

Question Paper

Conducted by the Central Board of Secondary Education (CBSE)



Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions

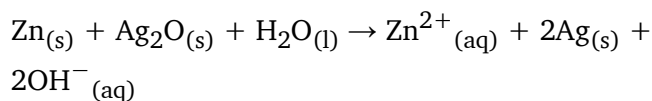
- (i) This question paper contains **33 questions**. All questions are compulsory.
- (ii) Section A: Questions 1 to 16 are multiple choice questions, carrying 1 mark each.
- (iii) Section B: Questions 17 to 21 are very short answer questions, carrying 2 marks each.
- (iv) Section C: Questions 22 to 28 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. Identify the correct statement:

- | | |
|--|--|
| (A) Molecularity of a reaction is an experimental quantity. | (B) For complex reactions molecularity has no meaning. |
| (C) Molecularity of a reaction can be zero or even a fraction. | (D) Molecularity more than three is very common in chemical reactions. |

2. Consider the following reaction:



Given: $E^{\circ}_{\text{Ag}^+/\text{Ag}} = 0.80 \text{ V}$, $E^{\circ}_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$, $1 \text{ F} = 96500 \text{ C mol}^{-1}$.

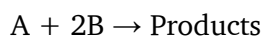
$\Delta_r G^{\circ}$ for the above reaction is:

- | | |
|------------------------------------|------------------------------------|
| (A) $-301.080 \text{ kJ mol}^{-1}$ | (B) $+310.080 \text{ kJ mol}^{-1}$ |
| (C) $-326.070 \text{ kJ mol}^{-1}$ | (D) $-375.060 \text{ kJ mol}^{-1}$ |

3. Electronic configuration of chromium is:

- | | |
|-----------------------------|-----------------------------|
| (A) $[\text{Ar}] 3d^4 4s^1$ | (B) $[\text{Ar}] 3d^4 4s^2$ |
| (C) $[\text{Ar}] 3d^5 4s^1$ | (D) $[\text{Ar}] 3d^5 4s^2$ |

4. The order for the given reaction is:



$$\text{Rate} = k[\text{A}]^{1/2}[\text{B}]^1$$

- | | |
|---------|-------|
| (A) 1.5 | (B) 1 |
| (C) 0.5 | (D) 2 |

5. Which of the following is a heteroleptic complex?

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

6. The correct IUPAC name of the complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ is:

- (A) diamminedichloridoplatinum (IV)
 (B) diamminedichloridoplatinum (II)
 (C) dichloridodiammineplatinum (IV)
 (D) dichloridodiammineplatinum (II)

7. Identify the correct increasing order of boiling points of the given compounds:

- | | |
|---|---|
| (A) Propan-1-ol < butan-1-ol < butan-2-ol < pentan-1-ol | (B) Pentan-1-ol < butan-1-ol < butan-2-ol < propan-1-ol |
| (C) Propan-1-ol < butan-2-ol < butan-1-ol < pentan-1-ol | (D) Butan-1-ol < butan-2-ol < propan-1-ol < pentan-1-ol |

8. Which of the following molecules is chiral in nature?

- | | |
|-------------------|--------------------|
| (A) Propan-2-ol | (B) Butan-2-ol |
| (C) 1-Bromobutane | (D) 2-Bromopropane |

9. The base which is present in DNA but not in RNA is:

- | | |
|-------------|--------------|
| (A) Guanine | (B) Cytosine |
| (C) Thymine | (D) Adenine |

10. Identify the compound produced by the reduction of Ethanenitrile with Lithium aluminium hydride:

- (A) Ethylamine (B) Ethanal
(C) Propylamine (D) Methylamine

11. Which of the following reactions is not explained by the open chain structure of glucose?

- (A) Glucose on prolonged heating with HI forms *n*-hexane. (B) Glucose reacts with hydroxylamine to form an oxime.
(C) Glucose gets oxidized to gluconic acid on reaction with bromine water. (D) Glucose exists in two different crystalline forms, alpha (α) and beta (β).

12. Proteins are polymers of α -amino acids which are joined to each other by:

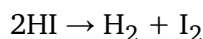
- (A) Covalent Bond (B) Peptide Bond
(C) Glycosidic Bond (D) Coordinate Bond

13. **Assertion (A):** Zinc, cadmium and mercury are not considered as transition elements.

Reason (R): These elements have completely filled orbitals in their ground state as well as in their common 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):** The molecularity of the given reaction is 2.



Reason (R): Two molecules of the reactants are involved in simultaneous collision between them.

- (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):** Glucose gets oxidized to six carbon gluconic acid on reaction with bromine water.

Reason (R): The carbonyl group is absent in the open chain structure of glucose.

- (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):** Aromatic primary amines can be prepared by Gabriel Phthalimide synthesis.

Reason (R): Aryl halides do not undergo nucleophilic substitution with the anion formed by phthalimide.

- (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. (a) Define coordination number.

