

Total No. of Printed Pages—12

HS/XII/Sc/Ch/24

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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 carrying *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, an internal choice has been provided in four questions of 2 marks, four questions of 3 marks, and all three 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

(Marks : 5)

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

1. When benzoic acid is dissolved in benzene, the van't Hoff factor will be
 - (a) 1
 - (b) 0.5
 - (c) 2
 - (d) 1.5

1
2. A device that converts energy of combustion of fuels like hydrogen and methane directly into electrical energy is known as
 - (a) fuel cell
 - (b) electrolytic cell
 - (c) dynamo
 - (d) Nickel-Cadmium cell

1

(3)

3. The number of *d*-electrons in $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ ion (atomic number of Cr = 24) is

(a) 2

(b) 3

(c) 4

(d) 5

1

4. The existence of two different coloured complexes with composition of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]$ is due to

(a) linkage isomerism

(b) geometrical isomerism

(c) coordination isomerism

(d) ionization isomerism

1

5. The strongest acid among the following aromatic compounds is

(a) *o*-nitrophenol

(b) *p*-chlorophenol

(c) *p*-nitrophenol

(d) *m*-nitrophenol

1

(4)

SECTION—B

(Marks : 14)

6. *Either*

- (a) Show that the half-life period of a first-order reaction is independent of the initial concentration of the reactant.

2

Or

- (b) A first-order reaction has a rate constant of 10^{-3} sec^{-1} . How much time will it take for 10 g of the reactant to reduce to 2.5 g?

7. (a) When does average rate become equal to instantaneous rate?

1

- (b) Write any one condition under which a bimolecular reaction may kinetically become first order.

1

8. *Either*

- (a) Why are Mn^{2+} compounds more stable than Fe^{2+} compounds towards oxidation to their 3 state?

2

Or

- (b) Write any two consequences of lanthanoid contraction.

2

9. *Either*

- (a) Give one example of a complex showing linkage isomerism.

1

(5)

- (b) Write the IUPAC name of the complex $[\text{Cr}(\text{NH}_3)_3(\text{H}_2\text{O})_3]\text{Cl}_3$. 1

Or

- (c) Explain, on the basis of valence bond theory, why $[\text{NiCl}_4]^{2-}$ is paramagnetic while $[\text{Ni}(\text{CO})_4]$ is diamagnetic though both are tetrahedral. 2

10.

Either

- (a) Name the reagent(s) used in the following conversions : 1+1=2

(i) Ethanoic acid to ethanol

(ii) Bromination of phenol to 2,4,6-trinitrophenol

Or

- (b) How would you convert methyl magnesium bromide to 2-methyl propan-2-ol? 2

11. (a) Name two components of starch. 1

- (b) Which vitamin deficiency causes poor coagulation of blood? 1

12. (a) What do you mean by glycosidic linkage? 1

- (b) Write the structure of product formed when D-glucose is treated with NH_2OH . 1

(6)

SECTION—C

(Marks : 36)

13.

Either

- (a) Give one example of a solution showing positive deviation from Raoult's law. 1
- (b) The vapour pressure of pure benzene at certain temperature is 0.850 bar. A non-volatile non-electrolyte solute weighing 0.5 g is added to 39 g of benzene. The vapour pressure of the solution is 0.845 bar. What is the molar mass of the solute added? (Given, molar mass of benzene 78 g mol^{-1}) 2

Or

- (c) What are azeotropic mixtures? 1
- (d) Calculate the mole fraction of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) in an aqueous solution containing 20% of ethylene glycol by mass. 2
14. (a) What are isotonic solutions? 1
- (b) A solution is prepared by dissolving 60 g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in 250 g of water. Calculate the freezing point of the solution. (K_f for H_2O $1.86 \text{ K kg mol}^{-1}$) 2

15.

Either

- (a) What is the difference between electrochemical cell and electrolytic cell? 1
- (b) Why does a dry cell become dead after a long time even if it has been not in use? 1
- (c) What is cathodic protection? 1

(7)

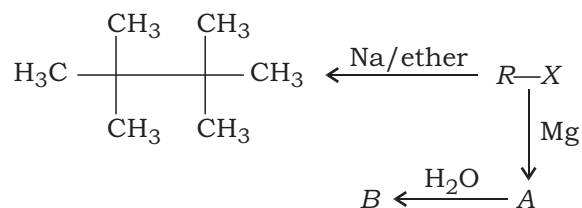
Or

- (d) When a current of 0.75 A is passed through CuSO_4 solution for 25 minutes, 0.369 g of copper is deposited at the cathode. Calculate the atomic mass of copper. ($F = 96500 \text{ C mol}^{-1}$) 2
- (e) Write the products of electrolysis of NaCl (aq) solution. 1
16. (a) What is the order of a reaction whose rate constant has same unit as the rate of reaction? 1
- (b) The rate constants of a reaction at 500 K and 700 K are 0.02 s^{-1} and 0.07 s^{-1} respectively. Calculate the activation energy of the reaction. ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$) 2
17. (a) What is crystal field splitting energy? 1
- (b) Write the coordination number and oxidation state of Pt in the complex $[\text{Pt(en)}_2\text{Cl}_2]$. 1
- (c) Name the type of hybridization of central metal atom in the complex $[\text{Fe(H}_2\text{O)}_6]^{2+}$. (Given atomic number of Fe = 26) 1
18. Either
- (a) Arrange the following compounds in order of their increasing boiling points : 1
- Bromomethane, Bromoform, Chloromethane, Dibromomethane

