

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 **35 questions**. All questions are compulsory.
- (ii) Section A: Questions 1 to 18 are multiple choice questions, carrying 1 mark each.
- (iii) Section B: Questions 19 to 25 are very short answer questions, carrying 2 marks each.
- (iv) Section C: Questions 26 to 30 are short answer questions, carrying 3 marks each.
- (v) Section D: Questions 31 to 32 are case-based questions, carrying 4 marks each.
- (vi) Section E: Questions 33 to 35 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

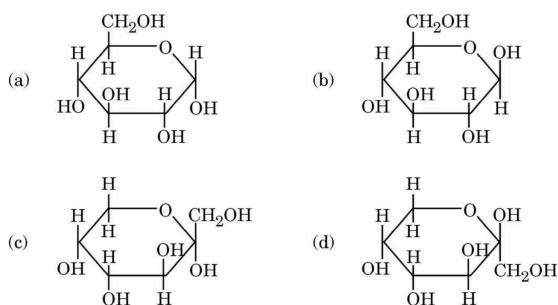
1. A compound undergoes complete tetramerization in a given organic solvent. The Van't Hoff factor 'i' is:

- (A) 4.0 (B) 0.25
(C) 0.125 (D) 2.0

2. The half-life for a zero order reaction equals (where R is the initial concentration):

- (A) $\frac{2k}{R}$ (B) $\frac{1k}{2R^2}$
(C) $\frac{R^2}{2k}$ (D) $\frac{R}{2k}$

3. Which of the following structures represents α -D-glucose?



- (A) Structure (a) (B) Structure (b)
(C) Structure (c) (D) Structure (d)

4. The ions of metals of Group 12 (Zn, Cd and Hg) have completely filled d orbitals and so they:

- (A) behave like semiconductors (B) are very high melting solids
(C) do not behave like transition metals (D) behave like superconductors

5. $[\text{Co}(\text{NH}_3)_5\text{NO}_3]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{NO}_3$ exhibit:

- (A) linkage isomerism (B) ionization isomerism
(C) optical isomerism (D) coordination isomerism

6. Reaction of 1-phenyl-2-chloropropane with alcoholic KOH gives mainly:

- (A) 1-phenylpropene (B) 3-phenylpropene
(C) 1-phenylpropan-3-ol (D) 1-phenylpropan-2-ol

7. When diethyl ether is heated with excess of HI, it produces:

- (A) ethanol (B) iodoform
(C) methyl iodide (D) ethyl iodide

8. The reduction of ethanenitrile with sodium and alcohol gives:

- (A) 1-aminopropane (B) 1-aminoethane
(C) Ethanoic acid (D) Ethanamide

9. How many Faradays are required to reduce 1 mol of MnO_4^- to Mn^{2+} ?

- (A) 4 (B) 3
(C) 6 (D) 5

10. In a reaction, the initial concentration of the reactants increases four fold and the rate becomes sixteen times its initial value. The order of the reaction is:

- (A) 2.0 (B) 3.5
(C) 1.5 (D) 2.5

11. On hydrolysis, which of the following carbohydrates gives only glucose?

- (A) Maltose (B) Sucrose
(C) Lactose (D) Galactose

12. Deficiency of which of the following vitamins causes Pernicious anaemia?

- (A) Vitamin B₁ (B) Vitamin B₂
(C) Vitamin B₆ (D) Vitamin B₁₂

13. $\text{C}_6\text{H}_5\text{CHO} + \text{CH}_3\text{COCH}_3 \xrightarrow{\text{dil. NaOH}} \text{C}_6\text{H}_5\text{CH} = \text{CH} - \text{COCH}_3$

This reaction is known as:

- (A) Aldol condensation (B) Cross-Aldol condensation
(C) Cannizzaro's reaction (D) Friedel-Crafts reaction

14. In which of the following does the central atom exhibit an oxidation state of +3?

- (A) $\text{K}_2[\text{Ni}(\text{CN})_4]$ (B) $\text{K}_4[\text{Fe}(\text{CN})_6]$
(C) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ (D) $[\text{Cu}(\text{NH}_3)_4]^{2+}$

15. **Assertion (A):** When NaCl is added to water, a depression in freezing point is observed.

Reason (R): The lowering of vapour pressure of a solution causes depression in the freezing point.

- (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):** Λ_m for weak electrolytes shows a sharp decrease when the electrolytic solution is diluted.

Reason (R): For weak electrolytes, degree of dissociation increases with dilution of solution.

- (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.

17. **Assertion (A):** Zr and Hf have almost identical radii.

Reason (R): Both Zr and Hf exhibit similar properties.

- (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.

