

## 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 by-product is obtained in the manufacture of phenol from cumene ?

- (A) Acetaldehyde (B) Acetone  
(C) Anisole (D) o-Cresol

2. Which reagents are required for one step conversion of chlorobenzene to toluene ?

- (A)  $\text{NaNO}_2 + \text{HCl}$  (B)  $\text{CH}_3\text{Cl}/\text{Anhydrous AlCl}_3$   
(C)  $\text{CH}_3\text{Cl}/\text{Fe}$ , Dark (D)  $\text{CH}_3\text{Cl}$ , Na, Dry ether

3. Coordination number of Fe in  $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$  is :

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

4. Which of the following complexes shows geometrical isomerism ?

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

5. Which of the following does not show variable oxidation state ?

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

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

- (A)  $\text{Cu}/\text{HCl}$  (B)  $\text{H}_2\text{O}$   
(C)  $\text{CH}_3\text{CH}_2\text{OH}$  (D)  $\text{CuCN}$

7. The gas evolved when methylamine reacts with  $\text{HNO}_2$  is :

- (A) NO (B)  $\text{N}_2$   
(C)  $\text{NH}_3$  (D)  $\text{NO}_2$

8. A solution of acetone in chloroform :

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

9. 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)  $-3.72^\circ\text{C}$  (B)  $+3.72^\circ\text{C}$   
(C)  $-1.86^\circ\text{C}$  (D)  $+2.72^\circ\text{C}$

10. A galvanic cell can behave like an electrolytic cell when :

- (A)  $E_{\text{cell}} = E_{\text{ext}}$  (B)  $E_{\text{ext}} > E_{\text{cell}}$   
(C)  $E_{\text{cell}} > E_{\text{ext}}$  (D)  $E_{\text{cell}} = 0$

11. The value of rate constant for a pseudo first order reaction :

- (A) depends only on temperature. (B) depends on the concentration of reactants present in small amount.  
(C) depends on the concentration of reactants present in large excess. (D) is not dependent on the concentration of reactants.

**12.** Furanose ring of fructose is formed due to reaction between :

- (A)  $C_1$  and  $C_5$                       (B)  $C_2$  and  $C_5$   
(C)  $C_1$  and  $C_4$                       (D)  $C_2$  and  $C_4$
- 

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

**Reason (R) :** This is due to comparable energies of 5f, 6d and 7s orbitals.

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|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| (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.                                                                 |
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**14. Assertion (A) :** Order of the reaction can be zero or fractional.

**Reason (R) :** We cannot determine order from balanced chemical equation.

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|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
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| (C) Assertion (A) is true, but Reason (R) is false.                                                            | (D) Assertion (A) is false, but Reason (R) is true.                                                                 |
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**15. Assertion (A) :** Boiling point of  $(C_6H_5)_2NH$  is lower than that of  $n-C_4H_9NH_2$ .

**Reason (R) :** Hydrogen bonding is much more extensive in  $n-C_4H_9NH_2$  as compared to  $(C_6H_5)_2NH$ .

- |                                                                                                                |                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
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| (C) Assertion (A) is true, but Reason (R) is false.                                                            | (D) Assertion (A) is false, but Reason (R) is true.                                                                 |
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**16. Assertion (A) :** Phenol is less acidic than alcohol.

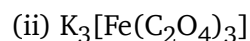
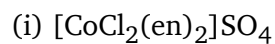
**Reason (R) :** Phenoxide ion is more stable than alkoxide ion.

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|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| (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.                                                                 |
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## Section B

17. State Raoult's law for a solution containing volatile components. Why is the vapour pressure of an aqueous solution of glucose lower than that of water ?

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



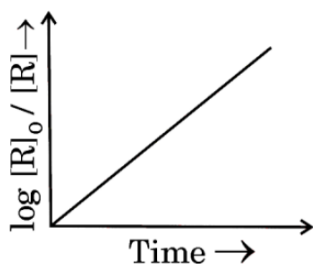
OR

(b) Differentiate between :

(i) Double salt and Complex compound

(ii) Didentate ligand and Ambidentate ligand

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



(a) Predict the order of reaction.

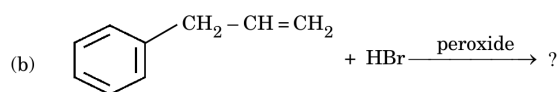
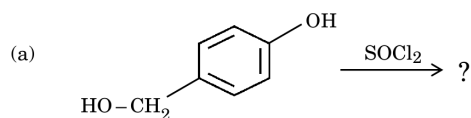
(b) What is the slope of the curve ?

