

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)



Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions

- (i) This question paper contains **33 questions**. All questions are compulsory.
- (ii) Section A: Questions 1 to 16 are multiple choice questions, carrying 1 mark each.
- (iii) Section B: Questions 17 to 21 are very short answer questions, carrying 2 marks each.
- (iv) Section C: Questions 22 to 28 are short answer questions, carrying 3 marks each.
- (v) Section D: Questions 29 to 30 are case-based questions, carrying 4 marks each.
- (vi) Section E: Questions 31 to 33 are long answer questions, carrying 5 marks each.
- (vii) Attempt one alternative where an internal choice is provided. Follow the instructions within each question.
- (viii) Use of calculators is not allowed.

Section A

1. Which of the following does not show variable oxidation states ?

- (A) Fe (B) Cu
(C) Mn (D) Sc

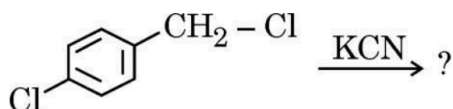
2. The type of isomerism shown by the complex $[\text{CoCl}_2(\text{en})_2]^+$ is :

- (A) Ionisation isomerism (B) Geometrical isomerism
(C) Linkage isomerism (D) Coordination isomerism

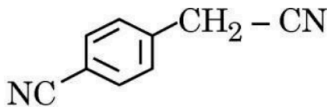
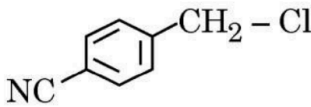
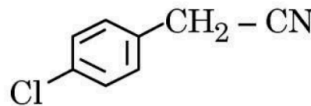
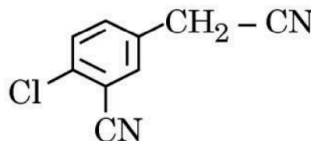
3. Which of the following is diamagnetic in nature ? [Atomic number : Co = 27]

- (A) Co^{3+} , octahedral complex with strong field ligand (B) Co^{3+} , octahedral complex with weak field ligand
(C) Co^{2+} , in a square planar complex (D) Co^{2+} , in a tetrahedral complex

4. Consider the following reaction:



The major product of the reaction is :

- (A) 
(B) 
(C) 
(D) 

- (A) Structure (A) (B) Structure (B)
(C) Structure (C) (D) Structure (D)

5. Which one of the following compounds has the lowest pK_a value ?

- (A) p-Cresol (B) p-Nitrophenol
(C) m-Nitrophenol (D) 2,4,6-Trinitrophenol

6. $(\text{CH}_3)_2\text{CH}-\text{O}-\text{CH}_3$ when treated with HI gives :

- (A) $(\text{CH}_3)_2\text{CH}-\text{I} + \text{CH}_3\text{OH}$ (B) $(\text{CH}_3)_2\text{CH}-\text{OH} + \text{CH}_3-\text{I}$
(C) $(\text{CH}_3)_2\text{CH}-\text{I} + \text{CH}_3-\text{I}$ (D) $(\text{CH}_3)_2\text{CH}-\text{OH} + \text{CH}_3\text{OH}$

7. Which of the following compounds on treatment with benzene sulphonyl chloride forms an alkali-soluble precipitate ?

- (A) CH_3CONH_2 (B) $(\text{CH}_3)_3\text{N}$
(C) $(\text{CH}_3)_2\text{NH}$ (D) $\text{CH}_3\text{CH}_2\text{NH}_2$

8. The order of increasing basicities of CH_3NH_2 (I), $(\text{CH}_3)_2\text{NH}$ (II), $(\text{CH}_3)_3\text{N}$ (III) and $\text{C}_6\text{H}_5\text{NH}_2$ (IV) in aqueous media is :

- (A) $\text{IV} < \text{III} < \text{I} < \text{II}$ (B) $\text{II} < \text{I} < \text{IV} < \text{III}$
(C) $\text{I} < \text{II} < \text{III} < \text{IV}$ (D) $\text{I} < \text{III} < \text{II} < \text{IV}$

9. The vitamin which plays an important role in coagulating blood is :

- (A) Vitamin A (B) Vitamin E
(C) Vitamin D (D) Vitamin K

10. When a catalyst increases the rate of a chemical reaction, then the rate constant (k) :

- (A) remains constant (B) decreases
(C) increases (D) may increase or decrease depending on the order of the reaction

11. A 1% solution of solute 'X' is isotonic with a 6% solution of sucrose (molar mass = 342 g mol⁻¹). The molar mass of solute 'X' is :

- (A) 34.2 g mol⁻¹ (B) 57 g mol⁻¹
(C) 114 g mol⁻¹ (D) 3.42 g mol⁻¹

12. During the electrolysis of aqueous NaCl, the cathodic reaction is :

- (A) Oxidation of Cl⁻ ion (B) Reduction of Na⁺ ion
(C) Oxidation of H₂O (D) Reduction of H₂O

13. **Assertion (A):** Addition of ethylene glycol to water lowers its freezing point.

