

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. Williamson synthesis of preparing unsymmetrical ether is :

- | | |
|-------------------------------------|--------------------------|
| (A) S_N1 reaction | (B) S_N2 reaction |
| (C) Electrophilic addition reaction | (D) Elimination reaction |

2. Which of the following compounds would be hydrolysed by aqueous KOH most easily ?

- | | |
|----------------------|-----------------------|
| (A) $CH_2=CH-Br$ | (B) CH_3-CH_2-Br |
| (C) $CH_3-CHBr-CH_3$ | (D) $CH_2=CH-CH_2-Br$ |

3. According to Werner's theory of coordination compounds :

- | | |
|--|--|
| (A) Primary valences are ionisable. | (B) Secondary valences are ionisable. |
| (C) Both primary and secondary valences are non-ionisable. | (D) Both primary and secondary valences are ionisable. |

4. Which of the following complex ion is not optically active ?

- | | |
|------------------------------|----------------------------|
| (A) $[Co(ox)_3]^{3-}$ | (B) $cis-[Co(en)_2Cl_2]^+$ |
| (C) $trans-[Co(en)_2Cl_2]^+$ | (D) $[Co(en)_3]^{3+}$ |

5. Which of the following is the softest metal ?

- | | |
|--------|--------|
| (A) Zn | (B) Sc |
| (C) Cu | (D) Fe |

6. In the Hinsberg's method for separation of primary, secondary and tertiary amines, the reagent used is :

- | | |
|---|-------------------------|
| (A) Nitrous acid | (B) $CHCl_3 + aq. NaOH$ |
| (C) $C_6H_5SO_2Cl$
(benzenesulphonyl chloride) | (D) $HCl/ZnCl_2$ |

7. Which one of the following amines gives an alcohol on reaction with HNO_2 ?

- | | |
|----------------------------|-------------------|
| (A) $C_6H_5NH_2$ (aniline) | (B) $C_2H_5NH_2$ |
| (C) $(C_2H_5)_2NH$ | (D) $(C_2H_5)_3N$ |

8. The freezing point of one molal KCl solution, assuming KCl to be completely dissociated in water, is :

(K_f for water = $1.86 \text{ K kg mol}^{-1}$)

- | | |
|---------------------------|---------------------------|
| (A) -3.72°C | (B) $+3.72^\circ\text{C}$ |
| (C) -1.86°C | (D) $+2.72^\circ\text{C}$ |

9. A solution of acetone in ethanol :

- | | |
|---|---|
| (A) obeys Raoult's law. | (B) forms an ideal solution. |
| (C) shows a positive deviation from Raoult's law. | (D) shows a negative deviation from Raoult's law. |

10. Which of the following cell converts the energy of combustion of fuel into electrical energy ?

- | | |
|------------------|-----------------------|
| (A) Mercury cell | (B) Fuel cell |
| (C) Dry cell | (D) Lead storage cell |

11. The unit of rate and rate constant are same for a :

- (A) First order reaction (B) Second order reaction
(C) Zero order reaction (D) Third order reaction

12. Pyranose ring of glucose is formed due to the reaction between :

- (A) C_1 and C_3 (B) C_1 and C_6
(C) C_1 and C_4 (D) C_1 and C_5

13. **Assertion (A)** : Actinoids show wide range of oxidation states.

Reason (R) : Actinoids are radioactive in nature.

- (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)** : Hydrolysis of an ester follows first order kinetics.

Reason (R) : The concentration of water does not get altered much during the 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.

15. **Assertion (A)** : Boiling point of $(CH_3)_3N$ is higher than that of $CH_3CH_2CH_2NH_2$.

Reason (R) : Hydrogen bonding is more extensive in $CH_3CH_2CH_2NH_2$.

- (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)** : Phenol is strongly acidic as compared to ethanol.

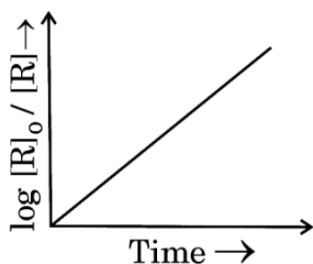
Reason (R) : Phenoxide ion is more stable than ethoxide ion.

- (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. State Henry's law. Why are aquatic species more comfortable in cold water as compared to warm water ?

18. Observe the graph in the given figure and answer the following questions :



- (a) Predict the order of reaction.
- (b) What is the slope of the curve ?

