

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. Van't Hoff factor for K_2SO_4 solution, assuming complete ionization is

- (A) 1 (B) 3
(C) 13 (D) 2

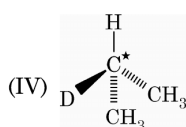
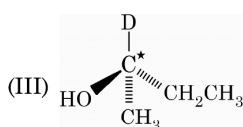
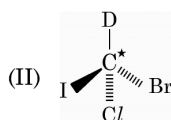
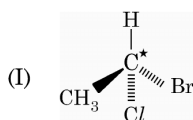
2. Dilution affects both conductivity as well as molar conductivity. Effect of dilution on both is as follows:

- (A) both increase with dilution. (B) both decrease with dilution.
(C) conductivity increases whereas molar conductivity decreases on dilution. (D) conductivity decreases whereas molar conductivity increases on dilution.

3. Which of the following species can act as the strongest base?

- (A) OH^- (B) $C_6H_5O^-$
(C) RO^- (D) $p-O_2N-C_6H_4-O^-$

4. In which of the following molecules, C atom marked with asterisk is chiral?



- (A) I, II, III (B) I, II, III, IV
(C) II, III, IV (D) I, II, IV

5. The rate of a reaction increases sixteen times when the concentration of the reactant increases four times. The order of the reaction is

- (A) 2.5 (B) 2.0
(C) 1.5 (D) 0.5

6. Which of the following cell is used in hearing aids?

- (A) Mercury cell (B) $H_2 - O_2$ fuel cell
(C) Dry cell (D) Ni-Cd cell

7. Isotonic solutions have the same

- (A) density (B) refractive index
(C) osmotic pressure (D) volume

8. Transition metals are known to make interstitial compounds. Formation of interstitial compounds makes the transition metal

- (A) more hard (B) more soft
(C) more ductile (D) more metallic

9. Auto-oxidation of chloroform in air and light produces a poisonous gas known as

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

10. Out of the following alkenes, the one which will produce tertiary butyl alcohol on acid catalysed hydration is

- (A) $CH_3CH_2CH = CH_2$ (B) $CH_3CH = CH_2$
(C) $CH_3-CH = CH-CH_3$ (D) $(CH_3)_2C = CH_2$

11. The correct name of the given reaction is



- (A) Sandmeyer's reaction (B) Gabriel Phthalimide synthesis
(C) Carbyl amine reaction (D) Hoffmann bromamide degradation reaction

12. The specific sequence in which amino acids are arranged in a protein is called its

- (A) Primary structure (B) Secondary structure
(C) Tertiary structure (D) Quaternary structure

13. Two statements are given – Assertion (A) and Reason (R). Select the correct option:

Assertion (A): The units of rate constant of a zero order reaction and rate of reaction are the same.

Reason (R): In zero order reaction, the rate of reaction is independent of the concentration of reactants.

- (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 Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

14. Two statements are given – Assertion (A) and Reason (R). Select the correct option:

Assertion (A): Zr and Hf are of almost similar atomic radii.

Reason (R): This is due to the Lanthanoid contraction.

- (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 Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

15. Two statements are given – Assertion (A) and Reason (R). Select the correct option:

Assertion (A): p-methoxyphenol is a stronger acid than m-methoxyphenol.

Reason (R): Methoxy group exerts +R effect at both ortho and para position.

- (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 Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

16. Two statements are given – Assertion (A) and Reason (R). Select the correct option:

Assertion (A): Inversion of configuration is observed when 1-Bromobutane is hydrolysed.

Reason (R): The reaction is S_N2 and proceeds with the formation of transition state.

- (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 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. (a) Carry out the following conversions:

(i) Nitrobenzene to Aniline

(ii) Aniline to Phenol

OR

(b) (i) Write a chemical test to distinguish between Dimethyl amine and Ethanamine.

(ii) Write the product formed when benzene diazonium chloride is treated with KI.

18. Define the following terms:

(a) Limiting molar conductivity (Λ_m°)

(b) Fuel cell

19. Classify the following sugars into monosaccharides and disaccharides:

Sucrose, Lactose, Glucose, Fructose

20. Resistance of a conductivity cell filled with 0.2 mol L^{-1} KCl solution is 200Ω . If the resistance of the same cell when filled with 0.05 mol L^{-1} KCl solution is 620Ω , calculate the conductivity and molar conductivity of 0.05 mol L^{-1} KCl solution. The conductivity of 0.2 mol L^{-1} KCl solution is 0.0248 S cm^{-1} .

21. A first order reaction takes 40 min for 75% decomposition. Calculate rate constant.

[Given: $\log 2 = 0.30$, $\log 4 = 0.60$]

Section C

22. A compound 'X' with molecular formula C_7H_9N reacts with $C_6H_5SO_2Cl$ to give a solid, insoluble in alkali. Identify 'X' and give the IUPAC name of the product. Write the reaction involved.

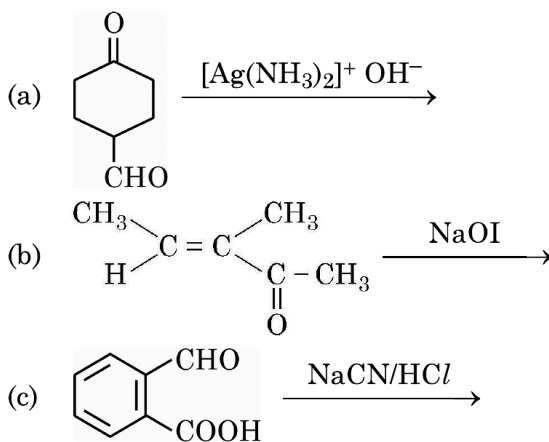
23. Account for the following:

- (a) Haloalkanes react with $AgCN$ to form isocyanide as main product.
- (b) Allyl chloride shows high reactivity towards S_N1 reaction.
- (c) Haloarenes are extremely less reactive towards nucleophilic substitution reactions.

