

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. During dehydration of alcohol to alkene by heating with conc. H_2SO_4 , the initiation step is :

- | | |
|----------------------------|------------------------------|
| (A) Formation of an ester | (B) Formation of carbocation |
| (C) Protonation of alcohol | (D) Elimination of water |

2. Which reagents are required for one step conversion of Chlorobenzene to Diphenyl ?

- | | |
|----------------------------------|--|
| (A) Chlorobenzene, Na, Dry ether | (B) Benzene, Anhydrous AlCl_3 |
| (C) Chlorobenzene/Fe, Dark | (D) $\text{NaNO}_2 + \text{HCl}$ |

3. Which of the following complexes show linkage isomerism ?

- (A) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$
 (B) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$
 (C) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
 (D) $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$

4. Which of the following transition metals has the highest melting point ?

- | | |
|--------|--------|
| (A) Sc | (B) Cr |
| (C) Mn | (D) Zn |

5. 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) $+2.72^\circ\text{C}$ |

6. The reagent that can be used to convert benzenediazonium chloride to benzonitrile is :

- | | |
|---------------------|----------------------------|
| (A) Cu/HCl | (B) CH_3CN |
| (C) CuCN | (D) AgCN |

7. The strongest base in aqueous solution among the following amines is :

- | | |
|---|--|
| (A) $(\text{C}_2\text{H}_5)_2\text{NH}$ | (B) $(\text{C}_2\text{H}_5)_3\text{N}$ |
| (C) $\text{C}_2\text{H}_5\text{NH}_2$ | (D) $\text{C}_6\text{H}_5\text{NH}_2$ |

8. On mixing 30 mL of acetone with 20 mL of chloroform, the total volume of solution is :

- | | |
|------------------------|---------------------|
| (A) equal to 10 mL | (B) less than 50 mL |
| (C) greater than 50 mL | (D) equal to 50 mL |

9. We cannot measure the resistance of an ionic solution using DC because :

- | | |
|---|---|
| (A) it changes the composition of the solution. | (B) it can cause sparks and shocks. |
| (C) it does not affect the composition of the solution. | (D) it converts electrolytic cell to galvanic cell. |

10. The primary and secondary valences of Co in $[\text{Co}(\text{en})_3]\text{Cl}_3$ respectively are :

- | | |
|----------|----------|
| (A) 3, 3 | (B) 0, 3 |
| (C) 6, 3 | (D) 3, 6 |

11. In the Arrhenius equation $k = Ae^{-E_a/RT}$, 'A' represents :

- | | |
|----------------------------|----------------------|
| (A) effective collisions | (B) frequency factor |
| (C) fraction of collisions | (D) threshold energy |

12. α -D-glucose and β -D-glucose differ from each other with respect to the :

- | | |
|---------------------------------|---------------------------------------|
| (A) size of the hemiacetal ring | (B) configuration at the C_6 carbon |
| (C) number of -OH groups | (D) configuration at the C_1 carbon |

13. **Assertion (A)** : Actinoid contraction is greater from element to element than lanthanoid contraction.

Reason (R) : Actinoids show wide range of oxidation states.

- | | |
|--|---|
| (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)** : Molecularity of reaction is determined experimentally.

Reason (R) : Molecularity is applicable only for an elementary reaction and not for a complex 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 $(C_2H_5)_2NH$ is lower than that of $n-C_4H_9NH_2$.

Reason (R) : Hydrogen bonding is much more extensive in $(C_2H_5)_2NH$ as compared to $n-C_4H_9NH_2$.

- | | |
|--|---|
| (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)** : The bond angle C - O - C in ethers is slightly greater than tetrahedral angle.

Reason (R) : This is because of the repulsive interaction between the two bulky alkyl groups.