(b) Indicate the type of isomerism exhibited by the following complex: $[\text{Co}(\text{en})_3]\text{Cl}_3$

18. (a) Define Effective collision.

(b) Write the unit of (i) second order reaction and (ii) zero order reaction.

19. (a) Why are the second ionization enthalpies of chromium and copper exceptionally higher than those of their neighbouring elements?

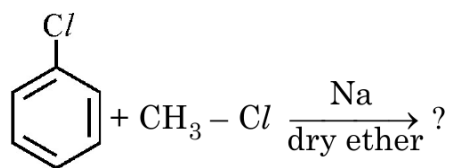
(b) Why do transition elements form interstitial compounds?

20(A). The concentration of the reactant is reduced from 0.6 mol L^{-1} to 0.2 mol L^{-1} in 5 minutes in a first order reaction. Calculate the rate constant of the reaction. ($\log 3 = 0.48$)

OR

20(B). Rate constant k for the first order reaction is $2.54 \times 10^{-3} \text{ s}^{-1}$. Calculate the time required for three-fourth of the reactant to decompose. ($\log 4 = 0.60$)

21. (a) Write the major product in the following reaction:

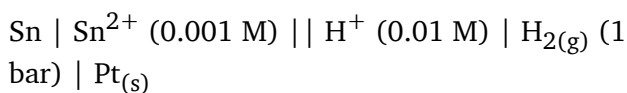


(b) What happens when 2-Bromobutane is made to react with alcoholic potassium hydroxide?

Section C

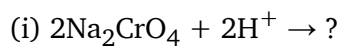
22. 60 g of glucose is dissolved in 250 g of water. Calculate the freezing point of this solution. (molar mass of glucose = 180 g mol^{-1} , K_f for water = $1.86 \text{ K kg mol}^{-1}$)

23. Calculate emf of the following cell at 298 K:



Given: $E_{\text{Sn}^{2+}/\text{Sn}}^\circ = -0.14 \text{ V}$, $E_{\text{H}^+/\text{H}_2}^\circ = 0.00 \text{ V}$, $[\log 10 = 1]$

24. (a) Complete and balance the following equations:



(b) Why is the chemistry of actinoids complicated as compared to lanthanoids?

25. (a) Explain why $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ is strongly paramagnetic whereas $[\text{Fe}(\text{CN})_6]^{4-}$ is weakly paramagnetic. [Atomic number of Fe = 26]

(b) On the basis of crystal field theory, write the electronic configuration for d^6 ion for which $\Delta_o < P$.

26. (a) Write the IUPAC name of the given compound: $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{Br})\text{CH}_3$

(b) Define Racemisation.

(c) The boiling points of the alkyl halides with the same alkyl group decrease in the given order: $\text{RI} > \text{RBr} > \text{RCl} > \text{RF}$. Explain the above statement.

27. Write the reaction involved in:

(a) Rosenmund's reduction

(b) Cannizzaro's reaction

(c) Hell-Volhard-Zelinsky reaction

28(A). (a) Define the following terms:

(i) Invert Sugar

(ii) Polysaccharides

(b) On the basis of structure differentiate between fibrous and globular proteins.

OR

28(B). (a) Why is glycogen known as animal starch?

(b) Differentiate between essential amino acids and non-essential amino acids.

(c) What is the effect of denaturation on the structure of proteins?

29(a). Read the passage carefully and answer the questions that follow:

Osmosis is a process by which the molecules of a solvent pass from a solution of low solute concentration to a solution of high solute concentration through a semi-permeable membrane. Osmotic pressure is a colligative property. When the applied pressure on a solution exceeds its osmotic pressure, reverse osmosis occurs. When two solutions are separated by a semipermeable membrane and they have same osmotic pressure they are said to be isotonic. Of the two solutions separated by a semipermeable membrane, if one is at a lower osmotic pressure, it is said to be hypotonic relative to the second solution. If it has a higher osmotic pressure than the second solution, it is said to be hypertonic relative to the second solution. The osmotic pressure associated with the fluid inside the blood cell is equivalent to that of 0.9% (mass/volume) sodium chloride solution called normal saline solution and it is safe to inject intravenously. Osmotic pressure is vital in daily life and nature. It helps in explaining why IV fluids match blood's osmotic pressure; it is also the principle behind food preservation using salt or sugar.

(a) Calculate the amount of CaCl_2 ($i = 2.59$) dissolved in 2.46 litre of water such that its osmotic pressure is 0.70 atm at 27°C . [Given: $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$, molar mass of $\text{CaCl}_2 = 111 \text{ g mol}^{-1}$]

29(b). When raisins are kept in water, they get swollen. Name the phenomenon involved in this process.

OR

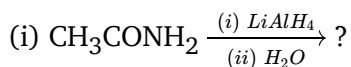
29(b). Why is osmotic pressure more advantageous than other colligative properties?

29(c). Which phenomenon is responsible for desalination of sea water?

