

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

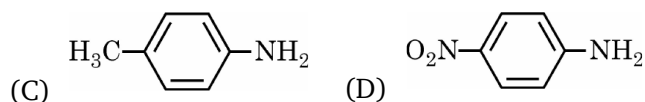
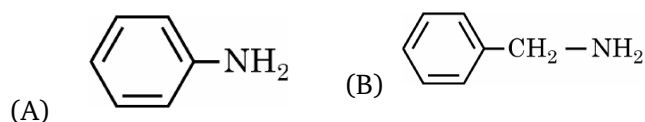
1. Auto oxidation of chloroform in air and sunlight produces a poisonous gas known as

- (A) Tear gas (B) Mustard gas
(C) Phosgene gas (D) Chlorine gas

2. Which of the following ligands is an ambidentate ligand?

- (A) CO (B) NO_2^-
(C) NH_3 (D) H_2O

3. Among the following, which has the highest value of pK_b ?



4. The slope in the plot of $\log \frac{a}{a-x}$ vs. time for a first order reaction is

- (A) $\frac{+k}{2.303}$ (B) $+k$
(C) $\frac{-k}{2.303}$ (D) $-k$

5. When D-glucose reacts with HI, it forms

- (A) Gluconic acid (B) n-hexane
(C) Saccharic acid (D) Iodohexane

6. Inversion of configuration occurs in

- (A) $\text{S}_{\text{N}}2$ reaction (B) $\text{S}_{\text{N}}1$ reaction
(C) Neither $\text{S}_{\text{N}}2$ nor $\text{S}_{\text{N}}1$ reaction (D) $\text{S}_{\text{N}}1$ as well as $\text{S}_{\text{N}}2$ reaction

7. Solubility of gas in liquid decreases with increase in

- (A) Pressure (B) Temperature
(C) Volume (D) Number of solute molecules

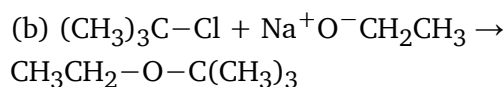
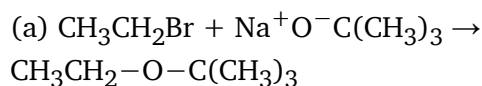
8. Which of the following relations is incorrect?

- (A) $R = \rho \frac{l}{A}$ (B) $\kappa = k \left(\frac{l}{A} \right)$
(C) $G = \kappa \left(\frac{A}{l} \right)$ (D) $\Lambda_m = \frac{\kappa}{c}$

9. The reagent that can be used to distinguish acetophenone and benzophenone is

- (A) 2,4-dinitrophenyl hydrazine (B) aqueous NaHSO_3
(C) Fehling solution (D) I_2 and NaOH

10. Which of the following reactions are feasible?



- (A) (a) only (B) (b) only
(C) Both (a) and (b) (D) Neither (a) nor (b)

11. Which of the following compounds will undergo self-condensation in the presence of dilute NaOH solution?

- (A) $\text{C}_6\text{H}_5\text{CHO}$ (B) $\text{CH}_3\text{CH}_2\text{CHO}$
(C) $(\text{CH}_3)_3\text{C-CHO}$ (D) H-CHO

12. For the reaction $3\text{A} \rightarrow 2\text{B}$, rate of reaction

$-\frac{d[\text{A}]}{dt}$ is equal to

- (A) $\frac{+3}{2} \frac{d[\text{B}]}{dt}$ (B) $\frac{+2}{3} \frac{d[\text{B}]}{dt}$
(C) $\frac{+1}{3} \frac{d[\text{B}]}{dt}$ (D) $\frac{+1}{2} \frac{d[\text{B}]}{dt}$

13. Which of the following transition metals shows +1 and +2 oxidation states?

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

14. The formula of the complex Iron(III) hexacyanidoferrate(II) is:

- (A) $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ (B) $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$
(C) $\text{Fe}[\text{Fe}(\text{CN})_6]$ (D) $\text{Fe}_2[\text{Fe}(\text{CN})_6]$

15. **Assertion (A):** The enthalpy of mixing $\Delta_{mix}H$ is equal to zero for an ideal solution.

Reason (R): For an ideal solution the interaction between solute and solvent molecules is stronger than the interactions between solute-solute or solvent-solvent molecules.