- | | |
|--|---|
| (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. |

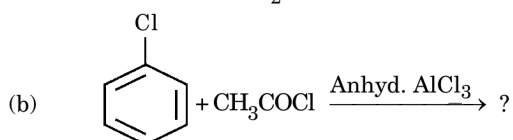
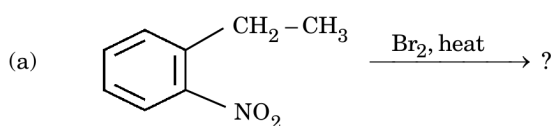
Section B

17. Define osmotic pressure. Why is measurement of osmotic pressure method preferred for the determination of molar masses of macromolecules such as proteins and polymers ?

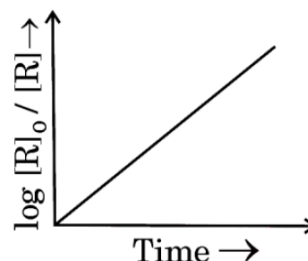
18. How do you explain the following ?

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

19. Draw the structures of product(s) in each of the following reactions :



20. 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 ?

21. (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

Section C

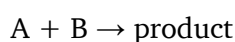
22. How can you obtain the following ?

- (a) Aniline from ammonium benzoate
- (b) Benzene diazonium chloride from nitrobenzene
- (c) 2,4,6-tribromoaniline from aniline

23. Give reasons for the following :

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

24. The rate of a reaction :

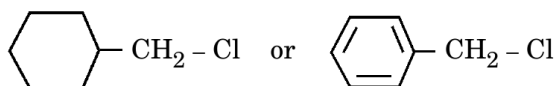


is given below as a function of different initial concentrations of A and B.

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.

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



26. A compound (A) with molecular formula C₄H₅N 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.

27. (a) Answer the following about the complexes [FeF₆]³⁻ and [Fe(CN)₆]⁴⁻ :

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

[Atomic number : Fe = 26]

OR

(b) (i) What happens to the colour of complex [Ti(H₂O)₆]³⁺ when heated gradually ?

(ii) Write the electronic configuration for d⁵ ion if Δ_o < P

(iii) Write the hybridization and magnetic behaviour of the complex [Ni(CO)₄].

[Atomic number : Ni = 28]

28. 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 K kg mol⁻¹)

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) 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 V) as compared to $\text{Cr}^{3+}/\text{Cr}^{2+}$.

(ii) What happens when :

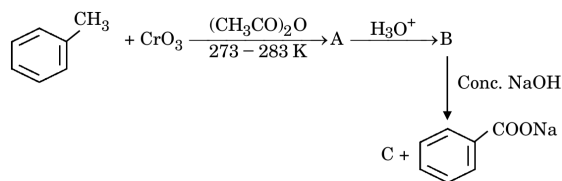
- (I) Manganate ion undergoes disproportionation reaction in acidic medium ?
- (II) KMnO_4 is heated ? [3+2=5]

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 ?

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

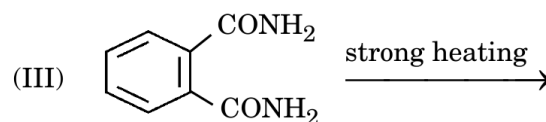
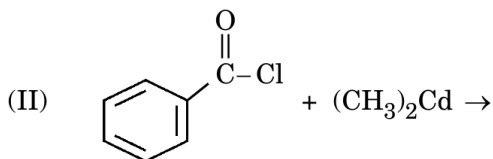


(ii) Give reasons for the following :

- (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

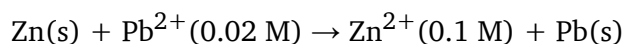
(b) (i) Write the product(s) in the following reactions :



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

- (I) Wolff-Kishner Reduction
- (II) Decarboxylation Reaction [3+2=5]

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



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

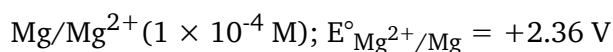
(ii) State Faraday's first law of electrolysis. How much electricity, in terms of Faraday, is required to reduce one mol of MnO_4^- to Mn^{2+} ion ?

[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]

- End of Question Paper -