Reason (R): Ethylene glycol is insoluble in water due to lack of its ability to form hydrogen bonds with water molecules.

- (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

14. **Assertion (A):** Order of reaction and molecularity are always same for complex reactions.

Reason (R): Order is determined experimentally and molecularity is applicable only for elementary reactions.

- (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

15. **Assertion (A):** The boiling point of ethanol is higher than that of dimethyl ether.

Reason (R): Ethanol molecules are associated through hydrogen bonding whereas in dimethyl ether, it is not possible.

- (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

16. **Assertion (A):** Aniline does not undergo Friedel-Crafts reaction.

Reason (R): Friedel-Crafts reaction is an electrophilic substitution reaction.

- (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Section B

17. (a) Define molal depression constant. How is it related to enthalpy of fusion ?

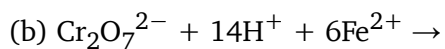
OR

(b) What type of deviation is shown by ethanol and acetone mixture ? Give reason. What type of azeotropic mixture is formed by that deviation ?

18. (a) In a reaction, if the concentration of reactant 'X' is tripled, the rate of reaction becomes twenty-seven times. What is the order of the reaction ?

(b) State a condition under which a bimolecular reaction is kinetically a first-order reaction. Give an example of such a reaction.

19. Complete the following ionic equations :



20. (a) Which halogen compound in the following pair will react faster in $\text{S}_{\text{N}}2$ reactions and why ? $\text{CH}_3\text{-CH}_2\text{-I}$ OR $\text{CH}_3\text{-CH}_2\text{-Br}$

(b) Why is chloroform stored in closed dark coloured bottles ?

21. Give reaction of glucose with the following :

(a) HCN

(b) Conc. HNO_3

Section C

22. A solution is prepared by dissolving 5 g of a non-volatile solute in 200 g of water. It has a vapour pressure of 31.84 mm Hg at 300 K. Calculate the molar mass of the solute. (Vapour pressure of pure water at 300 K = 32 mm Hg)

23. The conductivity of 0.2 M solution of KCl is $2.48 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation (α).

Given : $\lambda_{K^+}^0 = 73.5 \text{ S cm}^2 \text{ mol}^{-1}$, $\lambda_{Cl^-}^0 = 76.5 \text{ S cm}^2 \text{ mol}^{-1}$

24. A first-order reaction is 25% complete in 40 minutes. Calculate the value of rate constant. In what time will the reaction be 80% complete ?

[Given : $\log 2 = 0.30$, $\log 3 = 0.48$, $\log 4 = 0.60$, $\log 5 = 0.69$]

25. (a) What type of nucleophilic substitution (S_N1 or S_N2) occurs in the hydrolysis of 2-Bromobutane to form ($\pm$)-Butan-2-ol ? Give reason.

(b) What happens when chlorobenzene and methyl chloride are treated with sodium metal in dry ether ?

26. (a) Write the equations of the reactions involved in the following :

(i) Reimer-Tiemann reaction

(ii) Kolbe's reaction

(b) Name the reagent used in the bromination of phenol to form 2,4,6-Tribromophenol.

27. How will you bring about the following conversions ? (any three)

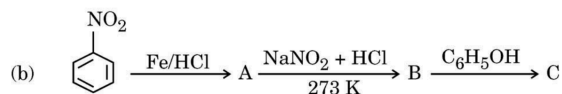
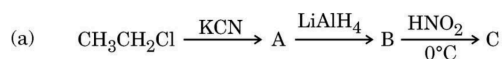
(a) Benzoic acid to Benzaldehyde

(b) Ethanal to Propanone

(c) Acetophenone to Benzoic acid

(d) Bromobenzene to 1-Phenylethanol

28. Give the structures of A, B and C in the following reactions:



29. The involvement of $(n - 1)d$ electrons in the behaviour of transition elements impart certain distinct characteristics to these elements. Thus, in addition to variable oxidation states, they exhibit paramagnetic behaviour, catalytic properties and tendency for the formation of coloured ions. The transition metals react with a number of non-metals like oxygen, nitrogen and halogens. KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ are common examples.

The two series of inner transition elements, lanthanoids and actinoids, constitute the f-block of the periodic table. In the lanthanoids, there is regular decrease in atomic size with increase in atomic number due to the imperfect shielding effect of 4f-orbital electrons which causes contraction.

