Total No. of Printed Pages—11

HS/XII/Sc/Ch/22

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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.

(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. 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°), secondary (2°) and tertiary (3°) alcohols is

(a) 1° > 2° > 3°

(b) 3° > 2° > 1°

(c) 2° > 1° > 3°

(d) 2° > 3° > 1° 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 $0{\cdot}0030\ \text{mol}\ L^{-1}s^{-1}$. How long will it take for the initial concentration of A to fall from $0{\cdot}10\ M$ to $0{\cdot}075\ M$? 2

8. *Either*

(a) Calculate the mole fraction of ethylene glycol ($C_2H_6O_2$) in a solution containing 20% of ethylene glycol by mass. 2

Or

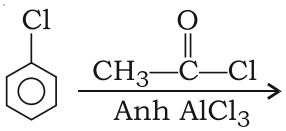
(b) $200\ cm^3$ of an aqueous solution of a protein contains $1{\cdot}26$ g of the protein. The osmotic pressure of such a solution at 300 K is found to be $2{\cdot}57 \times 10^{-3}$ bar. Calculate the molar mass of the protein ($R = 0{\cdot}083$ L bar $mol^{-1}\ K^{-1}$). 2

9. X-ray diffraction studies show that copper crystallises in an f.c.c. unit cell with cell edge of $3{\cdot}608 \times 10^{-8}$ cm. In a separate experiment, copper is determined to have a density of $8{\cdot}92\ g/cm^3$. Calculate the atomic mass of copper. 2

10. *Either*

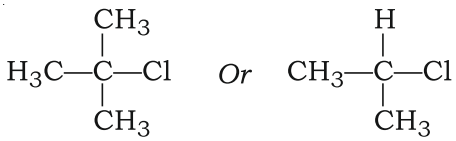
(a) Complete the following reactions : 1+1

(i) $CH_3—CH_2—Br + KCN \longrightarrow$

(ii) 

Or

(b) In the following pair of halogen compounds, which compound will react faster by S_N1 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 ½+½=1

12. *Either*

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

Or

(b) Explain why Cr^{+2} is a good reducing agent and 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 $MgCl_2$ and $AlCl_3$ 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 H_3PO_2 on the basis of its structure? 1

(b) Explain why phosphorus forms PCl_5 whereas N does not form NCl_5. 1

(c) Why is H_2O a liquid and H_2S a gas? 1

17. *(a)* Why do transition elements show variable oxidation states? 1

(b) What is lanthanoid contraction? 1

(c) Give the ionic equation when acidified $KMnO_4$ reacts with ferrous sulphate. 1

18. *Either*

(a) Write the IUPAC name of the following complex : 1

$$[Cr(NH_3)_3(H_2O)_3]Cl_3$$

(b) What are chelating ligands? 1

(c) Why are geometrical isomers not possible in tetrahedral complexes? 1

Or

(d) Explain according to CFT $[Ti(H_2O)_6]^{+3}$ is coloured while $[Ti(H_2O)_6]^{+4}$ is colourless. 2

(e) Draw the geometrical isomers of $[Co(NH_3)_4Cl_2]^+$. 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 :

$$H_2O,\quad CH_3OH,\quad C_2H_5OH,\quad C_6H_5OH$$ 1

(b) Why electrophilic substitution in phenols takes place at *ortho*- and *para*-position? 1

(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

Or

(d) What is a reducing sugar? 1

(e) Which α-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 :

$$Cu(s) + 2\,Ag^{+}(aq) \rightarrow Cu^{+2}(aq) + 2\,Ag(s)$$

Given $E^{\circ}_{cell} = 0 \cdot 46$ 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 $CaCl_2$? 2

Or

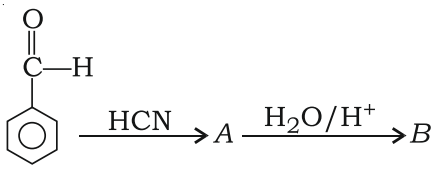
(d) Define Kohlrausch's law of independent migration of ions. 1

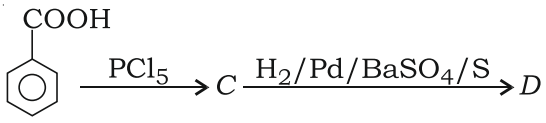
(e) A solution of $CuSO_4$ is electrolysed for 10 minutes with a current of 1·5 amperes. What is the mass of copper deposited at the cathode? (Given atomic mass of Cu = 63 g mol^{-1}) (1F = 96500 C mol^{-1}) 2

(f) How much charge is required for the reduction of 1 mol of 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

(i) 

(ii) 

(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 I—Cl more reactive than 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 HNO_3 by Ostwald process. 2

(e) Noble Gases have very low boiling points. Why? 1

(f) What happens when—

(i) concentrated H_2SO_4 is added to calcium fluoride; 1

(ii) XeF_4 is treated with H_2O? 1

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