



General Instructions

- (i) The test is of 1 hour duration.
- (ii) The question paper consists of 50 questions. The maximum marks are 250.
- (iii) 5 marks are awarded for every correct answer, and 1 mark is deducted for every wrong answer.

1. For a first-order reaction, if the time taken for 90% completion is t , what will be the approximate time taken for 99.9% completion of the same reaction?

- (A) $2t$
 - (B) $3t$
 - (C) $4t$
 - (D) $1.5t$
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2. According to collision theory, increasing the starting concentration of a collection of reacting molecules directly results in a change in which of the following system factors?

- (A) Activation energy
 - (B) Collision frequency
 - (C) Rate constant
 - (D) Fraction of molecules with energy greater than activation energy
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3. What is the cell potential (E_{cell}) for a concentration cell consisting of two hydrogen electrodes at 298 K, where the anode compartment is at $\text{pH} = 3$ and the cathode compartment is at $\text{pH} = 1$

under standard pressure conditions?

- (A) 0.0591 V
 - (B) 0.1182 V
 - (C) -0.1182 V
 - (D) 0.0000 V
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4. Which of the following expressions correctly relates the limiting molar conductivity (Λ_m°) of aluminum sulfate, $\text{Al}_2(\text{SO}_4)_3$, to its individual ionic components according to Kohlrausch's Law?

- (A) $\Lambda_m^\circ = \lambda^\circ(\text{Al}^{3+}) + \lambda^\circ(\text{SO}_4^{2-})$
 - (B) $\Lambda_m^\circ = 2\lambda^\circ(\text{Al}^{3+}) + 3\lambda^\circ(\text{SO}_4^{2-})$
 - (C) $\Lambda_m^\circ = 3\lambda^\circ(\text{Al}^{3+}) + 2\lambda^\circ(\text{SO}_4^{2-})$
 - (D) $\Lambda_m^\circ = \frac{1}{2}\lambda^\circ(\text{Al}^{3+}) + \frac{1}{3}\lambda^\circ(\text{SO}_4^{2-})$
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5. What is the correct increasing order of basic strength for the following amines when measured inside an aqueous medium?

(I) CH_3NH_2 , (II) $(\text{CH}_3)_2\text{NH}$, (III) $(\text{CH}_3)_3\text{N}$, (IV) NH_3

- (A) $\text{IV} < \text{III} < \text{I} < \text{II}$
 - (B) $\text{IV} < \text{I} < \text{II} < \text{III}$
 - (C) $\text{III} < \text{I} < \text{II} < \text{IV}$
 - (D) $\text{I} < \text{II} < \text{III} < \text{IV}$
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6. An organic compound with the molecular formula $\text{C}_7\text{H}_8\text{O}$ is completely insoluble in water but dissolves readily in an aqueous NaOH solution. When treated with bromine water, it forms a white precipitate. Identify the compound.

- (A) Benzyl alcohol
- (B) Anisole
- (C) *o*-Cresol
- (D) Methoxybenzene

7. Which of the following coordination complex ions exhibits structural asymmetry leading to optical isomerism?

- (A) $\text{trans} - [\text{Co}(\text{en})_2\text{Cl}_2]^+$
- (B) $\text{cis} - [\text{Co}(\text{en})_2\text{Cl}_2]^+$
- (C) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
- (D) $[\text{Cr}(\text{NH}_3)_5\text{Cl}]^{2+}$

8. Using Crystal Field Theory (CFT), what is the correct electronic configuration and magnetic behavior of the high-spin complex $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$?

- (A) $t_{2g}^4 e_g^2$, Paramagnetic
- (B) $t_{2g}^6 e_g^0$, Diamagnetic
- (C) $t_{2g}^3 e_g^3$, Paramagnetic
- (D) $t_{2g}^5 e_g^1$, Paramagnetic

9. Which of the following alkyl halides will undergo the fastest rate of nucleophilic substitution via an $\text{S}_{\text{N}}1$ mechanism when treated with an aqueous nucleophile?

- (A) CH_3Cl
- (B) $(\text{CH}_3)_3\text{CCl}$
- (C) $\text{CH}_3\text{CH}_2\text{Cl}$
- (D) $(\text{CH}_3)_2\text{CHCl}$

10. When phenol is treated with chloroform (CHCl_3) in the presence of an aqueous sodium hydroxide solution followed by acidification, a prominent aromatic aldehyde is generated. What is the name of this organic reaction?

- (A) Kolbe's Reaction
- (B) Reimer-Tiemann Reaction
- (C) Rosenmund Reduction

(D) Friedel-Crafts Acylation
