

Total No. of Printed Pages—11

**HS/XII/Sc/Ch/22**

**2 0 2 2**

**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 in 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 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, an internal choice has been provided in all five questions of *1* mark, three questions of *2* marks, in four questions of *3* marks and two questions of *5* marks weightage. Students have to attempt only one of the choices in such questions.

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- (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. NaCl does not show Frenkel defect because

- (a) cations and anions have almost equal size
- (b) there is large differences in size of cations and anions
- (c) cations and anions have low coordination number
- (d) anions cannot be accommodated in voids

1

2. The colligative properties of a dilute solution depend upon the

- (a) nature of solute
- (b) number of particles of solute
- (c) number of particles of solvent
- (d) nature of solvent

1

( 3 )

3. Shape selective catalysis is a reaction catalysed by

- (a) zeolite
- (b) enzymes
- (c) platinum
- (d) Ziegler-Natta catalyst

1

4. The reaction of ethylbromide with NaI in dry acetone to give ethyliodide is called

- (a) Finkelstein reaction
- (b) Swarts reaction
- (c) Wurtz reaction
- (d) Wurtz-Fittig reaction

1

5. The correct order of boiling points for primary ( $1^\circ$ ), secondary ( $2^\circ$ ) and tertiary ( $3^\circ$ ) alcohols is

- (a)  $1^\circ > 2^\circ > 3^\circ$
- (b)  $3^\circ > 2^\circ > 1^\circ$
- (c)  $2^\circ > 1^\circ > 3^\circ$
- (d)  $2^\circ > 3^\circ > 1^\circ$

1

SECTION—B

6. (a) How many atoms are there in a unit cell of a metal crystallizing in f.c.c. structure? 1
- (b) What type of impurity should be added to group-14 elements to convert into *n*-type semiconductor? 1
7. The rate constant for a reaction of zero order in *A* is  $0.0030 \text{ mol L}^{-1}\text{s}^{-1}$ . How long will it take for the initial concentration of *A* to fall from  $0.10 \text{ M}$  to  $0.075 \text{ M}$ ? 2
8. *Either*
- (a) Calculate the mole fraction of ethylene glycol ( $\text{C}_2\text{H}_6\text{O}_2$ ) in a solution containing 20% of ethylene glycol by mass. 2
- Or*
- (b)  $200 \text{ cm}^3$  of an aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300 K is found to be  $2.57 \times 10^{-3} \text{ bar}$ . Calculate the molar mass of the protein ( $R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$ ). 2
9. X-ray diffraction studies show that copper crystallises in an f.c.c. unit cell with cell edge of  $3.608 \times 10^{-8} \text{ cm}$ . In a separate experiment, copper is determined to have a density of  $8.92 \text{ g/cm}^3$ . Calculate the atomic mass of copper. 2

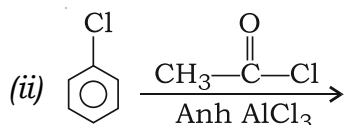
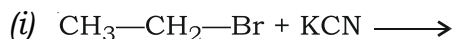
( 5 )

10.

*Either*

(a) Complete the following reactions :

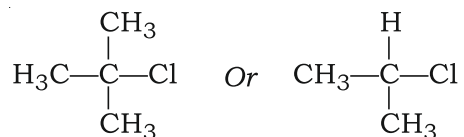
1+1



*Or*

(b) In the following pair of halogen compounds, which compound will react faster by  $\text{S}_{\text{N}}1$  mechanism? Why?

1+1



11. How will you carry out the following conversions?

(a) Propene to propan-1-ol

1

(b) Ethylchloride to propanoic acid

$\frac{1}{2} + \frac{1}{2} = 1$

12.

*Either*

(a) Why  $\text{Zn}^{2+}$  is colourless whereas  $\text{Mn}^{2+}$  is violet in colour?

2

*Or*

(b) Explain why  $\text{Cr}^{+2}$  is a good reducing agent and  $\text{Mn}^{+3}$  is a good oxidising agent even though both ions have the same  $d^4$  configuration.

2

SECTION—C

- 13.** (a) Differentiate between physisorption and chemisorption. 2
- (b) Out of  $\text{MgCl}_2$  and  $\text{AlCl}_3$  which one is more effective in causing coagulation of negatively charged sol and why? 1
- 14.** *Either*
- (a) Derive the integrated rate equation for the first-order reaction. Hence prove that half-life period is independent of initial concentration of the reactant. 3
- Or*
- (b) Time for half-life change for a first-order reaction is 25 sec. Find the time taken for the completion of 99.9% reaction. 2
- (c) Calculate the overall order of a reaction which has the rate expression of  
$$\text{Rate} = K[A]^{1/2} [B]^{3/2}$$
 1
- 15.** (a) What will happen to the vapour pressure of a pure liquid on addition of non-volatile solute? 2
- (b) State Henry's law on solubility of a gas in liquid. 1
- 16.** (a) How do you account for the reducing behaviour of  $\text{H}_3\text{PO}_2$  on the basis of its structure? 1
- (b) Explain why phosphorus forms  $\text{PCl}_5$  whereas N does not form  $\text{NCl}_5$ . 1
- (c) Why is  $\text{H}_2\text{O}$  a liquid and  $\text{H}_2\text{S}$  a gas? 1

