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.

(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 $[Co(NO_2)(NH_3)_5]Cl_2$ is

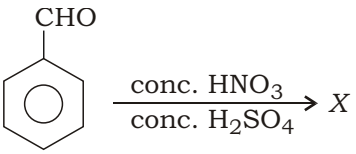
(a) pentaammine nitrito-N-cobalt(II) chloride

(b) nitrito-N-pentaammine cobalt(III) chloride

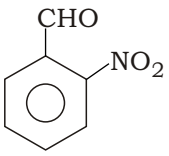
(c) pentaammine nitrito-N-cobalt(III) chloride

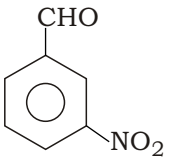
(d) nitrito-N-pentaammine cobalt(II) chloride 1

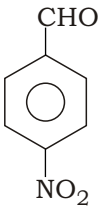
3. In the reaction

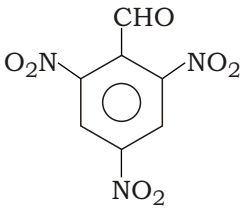


the compound *X* is

(a) 

(b) 

(c) 

(d) 

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

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

10. *Either*

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

$C_6H_5—NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$, $C_2H_5—NH_2$

(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

$C_6H_5—NH_2 \quad CHCl_3 \quad 3\,KOH\,(alc.) \quad ?$

11. *Either*

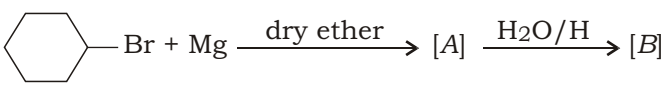
(a) A 5% solution of non-volatile solute in water has vapour pressure 745 mm at 373 K. Calculate the molar mass of the solute. 2

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 of H_2O 1 86 K kg mol ^{1}) 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

$E^{\circ}_{Cu^{2}\ /Cu}$ 0 34 V and $E^{\circ}_{Zn^{2}\ /Zn}$ 0 76 V 1½

(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 S cm^{2} mol^{1} and 76·34 S cm^{2} mol^{1} respectively. 1½

Or

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

$$Zn\,(s) \quad Ag_2O\,(s) \quad H_2O\,(l)$$
$$Zn^{2}\ (aq) \quad 2Ag(s) \quad 2\overline{O}H\,(aq)$$

where $E^{\circ}_{Zn^{2}\ /Zn}$ 0 76 V and $E^{\circ}_{Ag\ /Ag}$ 0 80 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

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 ^{1} mol ^{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 B_{12}. 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

$$C_6H_5—NH_2 + C_6H_5—OH \xrightarrow[(273\ K–278\ K)]{(NaNO_2 + HCl)} ?$$

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? ½+½=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 Mg^2 / Mg? 1

(b) Define 'pseudo first-order reaction' with a suitable chemical equation. 1+1=2

24. *(a)* Draw the geometrical isomers of $[Co(NO_2)_3(NH_3)_3]$. ½+½=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. ½+½=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

$2Cr \quad 3Fe^2 \qquad 2Cr^3 \quad 3Fe$

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

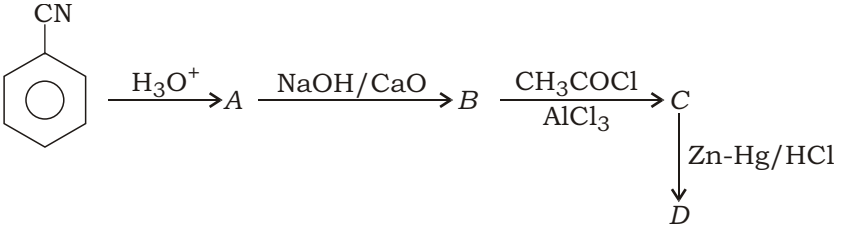
(c) Draw the structure of a dichromate ion. 1

(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



(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

★★★