

Total No. of Printed Pages—11

HS/XII/Sc/Ch/23

2 0 2 3

CHEMISTRY

(Theory)

Full Marks : 70

Time : 3 hours

The figures in the margin indicate full marks for the questions

General Instructions :

- (i) Attempt all parts of a question together at one place.
- (ii) All questions are compulsory.
- (iii) Section—A : Question Nos. **1** to **5** are of multiple choice type, each of *1* mark.
- (iv) Section—B : Question Nos. **6** to **12** are of short answer type questions and carry *2* marks each.
- (v) Section—C : Question Nos. **13** to **24** are also short answer type questions and carry *3* marks each.
- (vi) Section—D : Question Nos. **25** to **27** are long answer type questions and carry *5* marks each.

(2)

- (vii) There is no overall choice. However, four questions of 2 marks, three questions of 3 marks, and two questions of 5 marks weightage. Students have to attempt only one of the choices in such questions.
- (viii) Use of non-programmable ordinary scientific calculators and log tables are allowed.
- (ix) Mobile phones and pagers are not allowed inside the Examination Hall.

SECTION—A

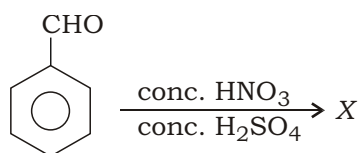
Choose and write the correct answers for the following in the answer script :

1. The value of Henry's law constant, k_H
 - (a) increases with increase in temperature
 - (b) decreases with increase in temperature
 - (c) remains constant
 - (d) first increases and then decreases 1

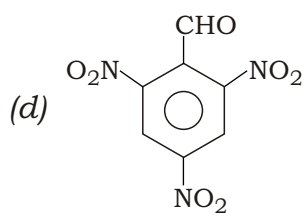
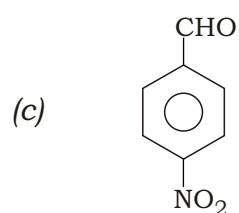
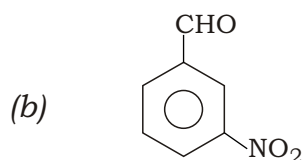
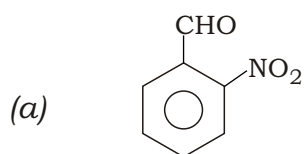
2. The IUPAC name for the complex $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]\text{Cl}_2$ is
 - (a) pentaammine nitrito-N-cobalt(II) chloride
 - (b) nitrito-N-pentaammine cobalt(III) chloride
 - (c) pentaammine nitrito-N-cobalt(III) chloride
 - (d) nitrito-N-pentaammine cobalt(II) chloride 1

(3)

3. In the reaction



the compound X is



1

4. The linkage which holds various amino acid units in the primary structure of protein is

- (a) glycosidic linkage
- (b) hydrogen bond
- (c) peptide linkage
- (d) ionic bond

1

(4)

5. S_N2 mechanism proceeds through the intervention of

- (a) carbonium ion
- (b) transition state
- (c) free radical
- (d) carbanion

1

SECTION—B

6. Mention any four factors that influence the rate of chemical reaction.

2

7. *Either*

- (a) Based on CFT, explain why [Fe(CN)₆]³⁻ is weakly paramagnetic, while [Fe(CN)₆]⁴⁻ is diamagnetic.

2

Or

- (b) Explain why tetrahedral Ni(II) complexes are paramagnetic, but square planar Ni(II) complexes are diamagnetic.

2

8. What is lanthanide contraction? What is its cause?

2

9. *Either*

- (a) How will you convert chlorobenzene to *p*-nitrophenol?

2

Or

- (b) Convert phenol to salicylic acid (2-hydroxybenzoic acid).

2

(5)

10.

Either

- (a) Arrange the following substances in increasing order of their basic strength in water : 1

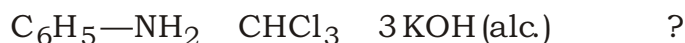


- (b) Out of ethyl amine and ethyl alcohol, which has higher boiling point and why? 1

Or

- (c) Acetamide is a weaker base than ethyl amine. Explain. 1

- (d) Complete the following reaction : 1



11.

