMm}{2a}$
 - (D) $\frac{GMm}{a}$
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4. A block is placed on a wedge with coefficient of friction $\mu = 0.5$. The wedge is accelerated horizontally towards the block. What is the minimum acceleration required so that the block does not slide down the wedge?

- (A) g
- (B) $\frac{g}{2}$
- (C) $\frac{g}{\sqrt{3}}$
- (D) $\frac{g}{1+\mu}$

5. In a pulley system, two blocks are connected by a string over a frictionless pulley. If tensions T_1 and T_2 are given in two segments of the string, what is their relation?

- (A) $T_1 = T_2$
 - (B) $T_1 > T_2$
 - (C) $T_1 < T_2$
 - (D) Depends on masses only
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Chemistry

6. 0.009 g of CaCO_3 is dissolved in 1 litre of solution. Calculate the concentration of the solution in parts per million (ppm).

- (A) 0.009 ppm
 - (B) 0.9 ppm
 - (C) 9 ppm
 - (D) 90 ppm
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7. In s-block chemistry, quicklime and slaked lime are represented as MO and $\text{M}(\text{OH})_2$ respectively. Identify the metal M.

- (A) Sodium
 - (B) Calcium
 - (C) Potassium
 - (D) Magnesium
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8. For a reaction, the initial concentrations and corresponding rates are given. Which method is used to calculate the rate constant?

- (A) Integration method

- (B) Differential method
(C) Initial rate method
(D) Half-life method
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Maths

9. Find the mean deviation about the mean for the data set: 1, 3, 5, 7, . . . , 101

- (A) 24
(b) 25
(c) 25.5
(d) 26
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10. If $\log_8 x = \frac{1}{3}$, find the value of x .

- (A) 2
(B) 4
(C) 8
(D) 1
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11. If a fair coin is tossed 5 times, what is the probability of getting exactly 3 heads?

- (A) $\frac{5}{32}$
(B) $\frac{10}{32}$
(C) $\frac{15}{32}$
(D) $\frac{20}{32}$
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12. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 3 & 2 & 1 \end{bmatrix}$. Find A^{100} .

- (A) Same as A
(B) Identity matrix

(C) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 300 & 200 & 1 \end{bmatrix}$

(D) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 100 & 200 & 1 \end{bmatrix}$

13. A person travels from Hyderabad to Goa and returns, but does not use the same bus for both journeys. If there are 25 buses available for each direction, how many ways can the round trip be made?

- (A) 600
(B) 625
(C) 650
(D) 700

14. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ such that $g(x) \neq 0$ for all $x \in \mathbb{R}$, and $f = f^{-1}$. Which of the following is correct?

- (A) f must be discontinuous
(B) f is bijective and symmetric about $y = x$
(C) f is constant
(D) f is not differentiable anywhere

15. Evaluate: $\int e^x \sin x \cos x \, dx$

- (A) $\frac{e^x \sin^2 x}{2} + C$
(B) $\frac{e^x \cos^2 x}{2} + C$
(C) $\frac{e^x \sin 2x}{4} + C$
(D) $\frac{e^x}{10}(\sin 2x - 2 \cos 2x) + C$

16. Evaluate: $\cot^{-1}(2) - \cot^{-1}(8) - \cot^{-1}(18) - \dots$

- (A) 0
 - (B) $\frac{\pi}{4}$
 - (C) $\frac{\pi}{2}$
 - (D) π
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17. Find the term independent of x in the expansion of $(1+x)^n(1+1/x)^n$.

- (a) $\binom{2n}{n}$
 - (b) nC_n
 - (c) $({}^nC_{n/2})^2$
 - (d) $({}^nC_n)^2$
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18. In a Linear Programming Problem (LPP), the objective function Z is minimized subject to constraints. Where does the minimum value occur?

- (a) Inside feasible region
 - (b) At corner points of feasible region
 - (c) Outside feasible region
 - (d) At origin only
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19. The angle between two lines in 3D space can be found using:

- (a) Dot product of direction vectors
 - (b) Cross product only
 - (c) Determinant method
 - (d) Distance formula
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20. The equation of a plane passing through three non-collinear points is determined using:

- (A) Vector form

- (B) Determinant method
(C) Cartesian equation
(D) All of the above
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21. Find the equation of the normal to a parabola which is perpendicular to a given line. This involves:

- (A) Slope comparison
(B) Differentiation
(C) Both A and B
(D) None of these
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LOGICAL REASONING

22. Statements:

- Some cashmere jackets are fashionable.
- Some cashmere jackets are not suede jackets.
- No suede jacket is fashionable.

Which of the following conclusions is correct?

- (A) Some fashionable jackets are not suede jackets
(B) All cashmere jackets are fashionable
(C) Some suede jackets are cashmere jackets
(D) No cashmere jacket is fashionable
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