18. **Assertion (A):** Monobromination of aniline can be conveniently done by protecting the amino group by acetylation.

Reason (R): Acetylation decreases the activating effect of the amino group.

- (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

19. An alkyl halide (A) of molecular formula $C_6H_{13}Cl$ on treatment with alcoholic KOH gives two isomeric alkenes (B) and (C) of molecular formula C_6H_{12} . Both alkenes on hydrogenation give 2,3-dimethylbutane. Write the structures of (A), (B) and (C).

20. (a) What type of deviation from Raoult's law is shown by a mixture of ethanol and acetone? Give reason.

OR

(b) Define Azeotrope. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.

21. Name the cell which:

- (a) was used in Apollo Space programme.
- (b) is used in automobiles and inverters.
- (c) is suitable for hearing aids and watches.
- (d) does not give a steady potential and is used in transistors.

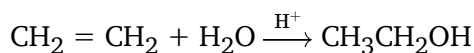
22. The rate constant for the first order decomposition of N_2O_5 is given by the following equation:

$$\log k = 23.6 - \frac{2 \times 10^4 \text{ K}}{T}$$

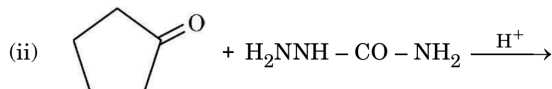
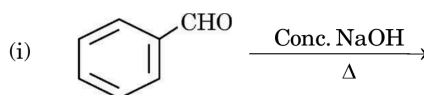
Calculate E_a for this reaction.

$$[R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}]$$

23. Write the mechanism of the following reaction:



24. (a) Write the products of the following reactions:

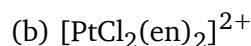
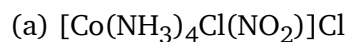


OR

(b) Do the following conversions in not more than two steps:

- (i) Toluene to Benzoic acid
- (ii) Benzaldehyde to 1-Phenylethanol

25. Write IUPAC names of the following coordination entities:



Section C

26. (a) (i) Write hydroboration-oxidation reaction with an example.
(ii) Write the products of the following reaction:
Anisole ($\text{C}_6\text{H}_5\text{OCH}_3$) + $\text{HBr} \rightarrow$
(iii) Why is p-nitrophenol more acidic than phenol?

OR

- (b) (i) What happens when phenol reacts with
(1) Conc. HNO_3 , and
(2) CHCl_3 in presence of aqueous NaOH followed by acidification?

Write equations only.

- (ii) Why does the reaction of CH_3ONa with $(\text{CH}_3)_3\text{C-Br}$ give 2-methylpropene and not $(\text{CH}_3)_3\text{C-OCH}_3$?

27. Account for the following:

- (a) Benzyl chloride is highly reactive towards $\text{S}_{\text{N}}1$ reaction.
(b) $(\pm)$ -Butan-2-ol is optically inactive, though it contains a chiral carbon atom.
(c) Chloroform is stored in closed dark coloured bottles.

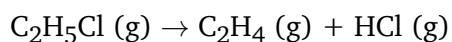
28. Answer any three of the following questions:

- (a) Explain the type of hybridization in $[\text{Fe}(\text{CN})_6]^{3-}$ on the basis of valence bond theory.
(Given: Atomic number of $\text{Fe} = 26$)
(b) Draw the geometrical isomers of $[\text{PtCl}_2(\text{en})_2]^{2+}$ ion.
(c) $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. Why?
(d) Name the type of isomerism when ambidentate ligands are attached to central metal ion. Give one example of ambidentate ligand.

29. If benzoic acid ($M = 122 \text{ g mol}^{-1}$) is associated into a dimer when dissolved in benzene and the osmotic pressure of a solution of 6.1 g of benzoic acid in 100 mL benzene is 6.5 atm at 27°C , then what is the percentage association of benzoic acid?

(Given: $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

30. The following data were obtained during the first order thermal decomposition of $\text{C}_2\text{H}_5\text{Cl}$ at a constant volume:



Experiment 1: Time = 0 s, Total pressure = 0.4 atm

Experiment 2: Time = 100 s, Total pressure = 0.6 atm

Calculate the rate constant.

(Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)

31. Living systems are made up of various complex biomolecules like carbohydrates, proteins, nucleic acids, lipids, etc. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis. They are broadly classified into three groups - monosaccharides, oligosaccharides and polysaccharides. Monosaccharides are held together by glycosidic linkages to form disaccharides like sucrose, maltose or polysaccharides like starch and cellulose.

Another biomolecule: proteins are polymers of α -amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids. 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.

