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.

(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. The number of *d*-electrons in $[Cr(H_2O)_6]^3$ 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 $[Co(NH_3)_4Cl_2]$ 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

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

(b) Write the IUPAC name of the complex $[Cr(NH_3)_3(H_2O)_3]Cl_3$. 1

Or

(c) Explain, on the basis of valence bond theory, why $[NiCl_4]^{2}$ is paramagnetic while $[Ni(CO)_4]$ 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

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 ($C_2H_6O_2$) 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 ($C_6H_{12}O_6$) in 250 g of water. Calculate the freezing point of the solution. (K_f for H_2O 1 86 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

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 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 J K ^{1} 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 $[Pt(en)_2Cl_2]$. 1

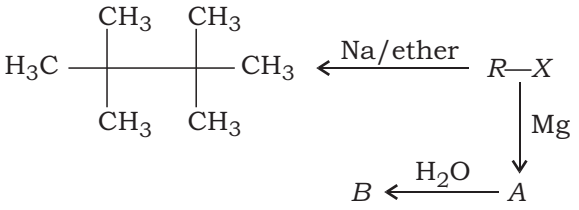
(c) Name the type of hybridization of central metal atom in the complex $[Fe(H_2O)_6]^{2}$. (Given atomic number of Fe 26) 1

18. *Either*

(a) Arrange the following compounds in order of their increasing boiling points : 1

Bromomethane, Bromoform, Chloromethane, Dibromomethane

(b) Identify *A*, *B* and *R* in the given sequence of reactions : 2



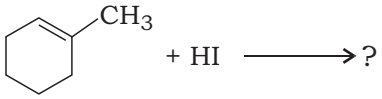
Or

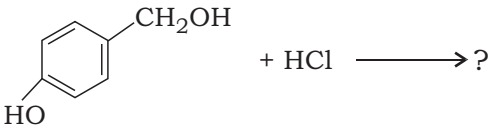
(c) Arrange the following compounds in order of their reactivity towards S_N2 reaction : 1

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

(i) 

(ii) 

(iii) $CH_3CH_2Br + AgCN \xrightarrow{\text{Ethanol}} ?$

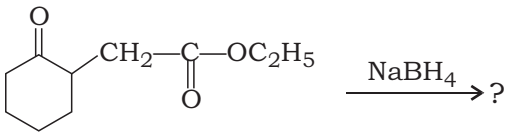
20. *Either*

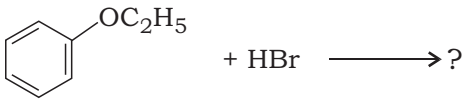
(a) Write the chemical equation for Kolbe's reaction. 1

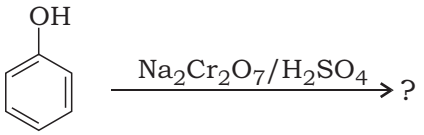
(b) Give the mechanism of acid catalyzed hydration of ethene. 2

Or

(c) Complete the following reactions : 1×3=3

(i) 

(ii) 

(iii) 

21. *(a)* Arrange the following in increasing order of their acidic character : 1

$HCOOH, CF_3COOH, ClCH_2COOH, CCl_3COOH$

(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

(i) $C_6H_5N_2Cl \xrightarrow{CuCN} ?$

(ii) $C_6H_5CN \xrightarrow{LiAlH_4} ?$

24. *(a)* What are nucleotides? 1

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

SECTION—D

(*Marks* : 15)

25. *Either*

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

$$Zn\,(s) \quad 2Ag\ (aq) \qquad Zn^{2}\ (aq) \quad 2Ag\,(s)$$

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 $Al_2(SO_4)_3$ and ionic conductivity of SO_4^{2} ion at infinite dilution are 858 S cm^{2} mol^{1} and 160 S cm^{2} 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

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

Zn, Ag, Ni, Cu

Given :

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

$E^{\circ}_{Ni^{2}/Ni}$ 0 25 V, $E^{\circ}_{Cu^{2}/Cu}$ 0 34 V 1

(g) The cell potential for the cell reaction

$Zn(s)$ Cu^{2} (1 0 *M*) Zn^{2} (0 1 *M*) $Cu(s)$

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

(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 3*d* 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

$$CH_3CH_2COOH \xrightarrow{SOCl_2} A \xrightarrow{H_2/Pd/BaSO_4/S} B$$

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

(i) $CH_3CH_2CH_2CHO \xrightarrow{NH_2—NH_2} ?$

(ii)  $+ C_6H_5COCl \xrightarrow[CS_2]{\text{Anhydrous } AlCl_3} ?$

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

$$CH_3COCH_3 \xrightarrow{LiAlH_4} A \xrightarrow{\text{conc.}H_2SO_4/} B$$

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