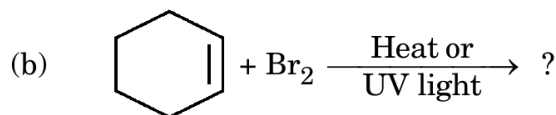
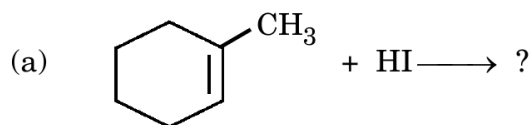
19. (a) Write IUPAC names of the following coordination compounds :

- (i) $[\text{CoCl}_2(\text{en})_2]\text{SO}_4$
- (ii) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$

OR

- (b) Differentiate between :
 - (i) Double salt and Complex compound
 - (ii) Didentate ligand and Ambidentate ligand

20. Draw the structures of major monohalo products in each of the following reactions :



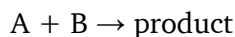
21. How do you explain the following ?

- (a) Presence of an aldehydic group in glucose.
- (b) Presence of five -OH groups in glucose.

Section C

22. Vapour pressure of pure water at 298 K is 24.8 mm Hg. Calculate the lowering in vapour pressure of an aqueous solution which freezes at -0.3°C . (K_f of water = $1.86 \text{ K kg mol}^{-1}$)

23. The rate of a reaction :



is given below as a function of different initial concentrations of A and B.

Experiment	[A] / mol L ⁻¹	[B] / mol L ⁻¹	Initial Rate / mol L ⁻¹ min ⁻¹
1	0.01	0.01	5×10^{-3}
2	0.02	0.01	1×10^{-2}
3	0.01	0.02	5×10^{-3}

Calculate the order of the reaction with respect to A and B. Determine the rate constant of the reaction.

24. Give reasons for the following :

- The pH of aqueous NaCl increases when it is electrolysed.
- Unlike dry cell, mercury cell has a constant cell potential through its lifetime.
- Conductivity of solution decreases with dilution.

25. (a) Answer the following about the complexes $[\text{FeF}_6]^{3-}$ and $[\text{Fe}(\text{CN})_6]^{4-}$:

- Write the hybridization involved in each case.
- Which of them is the outer orbital complex and which one is the inner orbital complex ?
- Compare their magnetic behaviour.

[Atomic number : Fe = 26]

OR

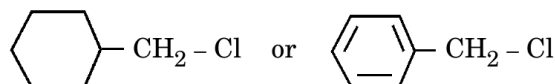
(b) (i) What happens to the colour of complex $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ when heated gradually ?

(ii) Write the electronic configuration for d^2 ion if $\Delta_o < P$

(iii) Write the hybridization and magnetic behaviour of the complex $[\text{Ni}(\text{CO})_4]$.

[Atomic number : Ni = 28]

26. Write any two differences between S_N1 and S_N2 reactions. Which of the following compounds would undergo S_N1 reaction faster and why ?



27. A compound (A) with molecular formula $\text{C}_4\text{H}_5\text{N}$ on reduction with DIBAL-H followed by hydrolysis, gives a compound (B). Compound (B) gives positive Tollens' test but does not give iodoform test. Compound (B) can also be obtained when ethanal is treated with dilute NaOH followed by heating. Identify (A) and (B). Write the reactions of (A) with DIBAL-H followed by hydrolysis.

28. How will you obtain the following from aniline ? Give chemical equations only.

- Sulphanilic acid
- Phenylisocyanide
- Acetanilide

29. Case-based: Alcohols undergo a number of reactions involving the cleavage of C - OH bond. However, phenols do not undergo reactions involving the cleavage of C - OH bond. Alcohols are weaker acids than water. Alcohols react with halogen acids to form the corresponding haloalkanes. Phenols are stronger acids than alcohols. A characteristic feature of phenols is that they undergo electrophilic substitution reactions such as halogenation, nitration, etc. Since -OH group is a strong activating group, phenol gives trisubstituted products during halogenation, nitration, etc.