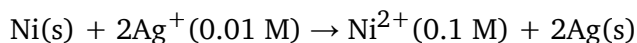
24. Write the IUPAC names of the following coordination compounds (any three):

- (a) $[Co(NH_3)_4Cl(NO_2)]Cl$
- (b) $[Ni(NH_3)_6]Cl_2$
- (c) $K_3[Cr(C_2O_4)_3]$
- (d) $[Co(en)_2Br_2]^+$

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



26. Calculate the emf of the following cell:



Given that $E^\circ_{cell} = 1.05\text{ V}$, $\log 10 = 1$

27. Give the structure of the major product expected from the following reactions:

- (a) Reaction of propanal with methyl magnesium bromide followed by hydrolysis.
- (b) Reaction of phenol with Br_2 in CS_2 .
- (c) Reaction of propene with diborane followed by oxidation.

28. The rate constant of a reaction quadruples when the temperature changes from 700 K to 720 K. Calculate the activation energy for this reaction.

[$\log 2 = 0.30$, $\log 4 = 0.60$, $2.303 R = 19.15\text{ J K}^{-1}\text{ mol}^{-1}$]

29(a). Case: The oxidation number of the central atom in a complex is defined as the charge it would carry if all the ligands are removed along with the electron pairs that are shared with the central atom. Similarly the charge on the complex is the sum of the charges of the constituent parts i.e. the sum of the charges on the central metal ion and its surrounding ligands. Based on this, the complex is called neutral if the sum of the charges of the constituents is equal to zero. However, for an anion or cationic complex, the sum of the charges of the constituents is equal to the charge on the coordination sphere.

(a) What is the secondary valence of Co in $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$?

29(b). (b) What type of isomerism is shown by the complex $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ and $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$?

29(c). (c) Write the electronic configuration of d^4 ion on the basis of crystal field theory when

(i) $\Delta_o < P$

(ii) $\Delta_o > P$

OR

(c) Find the oxidation state and coordination number of the central metal ion in $[\text{Co}(\text{H}_2\text{O})(\text{CN})(\text{en})_2]^{2+}$.

30(a). Case: Certain organic compounds are required in small amounts in our diet but their deficiency causes specific disease. These compounds are called vitamins. Most of the vitamins cannot be synthesized in our body but plants can synthesize almost all of them. So they are considered as essential food factors. However, the bacteria of the gut can produce some of the vitamins required by us. All the vitamins are generally available in our diet. The term 'vitamin' was coined from the words vital + amine, since the earlier identified compounds had amino group. Vitamins are classified into two groups depending upon their solubility in water or fat namely – fat soluble vitamins and water soluble vitamins.

(a) What is the other name of vitamin B₁?

30(b). (b) Name the vitamin whose deficiency causes increased blood clotting time.

30(c). (c) Xerophthalmia is caused by the deficiency of which vitamin? Give two sources of this vitamin.

OR

(c) Why can't vitamin C be stored in our body? Name the disease caused by the deficiency of this vitamin.

31. (a) (i) Ishan's automobile radiator is filled with 1.0 kg of water. How many grams of ethylene glycol (Molar mass = 62 g mol^{-1}) must Ishan add to get the freezing point of the solution lowered to -2.8°C . K_f for water is $1.86 \text{ K kg mol}^{-1}$.

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

OR

(b) (i) Boiling point of water at 750 mm Hg pressure is 99.68°C . How much sucrose (Molar mass = 342 g mol^{-1}) is to be added to 500 g of water such that it boils at 100°C ? (K_b for water = $0.52 \text{ K kg mol}^{-1}$)

(ii) State Henry's law and write its any one application.

32. (a) An organic compound (A) with the molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms 2,4-DNP derivative, reduces Fehling solution and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1,2-benzene dicarboxylic acid.

(i) Identify the compound (A) and write its IUPAC name.

(ii) Write the reaction of compound (A) with

(1) 2,4-Dinitrophenyl hydrazine and

(2) Fehling solution

(iii) Write the equation of compound (A) when it undergoes Cannizzaro reaction.

OR

(b) (i) Account for the following:

(1) The alpha (α)-hydrogens of aldehydes and ketones are acidic in nature.

(2) Oxidation of aldehydes is easier than ketones.

(ii) Arrange the following in:

(1) Decreasing reactivity towards nucleophilic addition reaction: propanal, acetone, benzaldehyde.

(2) Increasing order of boiling point: Propane, Ethanol, Dimethyl ether, Propanal.

(iii) Give simple chemical test to distinguish between Benzoic acid and Benzaldehyde.

33. Attempt any five of the following:

- (a) Ce(III) is easily oxidised to Ce(IV). Comment.
 - (b) $E^\circ(\text{Mn}^{2+}/\text{Mn})$ is -1.18 V . Why is this value highly negative in comparison to neighbouring d block elements?
 - (c) Which element of 3d series has lowest enthalpy of atomisation and why?
 - (d) What happens when sodium chromate is acidified?
 - (e) Zn, Cd and Hg are soft metals. Why?
 - (f) Why is permanganate titration not carried out in the presence of HCl?
 - (g) The lower oxides of transition metals are basic whereas the highest are amphoteric/acidic. Give reason.
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