( 7 )

17. (a) Why do transition elements show variable oxidation states? 1
- (b) What is lanthanoid contraction? 1
- (c) Give the ionic equation when acidified  $\text{KMnO}_4$  reacts with ferrous sulphate. 1

18. *Either*

- (a) Write the IUPAC name of the following complex : 1
- $[\text{Cr}(\text{NH}_3)_3(\text{H}_2\text{O})_3]\text{Cl}_3$
- (b) What are chelating ligands? 1
- (c) Why are geometrical isomers not possible in tetrahedral complexes? 1

*Or*

- (d) Explain according to CFT  $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$  is coloured while  $[\text{Ti}(\text{H}_2\text{O})_6]^{+4}$  is colourless. 2
- (e) Draw the geometrical isomers of  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ . 1

19. (a) Name the ore from which aluminium is extracted. Write its composition. 1
- (b) Write the chemical reaction which takes place in Mond's process for refining of nickel. 2

20. *Either*

- (a) Arrange the following in increasing order of their acid strength : 1
- $\text{H}_2\text{O}$ ,  $\text{CH}_3\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_6\text{H}_5\text{OH}$
- (b) Why electrophilic substitution in phenols takes place at *ortho*- and *para*-position? 1

( 8 )

- (c) Why are alcohols more soluble in water than hydrocarbons of comparable molecular mass? 1

*Or*

- (d) Give the chemical test to distinguish between phenol and benzoic acid. 1

- (e) Explain the following observations : 1+1

(i) The boiling point of ethanol is higher than that of methoxy methane.

(ii) Phenol is more acidic than ethanol.

- 21.** (a) What is carbylamine reaction? 1

- (b) Why is aniline less basic than ethanamine? 1

- (c) Write the product obtained in bromination of aniline in aqueous medium. 1

- 22.** *Either*

- (a) What is glycosidic linkage? 1

- (b) What are the products obtained on hydrolysis of sucrose? 1

- (c) Name the vitamin whose deficiency is responsible for night blindness. 1



( 9 )

Or

- (d) What is a reducing sugar? 1
- (e) Which  $\alpha$ -amino acid is not optically active? 1
- (f) Name the bases derived from purines and pyrimidines. 1
- 23.** (a) Name the monomers of bakelite. 1
- (b) What is a biodegradable polymer? Give example. 1+1
- 24.** (a) What are antacids? Give one example. 1
- (b) Name two artificial sweetening agents. 1
- (c) Write the difference between antiseptics and disinfectants. 1

SECTION—D

**25.** *Either*

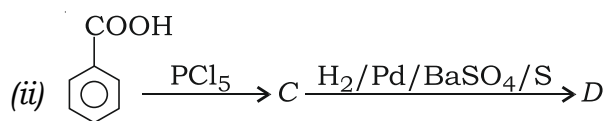
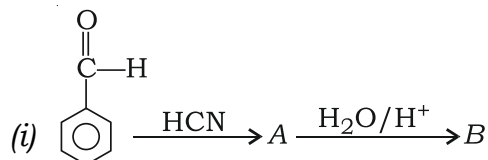
- (a) Calculate the equilibrium constant of the reaction :  
$$\text{Cu(s)} + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Cu}^{+2}(\text{aq}) + 2\text{Ag(s)}$$
  
Given  $E_{\text{cell}}^{\circ} = 0.46 \text{ V}$ . 2
- (b) State Faraday's first law of electrolysis. 1
- (c) How many coulombs of charge are required to produce 20 g of Ca from  $\text{CaCl}_2$ ? 2

( 10 )

Or

- (d) Define Kohlrausch's law of independent migration of ions. 1
- (e) A solution of  $\text{CuSO}_4$  is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode? (Given atomic mass of Cu =  $63 \text{ g mol}^{-1}$ ) ( $1\text{F} = 96500 \text{ C mol}^{-1}$ ) 2
- (f) How much charge is required for the reduction of 1 mol of  $\text{Cu}^{2+}$  to Cu? 1
- (g) Why does the conductivity of a solution decrease with dilution? 1

26. (a) Identify the products A, B, C and D from the following sequence of reactions : 1+1



- (b) Give the structure of the products expected from the following reactions : 1+1
- (i) 2-butanone is treated with Zn/Hg and conc. HCl.
- (ii) Two molecules of benzaldehyde are treated with conc. NaOH.
- (c) Convert toluene to benzaldehyde. 1

27.

*Either*

- (a) Fluorine has only  $-1$  oxidation state but other halogens have oxidation states as  $+1$ ,  $+3$ ,  $+5$ ,  $+7$  also. Give reasons. 1
- (b) What are interhalogens compounds? Why is  $\text{I}-\text{Cl}$  more reactive than  $\text{I}_2$ ? 1+1
- (c) Mention the conditions required to maximise the yield of ammonia by Haber's process. 2

*Or*

- (d) Write down the steps involved in the manufacture of  $\text{HNO}_3$  by Ostwald process. 2
- (e) Noble Gases have very low boiling points. Why? 1
- (f) What happens when—
- (i) concentrated  $\text{H}_2\text{SO}_4$  is added to calcium fluoride; 1
- (ii)  $\text{XeF}_4$  is treated with  $\text{H}_2\text{O}$ ? 1

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