



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 200 marks.
- (iii) **Structure:** The paper has 3 Sections:
 - **Section A:** 50 Multiple Choice Questions (Physics).
 - **Section B:** 50 Multiple Choice Questions (Chemistry).
 - **Section B:** 100 Multiple Choice Questions (Biology).
- (iv) **Compulsory Questions:** All 200 questions are compulsory.
- (v) Each question has four options. Only **one** option is correct.
- (vi) **Correct Answer:** +1 marks.
- (vii) **Incorrect Answer:** (No Negative marking).
- (viii) **Unanswered/Marked for Review:** 0 marks.

1. The rms velocity of hydrogen molecules at 27°C is v . At what temperature will the rms velocity of oxygen molecules equal v ?

- (A) 4800 K
 - (B) 4527°C
 - (C) 1200 K
 - (D) 27°C
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2. An ideal gas undergoes a cyclic process ABCA wherein AB is an isothermal expansion, BC is an isochoric pressure drop, and CA is an adiabatic compression. The work done by the gas in the complete cycle is:

- (A) Zero
 - (B) Positive
 - (C) Negative
 - (D) Cannot be determined
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3. A Carnot engine operates between temperatures T_1 and T_2 ($T_1 > T_2$). If T_1 is increased by ΔT and T_2 is decreased by ΔT , its efficiency will:

- (A) Increase
 - (B) Decrease
 - (C) Remain constant
 - (D) Depend on the working substance
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4. A particle executes simple harmonic motion of amplitude A and time period T . The time taken by the particle to travel from the mean position to a distance of $A/2$ is:

- (A) $T/4$
 - (B) $T/8$
 - (C) $T/12$
 - (D) $T/6$
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5. A pendulum clock gives correct time at 20°C . If the coefficient of linear expansion of the pendulum's material is $\alpha = 1.2 \times 10^{-5}/^\circ\text{C}$, the clock will lose time per day at 40°C by approximately:

- (A) 10.4 s
- (B) 5.2 s
- (C) 20.8 s
- (D) 2.6 s

6. Which of the following forces is involved in dinitrogen?

- (A) Dipole - dipole interaction
 - (B) Dipole - induced dipole interaction
 - (C) London dispersion force
 - (D) Hydrogen bonding
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7. Which from following compounds is NOT in gaseous phase at 25°C?

- (A) ClF
 - (B) BrF
 - (C) IF₃
 - (D) ClF₃
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8. Which of the following equations gives combined relationship of Boyle's law and Charle's law?

- (A) $\frac{P_1 V_2}{T_1} = \frac{P_2 V_1}{T_2}$
 - (B) $n = \frac{RT}{PV}$
 - (C) $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$
 - (D) $p = \frac{RT}{nV}$
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9. Find the concentration of sodium acetate when added to 0.1 M solution of acetic acid to form a buffer solution of pH = 5.5 ? (pK_a of $CH_3COOH = 4.5$)

- (A) 0.1 M
 - (B) 0.01 M
 - (C) 1.0 M
 - (D) 10.0 M
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10. The solubility product of AgBr is 4.9×10^{-13} at a certain temperature. Calculate the solubility.

- (A) $4 \times 10^{-6} \text{ mol} \cdot \text{dm}^{-3}$
 - (B) $4 \times 10^{-7} \text{ mol} \cdot \text{dm}^{-3}$
 - (C) $7 \times 10^{-7} \text{ mol} \cdot \text{dm}^{-3}$
 - (D) $3 \times 10^{-8} \text{ mol} \cdot \text{dm}^{-3}$
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11. Let $f(x) = \int \frac{\sqrt{x}}{(1+x)^2} dx (x \geq 0)$. Then $f(3) - f(1)$ is equal to:

- (A) $-\frac{\pi}{12} + \frac{1}{2} + \frac{\sqrt{3}}{4}$
 - (B) $\frac{\pi}{12} + \frac{1}{2} - \frac{\sqrt{3}}{4}$
 - (C) $-\frac{\pi}{6} + \frac{1}{2} + \frac{\sqrt{3}}{4}$
 - (D) $\frac{\pi}{6} + \frac{1}{2} - \frac{\sqrt{3}}{4}$
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12. Gas is being pumped into a spherical balloon at the rate of $30 \text{ ft}^3/\text{min}$. Then the rate at which the radius increases when it reaches the value 15 ft is:

- (A) $\frac{1}{30\pi} \text{ ft/min}$
 - (B) $\frac{1}{15\pi} \text{ ft/min}$
 - (C) $\frac{1}{20} \text{ ft/min}$
 - (D) $\frac{1}{25} \text{ ft/min}$
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13. Let the function $f(x)$ defined as $f(x) = \frac{x-|x|}{x}$, then:

- (A) the function is continuous everywhere
 - (B) the function is not continuous
 - (C) the function is continuous when $x < 0$
 - (D) the function is continuous for all x except zero
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14. If the direction ratio of two lines are given by $l + m + n = 0$ and $mn - 2ln + lm = 0$, then the angle between the lines is:

- (A) $\frac{\pi}{4}$
 - (B) $\frac{\pi}{3}$
 - (C) $\frac{\pi}{2}$
 - (D) 0
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15. The value of c of Lagrange's mean value theorem for $f(x) = \sqrt{25 - x^2}$ on $[1, 5]$ is:

- (A) $\sqrt{15}$
 - (B) 5
 - (C) $\sqrt{10}$
 - (D) 1
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