(a) What happens when phenol is treated with the following ? [2]

(i) Br₂ water (ii) Conc. HNO₃

(b) (i) Write the mechanism of alcohol reacting as nucleophile in a reaction with CH₃⁺. [1]

OR

(b) (ii) Why do phenols not undergo reactions involving cleavage of C - OH bond ? [1]

(c) How can you distinguish between Butan-1-ol and 2-Methylpropan-2-ol by using HCl in the presence of anhydrous ZnCl₂ ? [1]

30. Case-based: The α-amino acids are the building blocks of proteins. All α-amino acids exist as zwitter ion due to which they show amphoteric behaviour. All amino acids are joined through peptide bond. Proteins are broadly classified as globular proteins and fibrous proteins. Globular proteins are water soluble, whereas fibrous proteins are not. The complete structure of protein is discussed at four different levels i.e. primary, secondary, tertiary and quaternary structures. Protein loses its biological activity in denatured form.

(a) Define the following : [2]

(i) Peptide linkage (ii) Denatured protein

(b) Why do amino acids show amphoteric behaviour ? [1]

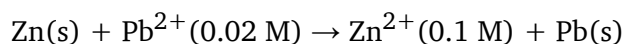
(c) (i) How can you differentiate between Fibrous protein and Globular protein ? [1]

OR

(c) (ii) Write the names of two different secondary structures of proteins. [1]

Section E

31. (a) (i) Calculate E_{cell} of a galvanic cell in which the following reaction takes place at 25°C :



[Given : $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$, $E^\circ_{\text{Pb}^{2+}/\text{Pb}} = -0.13 \text{ V}$; $\log 2 = 0.3010$, $\log 4 = 0.6021$, $\log 5 = 0.6990$]

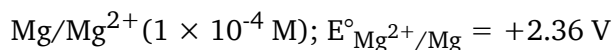
(ii) State Faraday's first law of electrolysis. How much electricity, in terms of Faraday, is required to reduce one mol of MnO_4^- to Mn^{2+} ion ?

[3+2=5]

OR

(b) (i) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1000 ohm . What is the cell constant if conductivity of 0.001 M KCl solution at 298 K is $0.125 \times 10^{-2} \text{ S cm}^{-1}$?

(ii) Calculate the $E_{\text{Mg}^{2+}/\text{Mg}}$ potential for the following half cell at 25°C :



[Given : $\log 10 = 1$]

(iii) What is the effect of temperature on the electrical conductance of metallic conductor ?

[2+2+1=5]

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

(I) Orange colour of $\text{Cr}_2\text{O}_7^{2-}$ ion changes to yellow when treated with an alkali.

(II) Zn , Cd and Hg are non-transition elements.

(III) E° value for $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is highly positive ($+1.57 \text{ V}$) as compared to $\text{Cr}^{3+}/\text{Cr}^{2+}$.

(ii) What happens when :

(I) Manganate ion undergoes disproportionation reaction in acidic medium ?

(II) KMnO_4 is heated ? [3+2=5]

OR

(b) Answer the following questions : [5×1=5]

(i) What is 'Misch metal' ? Give its one use.

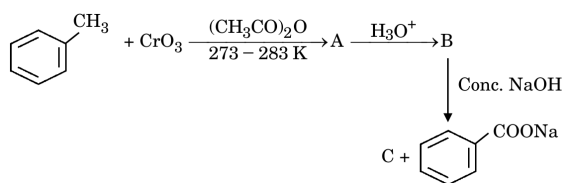
(ii) Write the formula of an oxoanion of chromium in which it shows the oxidation state equal to its group number.

(iii) Why does Vanadium pentoxide (V_2O_5) act as a catalyst ?

(iv) Why do transition elements have high enthalpies of atomisation ?

(v) How do you prepare $\text{Na}_2\text{Cr}_2\text{O}_7$ from Na_2CrO_4 ?

33. (a) (i) Identify A, B and C in the following reactions :



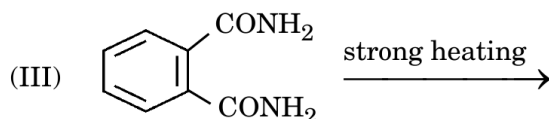
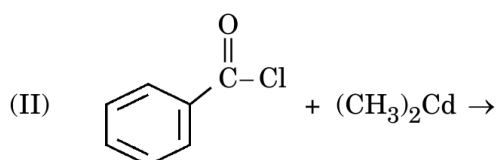
(ii) Give reasons for the following :

(I) Carboxylic acids do not give the characteristic reactions of carbonyl group.

(II) Ethanoic acid is a stronger acid than ethanol.
[3+2=5]

OR

(b) (i) Write the product(s) in the following reactions :



(ii) Write the reaction involved in the following reactions :

(I) Wolff-Kishner Reduction

(II) Decarboxylation Reaction [3+2=5]

- End of Question Paper -