29.a. Why do transition metals and their compounds act as good catalysts ?

29.b. What is the cause of contraction in the atomic size of lanthanoids ?

29.c. Define lanthanoid contraction. How does it affect the atomic radii of the third transition series and the second transition series ?

29.c.OR. OR

In aqueous media, which is a stronger reducing agent — Cr^{2+} or Fe^{2+} and why ?

30. Proteins are the most abundant biomolecules of the living system. Proteins are the polymers of about twenty different α -amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. In zwitter ionic form, amino acids show amphoteric behaviour as they react both with acids and bases.

On the basis of their molecular shape, proteins are classified into two types: Fibrous and Globular proteins. Structure and shape of proteins can be studied at four different levels i.e., primary, secondary, tertiary and quaternary, each level being more complex than the previous one. The secondary or tertiary structure of proteins get disturbed on change of pH or temperature and they are not able to perform their functions. This is called denaturation of proteins.

30.a. What are essential amino acids ?

30.b. What is meant by zwitter ionic form of amino acids ?

30.c. (i) Give one example each for Fibrous protein and Globular protein.

(ii) What type of linkages hold monomers of proteins together ?

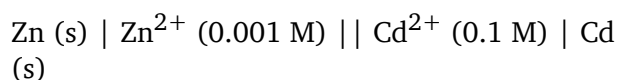
30.c.OR. OR

(i) What is the structural feature which characterises a reducing sugar ?

(ii) What is the structural difference between nucleoside and nucleotide ?

Section E

31. (a) (i) Calculate emf of the following cell at 25°C :

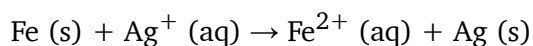


Given : $E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0.76 \text{ V}$, $E_{\text{Cd}^{2+}/\text{Cd}}^{\circ} = -0.40 \text{ V}$
[log 10 = 1]

(ii) State Faraday's second law of electrolysis. How will the pH of aqueous NaCl solution be affected when it is electrolysed ?

OR

(b) (i) Calculate the $\Delta_r G^{\circ}$ and log K_c for the following cell reaction :

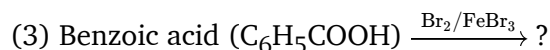
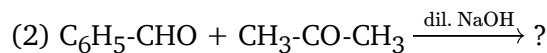
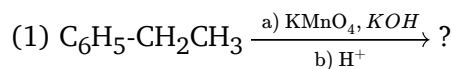


Given : $E_{\text{Fe}^{2+}/\text{Fe}}^{\circ} = -0.44 \text{ V}$, $E_{\text{Ag}^{+}/\text{Ag}}^{\circ} = +0.80 \text{ V}$, 1
F = 96500 C mol⁻¹

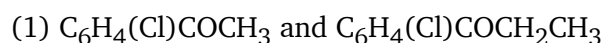
(ii) Write any two advantages of the fuel cells over primary and secondary batteries ?

(iii) How many Faradays are required for the oxidation of 1 mole of H₂O to O₂ ?

32. (a) (i) Write the major product(s) in the following reactions :



(ii) Give simple chemical tests to distinguish between the following pairs of compounds :



OR

(b) (i) Give reasons for the following :

(1) In semicarbazide, only one -NH₂ group is involved in the formation of semicarbazone.

(2) Acetaldehyde is more reactive than acetone towards addition of HCN.

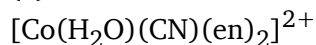
(ii) (1) Arrange the following in decreasing order of their acidic strength : CH₃COOH, O₂N-CH₂-COOH, HCOOH

(2) Name the reagent in the following reaction :
 $\text{CH}_3\text{-CH=CH-CH}_2\text{-CN} \rightarrow \text{CH}_3\text{-CH=CH-CH}_2\text{-CHO}$

(iii) Write the reaction involved in Hell-Volhard-Zelinsky reaction.

33. Attempt any five of the following :

(a) Write the IUPAC name of the complex :



(b) Why is geometrical isomerism not possible in tetrahedral complexes having two different types of unidentate ligands coordinated with the central metal ion ?

(c) Arrange the following complex ions in increasing order of their crystal field splitting energy (Δ_o) :



(d) Write the hybridization and magnetic character of the complex $[\text{Ni}(\text{CO})_4]$ on the basis of valence bond theory. [Atomic No. : Ni = 28]

(e) Out of $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$, which one complex is : (i) more stable ? (ii) the high spin complex ?

(f) What is the difference between an ambidentate ligand and bidentate ligand ?

(g) Write the electronic configuration of d^4 in terms of t_{2g} and e_g in an octahedral field when :

(i) $\Delta_o > P$ and (ii) $\Delta_o < P$

- End of Question Paper -