Answer the following questions:

- (i) What is the difference between a glycosidic linkage and peptide linkage?
- (ii) Which amino acids are called essential amino acids?
- (iii) What are the common types of secondary structures of proteins? Write any two forces which stabilise the secondary and tertiary structures of protein.

OR

- (iii) Define denaturation of protein with an example. During denaturation which structures of protein lose their biological activity?

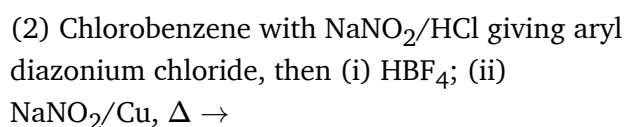
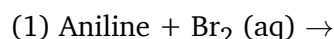
32. Amines are usually formed from nitro compounds, halides, amides, imides, etc. They exhibit hydrogen bonding which influences their physical properties. In alkyl amines, a combination of electron releasing, steric and hydrogen bonding factors influence the stability of the substituted ammonium cations in protic polar solvents and thus affect the basic nature of amines. In aromatic amines, electron releasing and withdrawing groups, respectively increase and decrease their basic character. Influence of the number of hydrogen atoms at nitrogen atom on the type of reactions and nature of products is responsible for identification and distinction between primary, secondary and tertiary amines. Presence of amino group in aromatic ring enhances reactivity of the aromatic amines. Aryl diazonium salts provide advantageous methods for producing aryl halides, cyanides, phenols and arenes by reductive removal of the diazo group.

Answer the following questions:

- (i) Arrange the following in the increasing order of their pK_b values in aqueous solution:
 $C_6H_5NH_2$, $(C_6H_5)_2NH$, $(C_6H_5)_3N$
- (ii) Aniline on nitration gives a substantial amount of m-nitroaniline, though amino group is o/p directing. Why?
- (iii) An aromatic compound 'A' of molecular formula $C_7H_6O_2$ on treatment with aqueous ammonia and heating forms compound 'B'. Compound 'B' on heating with Br_2 and aqueous KOH gives a compound 'C' of molecular formula C_6H_7N . Write the structures of A, B and C.

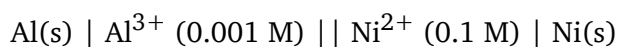
OR

- (iii) Complete the following reactions giving main products:



Section E

33. (a) (i) Calculate the emf of the following cell at 298 K:



[Given: $E_{\text{Al}^{3+}/\text{Al}}^{\circ} = -1.66 \text{ V}$, $E_{\text{Ni}^{2+}/\text{Ni}}^{\circ} = -0.25 \text{ V}$, $\log 10 = 1$]

(ii) With the help of a graph explain why it is not possible to determine Λ_m° for a weak electrolyte by extrapolating the molar conductivity (Λ_m) versus $C^{1/2}$ curve as for strong electrolyte.

OR

(b) (i) The molar conductivities of NH_4^+ and Cl^- ion are $73.8 \text{ S cm}^2 \text{ mol}^{-1}$ and $76.2 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. The conductivity of $0.1 \text{ M NH}_4\text{Cl}$ is $1.29 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.

(ii) Calculate the half-cell potential at 298 K for the reaction $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$ if $[\text{Zn}^{2+}] = 0.1 \text{ M}$ and $E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = -0.76 \text{ V}$.

34. (a) (i) Account for the following:

(1) Zn^{2+} salts are colourless while Ni^{2+} salts are coloured.

(2) Cr^{2+} is a strong reducing agent.

(3) Transition metals and their compounds show catalytic activities.

(ii) Write the ionic equations for the oxidizing action of MnO_4^- in acidic medium with

(1) I^- ion, and

(2) Fe^{2+} ion.

OR

(b) (i) Name two oxometal anions of the 3d series of the transition metals in which the metal exhibits the oxidation state equal to its group number.

(ii) What is the effect of increasing pH on a solution of $\text{K}_2\text{Cr}_2\text{O}_7$?

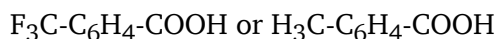
(iii) Why is Cu^+ not stable in aqueous solution?

(iv) Name a member of Lanthanoid series which is well-known to exhibit +4 oxidation state.

(v) Name two elements of 3d series which show anomalous electronic configuration.

35. (a) Draw structure of the 2,4-dinitrophenylhydrazone of benzaldehyde.

(b) Which acid of the following pair is a stronger acid?



(c) Write the chemical equation involved in Rosenmund's reduction.

(d) Why are α -hydrogen atoms of aldehydes and ketones acidic in nature?

(e) Write a chemical test to distinguish between Benzaldehyde and Benzoic acid.

- End of Question Paper -