Select the most appropriate answer from the options given below:

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

16. **Assertion (A):** Molar conductivity decreases with increase in concentration.

Reason (R): When concentration approaches zero, the molar conductivity is known as limiting molar conductivity.

Select the most appropriate answer from the options given below:

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

17. **Assertion (A):** Transition metals show their highest oxidation state with oxygen.

Reason (R): The ability of oxygen to form multiple bonds to metals.

Select the most appropriate answer from the options given below:

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

18. **Assertion (A):** Chlorobenzene is resistant to nucleophilic substitution reaction at room temperature.

Reason (R): C-Cl bond gets weaker due to resonance.

Select the most appropriate answer from the options given below:

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

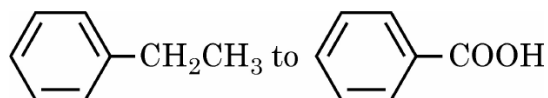
Section B

19. What are nucleic acids? Why two strands in DNA are not identical but are complementary?

20. Do the following conversions in not more than two steps:

(a) CH_3COOH to CH_3COCH_3

(b)



21. Write the chemical equation involved in the following reactions:

(a) Reimer-Tiemann reaction

(b) Acetylation of Salicylic acid

22. (a) The conversion of molecule A to B follows second order kinetics. If concentration of A is increased to three times, how will it affect the rate of formation of B?

(b) Define Pseudo first order reaction with an example.

23. The vapour pressure of pure liquid X and pure liquid Y at 25°C are 120 mm Hg and 160 mm Hg respectively. If equal moles of X and Y are mixed to form an ideal solution, calculate the vapour pressure of the solution.

24. (a) Give reasons:

(i) Mercury cell delivers a constant potential during its lifetime.

(ii) In the experimental determination of electrolytic conductance, Direct Current (DC) is not used.

OR

(b) Define fuel cell with an example. What advantages do the fuel cells have over primary and secondary batteries?

25. (a) Write the IUPAC names of the following:

(i) $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$

(ii) $\text{K}_2[\text{NiCl}_4]$

OR

(b) (i) What is a chelate complex? Give one example.

(ii) What are heteroleptic complexes? Give one example.

Section C

26. Answer any 3 of the following:

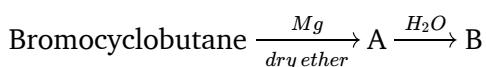
(a) Which isomer of C_5H_{10} gives a single monochloro compound C_5H_9Cl in bright sunlight?

(b) Arrange the following compounds in increasing order of reactivity towards S_N2 reaction:

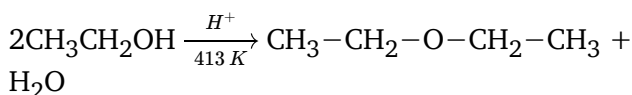
2-Bromopentane, 1-Bromopentane, 2-Bromo-2-methylbutane

(c) Why p-dichlorobenzene has higher melting point than those of ortho- and meta-isomers?

(d) Identify A and B in the following:



27. (a) (i) Write the mechanism of the following reaction:



(ii) Why ortho-nitrophenol is steam volatile while para-nitrophenol is not?

OR

(b) What happens when:

(i) Anisole is treated with CH_3Cl /anhydrous $AlCl_3$?

(ii) Phenol is oxidised with $Na_2Cr_2O_7/H^+$?

(iii) $(CH_3)_3C-OH$ is heated with $Cu/573\text{ K}$?

Write chemical equation in support of your answer.

28. (a) Draw the geometrical isomers of $[Co(en)_2Cl_2]^{2+}$. Which geometrical isomer of $[Co(en)_2Cl_2]^{2+}$ is not optically active and why?

(b) Write the hybridisation and magnetic behaviour of $[CoF_6]^{3-}$.

[Given: Atomic number of Co = 27]

29. A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (E_a) for the reaction.

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

[Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$]

30. When 19.5 g of $F-CH_2-COOH$ (Molar mass = 78 g mol^{-1}), is dissolved in 500 g of water, the depression in freezing point is observed to be 1°C . Calculate the degree of dissociation of $F-CH_2-COOH$.