Either

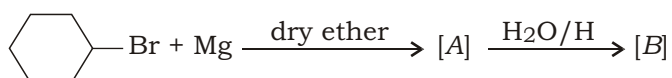
- (a) A 5% solution of non-volatile solute in water has vapour pressure 745 mm at 373 K. Calculate the molar mass of the solute. 2

Or

- (b) A solution containing 18 g of a non-volatile solute in 200 g of water freezes at 272.07 K. Find the molecular mass of the solute.

$$(K_f \text{ of H}_2\text{O} = 1.86 \text{ K kg mol}^{-1}) \quad 2$$

12. Identify A and B in the following reaction : 1+1=2



SECTION—C

13.*Either*

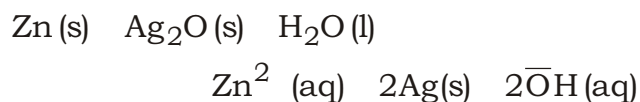
- (a) Can we keep CuSO_4 solution in a zinc container?
Given that

$$E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} = 0.34 \text{ V} \text{ and } E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = 0.76 \text{ V} \quad 1\frac{1}{2}$$

- (b) Calculate the molar conductivity of an aqueous solution at infinite dilution for BaCl_2 , when ionic conductances of Ba^{2+} and Cl^- ions are $127.30 \text{ S cm}^2 \text{ mol}^{-1}$ and $76.34 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. 1½

Or

- (c) In a button cell commonly used in electronic gadgets, the following reaction takes place :



where $E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = 0.76 \text{ V}$ and $E_{\text{Ag}^+/\text{Ag}}^{\circ} = 0.80 \text{ V}$.

Write the cell representation and calculate the value of E_{cell}° and G° for the reaction. 2

- (d) Define molar conductivity. 1

- 14.** (a) Why does the boiling point of a solvent increase by the presence of a non-volatile solute in it? 1

- (b) What is an isotonic solution? What is the molarity of cane sugar (molar mass 342) solution isotonic with solution of urea containing 6 g of urea (molar mass 60) per litre? 2

(7)

15.

Either

- (a) Define half-life period of a reaction. 1
- (b) Decomposition of a compound follows first-order kinetics. If it takes 15 minutes for 20% of original substance to decay, calculate—
- (i) the rate constant;
- (ii) the time at which 10% of the reactant remains undecayed. 1+1=2

Or

- (c) Define activation energy. 1
- (d) The rate of a particular reaction doubles when temperature changes from 27 °C to 37 °C. Calculate the value of activation energy. (R = 8.314 JK⁻¹mol⁻¹) 2

16.

Either

- (a) Define ambident ligand with one example. 1
- (b) What is a homoleptic complex? 1
- (c) Name a metal present in vitamin B₁₂. 1
- Or*
- (d) Name the central metal atom present in chlorophyll. 1
- (e) Define linkage isomerism with example. 1
- (f) Write the chemical formula of the compound potassium trioxalatoferrate(III). 1

- 17.** How would you convert the following? 1+1+1=3
- (a) Prop-1-ene to 1-nitropropane
- (b) Chlorobenzene to 2-chlorotoluene
- (c) But-1-ene to but-2-ene
- 18.** (a) Explain the mechanism of acid-catalyzed dehydration of ethanol. 2
- (b) Convert benzene diazonium chloride to phenol. 1
- 19.** (a) Explain why aniline does not undergo Friedel-Crafts reaction. 1
- (b) Why are aliphatic amines more basic than aromatic amines? 1
- (c) Complete the following reaction : 1
- $$\text{C}_6\text{H}_5\text{—NH}_2 + \text{C}_6\text{H}_5\text{—OH} \xrightarrow[(273 \text{ K} - 278 \text{ K})]{(\text{NaNO}_2 + \text{HCl})} ?$$
- 20.** (a) Name one fibrous protein and one globular protein. 1
- (b) Name the base that is found in RNA only. 1
- (c) What is denaturation of proteins? 1
- 21.** (a) Name the enzyme which is present in saliva. What is its important function? $\frac{1}{2} + \frac{1}{2} = 1$
- (b) What are aldoses and ketoses? 1
- (c) Write the names of the anomers of glucose. 1