20. How do you explain the following ?

(a) Presence of an aldehydic group in glucose.

(b) Presence of five -OH groups in glucose.

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



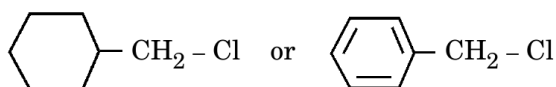
## Section C

**22.** How can you obtain the following from aniline ? Give only chemical equation.

- (a) p-nitroaniline
- (b) Chlorobenzene
- (c) Phenol

**23.** A compound (A) with molecular formula  $C_4H_5N$  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.

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



**25.** 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  $-0.3^\circ\text{C}$ . ( $K_f$  of water =  $1.86 \text{ K kg mol}^{-1}$ )

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

- (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

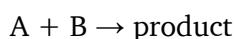
- (b) (i) What happens to the colour of complex  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  when heated gradually ?
- (ii) Write the electronic configuration for  $d^5$  ion if  $\Delta_o < P$
- (iii) Write the hybridization and magnetic behaviour of the complex  $[\text{Ni}(\text{CO})_4]$ .

[Atomic number : Ni = 28]

**27.** 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.

**28.** The rate of a reaction :



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

| Experi<br>ment | [A] / mol<br>L <sup>-1</sup> | [B] / mol<br>L <sup>-1</sup> | Initial Rate / mol<br>L <sup>-1</sup> min <sup>-1</sup> |
|----------------|------------------------------|------------------------------|---------------------------------------------------------|
| 1              | 0.01                         | 0.01                         | $5 \times 10^{-3}$                                      |
| 2              | 0.02                         | 0.01                         | $1 \times 10^{-2}$                                      |
| 3              | 0.01                         | 0.02                         | $5 \times 10^{-3}$                                      |

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

**29. Case-based:** The  $\alpha$ -amino acids are the building blocks of proteins. All  $\alpha$ -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]

**30. 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)  $\text{Br}_2$  water (ii) Conc.  $\text{HNO}_3$

(b) (i) Write the mechanism of alcohol reacting as nucleophile in a reaction with  $\text{CH}_3^+$ . [1]

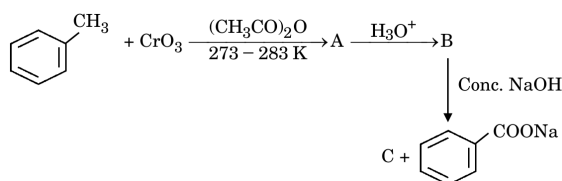
OR

(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  $\text{ZnCl}_2$  ? [1]

## Section E

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



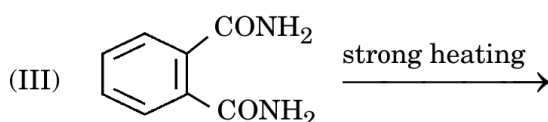
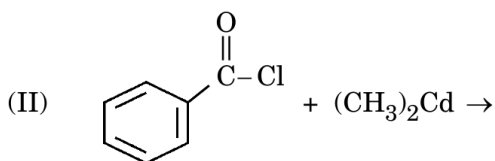
(ii) Give reasons for the following :

(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 :

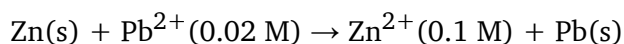


(ii) Write the reaction involved in the following reactions :

(I) Wolff-Kishner Reduction

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

32. (a) (i) Calculate  $E_{\text{cell}}$  of a galvanic cell in which the following reaction takes place at  $25^\circ\text{C}$  :



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

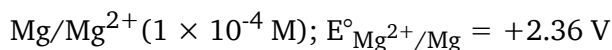
(ii) State Faraday's first law of electrolysis. How much electricity, in terms of Faraday, is required to reduce one mol of  $\text{MnO}_4^-$  to  $\text{Mn}^{2+}$  ion ?

[3+2=5]

OR

(b) (i) The resistance of a conductivity cell containing  $0.001\text{ M}$  KCl solution at  $298\text{ K}$  is  $1000\text{ ohm}$ . What is the cell constant if conductivity of  $0.001\text{ M}$  KCl solution at  $298\text{ K}$  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  $25^\circ\text{C}$  :



[Given :  $\log 10 = 1$ ]

(iii) What is the effect of temperature on the electrical conductance of metallic conductor ? [2+2+1=5]

33. (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)  $E^\circ$  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)  $\text{KMnO}_4$  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 ( $\text{V}_2\text{O}_5$ ) 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  $\text{Na}_2\text{CrO}_4$  ?

- End of Question Paper -