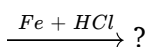
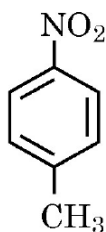
30(a). Read the passage carefully and answer the questions that follow:

Like NH_3 , nitrogen atom of amine is trivalent and carries an unshared pair of electrons. Nitrogen orbitals in amines are therefore sp^3 hybridised and the geometry of amines is pyramidal. Lower aliphatic amines are soluble in water due to the formation of hydrogen bond with water molecules. The solubility decreases as the molar mass of amines increases due to increase in size of hydrophobic part. Higher amines are insoluble in water. However amines are less soluble in water than alcohols because of low electronegativity of nitrogen as compared to oxygen. Boiling points of isomeric amines follow the order $1^\circ > 2^\circ > 3^\circ$. It is due to the fact that amines are held together due to hydrogen bonding. Extent of hydrogen bonding is more in primary amines than in secondary amines as two hydrogen atoms are available for hydrogen bond formation. Tertiary amines do not show hydrogen bonding because of the absence of hydrogen atom attached to nitrogen. Amines can be prepared from nitro compounds, nitriles, amides, etc.

(a) Complete the following equations:

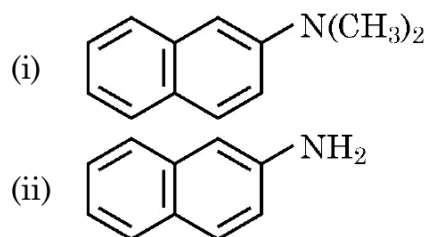


(ii)



30(b). Why do primary amines have higher boiling points than tertiary amines?

30(c). Classify the following amines as primary, secondary or tertiary:



OR

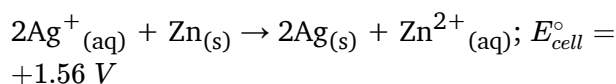
30(c). Out of Butan-1-amine and Butan-1-ol, which is more soluble in water?

Section E

31(A). (a) The conductivity of 0.1 mol L^{-1} solution of NaCl is $1.06 \times 10^{-2} \text{ S cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.

$$\lambda_{Na^+}^\circ = 50.1 \text{ S cm}^2 \text{ mol}^{-1}, \lambda_{Cl^-}^\circ = 76.5 \text{ S cm}^2 \text{ mol}^{-1}$$

(b) (i) Following cell reaction occurs in a galvanic cell:



Predict the direction of flow of current.

(ii) Differentiate between a primary battery and a secondary battery.

OR

31(B). (a) Resistance of a conductivity cell filled with 0.1 M KCl solution is 100Ω . If the resistance of the same cell when filled with 0.01 mol L^{-1} KCl solution is 300Ω , calculate the conductivity and molar conductivity of 0.01 mol L^{-1} KCl solution. The conductivity of 0.1 M KCl solution is $1.29 \times 10^{-2} \text{ S cm}^{-1}$.

(b) (i) Write any two advantages of $\text{H}_2\text{-O}_2$ fuel cell.

(ii) Why does the cell potential of mercury cell remain constant throughout the life?

32(A). An organic compound 'A', with molecular formula $\text{C}_2\text{H}_6\text{O}$ reacts with active metals such as sodium to give compound 'B' and hydrogen gas. 'A' on treatment with iodine and sodium hydroxide gives 'C' and in presence of H_2SO_4 at 413 K gives 'D' ($\text{C}_4\text{H}_{10}\text{O}$). 'D' on reaction with excess of HI gives 'E'. Identify 'A', 'B', 'C', 'D' and 'E' and write all the reactions involved.

OR

32(B). (a) Write the reagents which are used in the given conversions:

(i) Phenol to 2, 4, 6-tribromophenol

(ii) Propene to propan-1-ol

(iii) Butan-2-one to butan-2-ol

(b) Explain the mechanism of acid catalyzed hydration of alkene to form corresponding alcohol.

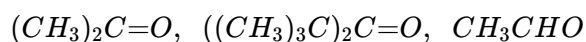
33(A). (a) How will you convert the following:

(i) Propanone to Propene

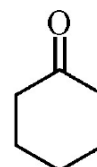
(ii) Benzoic acid to Benzaldehyde

(iii) Benzene to *m*-Nitroacetophenone

(b) (i) Arrange the following compounds in increasing order of their reactivity towards HCN:



(ii) Identify the compounds, which would undergo Aldol condensation: HCHO , $\text{C}_6\text{H}_5\text{CHO}$, CH_3CHO ,



OR

33(B). (a) Give chemical tests to distinguish between the following pairs of compounds:

(i) Acetophenone and Benzophenone

(ii) Propanal and Propanone

(iii) Pentan-2-one and Pentan-3-one

(b) (i) Which of the following acids is stronger and why? CH_2FCOOH , CH_3COOH

(ii) Arrange the following compounds in the increasing order of their boiling points: CH_3OCH_3 , $\text{CH}_3\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{OH}$, CH_3CHO

- End of Question Paper -