- 22.** (a) What is Rosenmund reduction? What is the purpose of BaSO_4 and S in this reaction? 1+1=2
- (b) When is the value of van't Hoff factor (i) greater than 1? 1
- 23.** (a) How would you determine the standard electrode potential of the system $\text{Mg}^{2+} / \text{Mg}$? 1
- (b) Define 'pseudo first-order reaction' with a suitable chemical equation. 1+1=2
- 24.** (a) Draw the geometrical isomers of $[\text{Co}(\text{NO}_2)_3(\text{NH}_3)_3]$. $\frac{1}{2} + \frac{1}{2} = 1$
- (b) How can the following pair be chemically distinguished? 1
- Phenol and Ethyl alcohol
- (c) What is Hoffmann's bromamide reaction? Give an example with a suitable chemical reaction. $\frac{1}{2} + \frac{1}{2} = 1$

SECTION—D

25.

Either

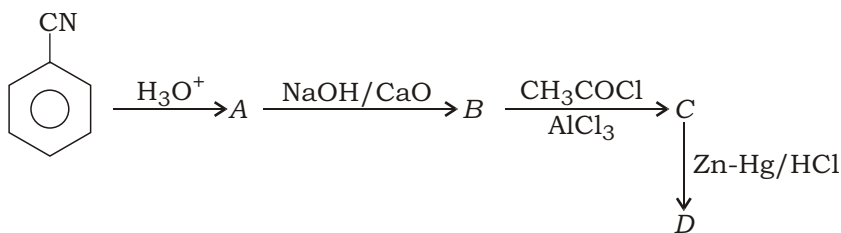
- (a) Why limiting molar conductivity of CH_3COOH cannot be determined experimentally? 1
- (b) Write two conditions necessary for corrosion to occur. 1
- (c) State Faraday's first law of electrolysis. 1
- (d) Write the Nernst equation for the following reaction : 2



(10)

Or

- (e) Why does the blue colour of copper sulphate solution get discharged when iron is dipped into it? 1
- (f) What are fuel cells? 1
- (g) Write two functions of a salt bridge. 1
- (h) Write all the reactions taking place during recharging of lead storage cell. 2
- 26.** (a) Name a transition element which does not exhibit variable oxidation states. 1
- (b) Mention the steps involved in the preparation of $K_2Cr_2O_7$ from chromite ore. 2
- (c) Draw the structure of a dichromate ion. 1
- (d) Calculate the spin only magnetic moment of M^{2+} (aq) ion ($Z = 27$). 1
- 27.** *Either*
- (a) Formic acid reduces Tollens' reagent while acetic acid does not. Why? 1
- (b) Complete the following reaction : 2



(11)

- (c) Arrange the following in the increasing order of their acidic strengths : 1

Benzoic acid, 4-nitrobenzoic acid, 3,4-dinitrobenzoic acid, 4-methoxybenzoic acid

- (d) What type of aldehydes and ketones undergo aldol condensation? 1

Or

- (e) Name one reagent used to distinguish acetaldehyde from acetone. 1

- (f) With chemical equations and conditions, name an aldehyde which can produce primary alcohol with Grignard's reagent. 1

- (g) An alkene *A* with molecular formula (C_5H_{10}) on ozonolysis gives a mixture of two compounds *B* and *C*. Compound *B* gives positive Fehling's test and also reacts with iodine and NaOH solution. Compound *C* does not give Fehling's test but forms iodoform. Identify the compounds *A*, *B* and *C*. Write the reagents needed for ozonolysis. Also give the reaction for iodoform formation from either *B* or *C*. 3