[Given: K_f for water = $1.86\text{ K kg mol}^{-1}$]

31(i). Case Study: The carbon-oxygen double bond is polarised in aldehydes and ketones due to higher electronegativity of oxygen relative to carbon. Therefore they undergo nucleophilic addition reactions with a number of nucleophiles such as HCN, NaHSO_3 , alcohols, ammonia derivatives and Grignard reagents. Aldehydes are easily oxidised by mild oxidising agents as compared to ketones. The carbonyl group of carboxylic acid does not give reactions of aldehydes and ketones. Carboxylic acids are considerably more acidic than alcohols and most of simple phenols.

(a) Write the name of the product when an aldehyde reacts with excess alcohol in presence of dry HCl.

31(ii). (b) Why carboxylic acid is a stronger acid than phenol?

31(iii). (c) (i) Arrange the following compounds in increasing order of their reactivity towards CH_3MgBr :

CH_3CHO , $(\text{CH}_3)_3\text{C}-\text{CO}-\text{CH}_3$, $\text{CH}_3-\text{CO}-\text{CH}_3$

(ii) Write a chemical test to distinguish between propanal and propanone.

OR

(c) Write the main product in the following:

(i) An aldehyde treated with $[\text{Ag}(\text{NH}_3)_2]^+$

(ii) An aldehyde/ketone treated with $\text{H}_2\text{NCONHNH}_2$ (semicarbazide)

32(i). Case Study: Carbohydrates are optically active polyhydroxy aldehydes and ketones. They are also called saccharides. All those carbohydrates which reduce Fehling's solution and Tollen's reagent are referred to as reducing sugars. Glucose, the most important source of energy for mammals, is obtained by the hydrolysis of starch. Vitamins are accessory food factors required in the diet. Proteins are the polymers of α -amino acids and perform various structural and dynamic functions in the organisms. Deficiency of vitamins leads to many diseases.

(a) The penta-acetate of glucose does not react with Hydroxylamine. What does it indicate?

32(ii). (b) Why cannot vitamin C be stored in our body?

32(iii). (c) Define the following as related to proteins:

(i) Peptide linkage

(ii) Denaturation

OR

(c) Define the following as related to carbohydrates:

(i) Anomers

(ii) Glycosidic linkage

Section E

33. (a) (I) Give reasons:

(i) Aniline on nitration gives good amount of m-nitroaniline, though $-\text{NH}_2$ group is o/p directing in electrophilic substitution reactions.

(ii) $(\text{CH}_3)_2\text{NH}$ is more basic than $(\text{CH}_3)_3\text{N}$ in an aqueous solution.

(iii) Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

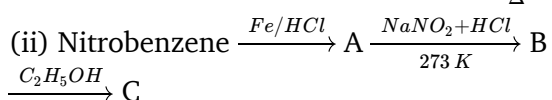
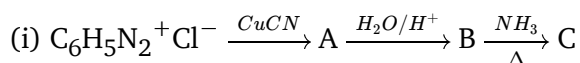
(II) Write the reaction involved in the following:

(i) Carbylamine test

(ii) Gabriel phthalimide synthesis

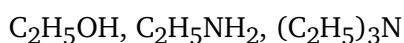
OR

(b) (I) Write the structures of A, B and C in the following reactions:



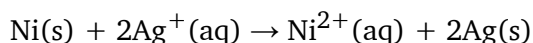
(II) Why aniline does not undergo Friedel-Crafts reaction?

(III) Arrange the following in increasing order of their boiling point:



34. (a) Conductivity of 2×10^{-3} M methanoic acid is $8 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation if Λ_m° for methanoic acid is $404 \text{ S cm}^2 \text{ mol}^{-1}$.

(b) Calculate the $\Delta_r G^\circ$ and $\log K_c$ for the given reaction at 298 K:



Given: $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25 \text{ V}$, $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$;
 $1 \text{ F} = 96500 \text{ C mol}^{-1}$.

35. (a) (I) Account for the following:

(i) E° value for $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is much more positive than that for $\text{Cr}^{3+}/\text{Cr}^{2+}$.

(ii) Sc^{3+} is colourless whereas Ti^{3+} is coloured in an aqueous solution.

(iii) Actinoids show wide range of oxidation states.

(II) Write the chemical equations for the preparation of KMnO_4 from MnO_2 .

OR

(b) (I) Account for the following:

(i) Transition metals form alloys.

(ii) Ce^{4+} is a strong oxidising agent.

(II) Write one similarity and one difference between chemistry of Lanthanoids and Actinoids.

(III) Complete the following ionic equation:



- End of Question Paper -