(8)

- (b) Identify A, B and R in the given sequence of reactions :

2



Or

- (c) Arrange the following compounds in order of their reactivity towards $\text{S}_{\text{N}}2$ reaction :

1

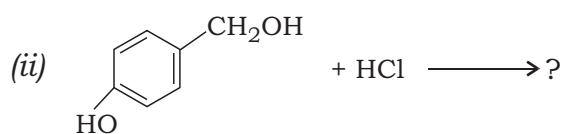
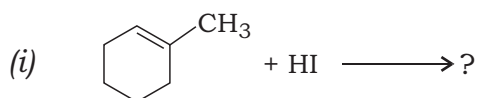
2-bromo-2-methylbutane, 1-bromobutane,
2-bromobutane

- (d) How would you convert 1-bromopropane to butanoic acid?

2

19. Complete the following reactions :

1×3=3



20.

Either

- (a) Write the chemical equation for Kolbe's reaction.

1

- (b) Give the mechanism of acid catalyzed hydration of ethene.

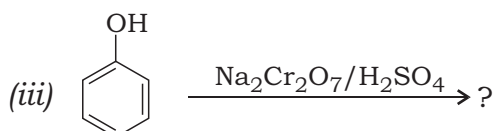
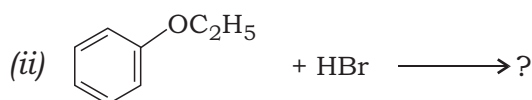
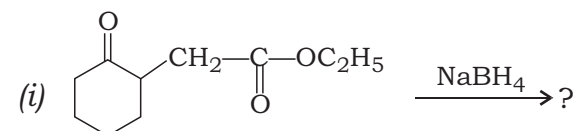
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(9)

Or

(c) Complete the following reactions :

1×3=3



21. (a) Arrange the following in increasing order of their acidic character :

1

HCOOH, CF₃COOH, ClCH₂COOH, CCl₃COOH

(b) How would you obtain the following?

1+1=2

(i) Benzoic acid from ethyl benzene

(ii) Butanoic acid from 1-chlorobutane

22. (a) Why do amines act as nucleophiles?

1

(b) How would you convert ethanoic acid into methanamine?

2

23. (a) Name a test to distinguish between aniline and N-methylaniline.

1

(b) Complete the following reactions :

1×2=2



(10)

24. (a) What are nucleotides? 1
- (b) What are essential and non-essential amino acids? 2
Give one example of each type.

SECTION—D

(Marks : 15)

25.

Either

- (a) Represent the cell in which the following cell reaction takes place :



Which one of the electrodes is negatively charged? 1+1=2

- (b) State Kohlrausch's law. 1
- (c) Calculate the molar conductivity of Al^{3+} ions at infinite dilution. Given that the molar conductivity of $\text{Al}_2(\text{SO}_4)_3$ and ionic conductivity of SO_4^{2-} ion at infinite dilution are $858 \text{ S cm}^2 \text{ mol}^{-1}$ and $160 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. 2

Or

- (d) What is electrochemical series? 1
- (e) Why is it necessary to use salt bridge in a galvanic cell? 1

(11)

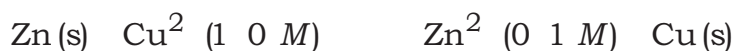
- (f) Arrange the following metals in increasing order of their reducing power :

Zn, Ag, Ni, Cu

Given :

$$\begin{array}{llll} E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} & 0.76 \text{ V}, & E_{\text{Ag}^{+}/\text{Ag}}^{\circ} & 0.80 \text{ V}, \\ E_{\text{Ni}^{2+}/\text{Ni}}^{\circ} & 0.25 \text{ V}, & E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} & 0.34 \text{ V} \end{array} \quad 1$$

- (g) The cell potential for the cell reaction



is 1.30 V at 25 °C . Calculate its standard cell potential. 2

26.

Either

- (a) Why do transition elements show variable oxidation states? 1
- (b) Why are Zn^{2+} salts white whereas Cu^{2+} salts are coloured? 1
- (c) Draw the structure of a permanganate ion (MnO_4^-). 1
- (d) Give the reactions of KMnO_4 with KI and FeSO_4 in acidic medium. 1+1=2

Or

- (e) Write the highest oxidation state shown by an element with atomic number 23. 1
- (f) What do you mean by disproportionation reaction? Give one example. 1+1=2

(12)

(g) Give reasons for the following : 1+1=2

- (i) Transition metals and their compounds generally exhibit paramagnetic behaviour.
- (ii) Manganese exhibits the highest oxidation state of +7 among 3d series of transition elements.

27.

Either

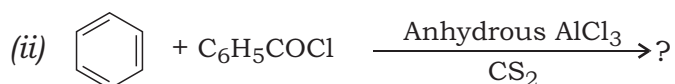
(a) Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions : 1

Ethanal, Propanal, Butanone, Propanone

(b) Identify the compounds A and B in the following sequence of reactions : 2



(c) Give the products of the following reactions : 1×2=2



Or

(d) Name the test to distinguish between propanal and propanone. 1

(e) How would you convert ethanal into but-2-enal in not more than two steps? 2

(f) Write the structures of A and B in the following sequence of reactions : 2



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