2024

CHEMISTRY

(Theory)

Full Marks : 70

Pass Marks : 21

Time : Three hours

All the questions are compulsory.

The figures in the right margin indicate full marks for the questions.

Question Nos. 1 – 10 are Very Short Answer (VSA) types of 1 mark each.

1. Write down the electrochemical reactions that takes place in the corrosion of iron. 1

2. State the hybridisation involved in the complex $[CoF_6]^{-3}$ 1

3. In general, what happens to the rate of reaction as the reaction progresses ? 1

4. Write the product formed when benzene diazonium chloride is treated with aniline in the presence of dilute hydrochloric acid. 1

5. What type of deviation from Raoult's law is observed when chloroform and acetone are mixed? 1

6. Identify the product obtained when phenol is heated with chromic acid. 1

7. The molar conductivity of 2.5×10^{-2} M of methanoic acid is 46.1 S cm^2 mol^{-1}. Calculate the degree of dissociation. (Molar conductivity of H$^+$ and HCOO$^-$ at infinite dilutions are $\lambda^\circ_{H^+} = 349.6$ S cm^2 mol^{-1} and $\lambda^\circ_{HCOO^-} = 54.6$ S cm^2 mol^{-1}).

1

8. Alkyl halides react with sodium in dry ether to form symmetrical alkanes containing double the number of carbon atoms present in the halides. Name the reaction.

1

9. Blood cells are isotonic with 0.9% of NaCl solution. What happens if we placed blood cells in 1.2% of NaCl solution ?

1

10. The rate of hypothetical reaction $A + B \rightarrow C$ is rate $= k\,[C]^{3/2}\,[B]^{-1}$. What is the order of the reaction ?

1

Question Nos. 11-17 are Objective types carrying of 1 mark each. Choose and rewrite the best answer out of the given alternatives.

11. The magnetic moment of Mn^{+2} in aqueous solution is –

1

    (A) 2.84 B.M

    (B) 3.87 B.M

    (C) 4.90 B.M

    (D) 5.92 B.M

12. According to Raoult's law, the relative lowering of vapour pressure is equal to –

1

    (A) Molarity of the solution

    (B) Molality of the solution

    (C) Mole fraction of the solute

    (D) Mole fraction of the solvent

13. Which of the following hormone is responsible in keeping the blood glucose level within a narrow limit ?   1

    (A)   Thyroxine

    (B)   Epinephrine

    (C)   Insulin

    (D)   Bile-acids

14. The activation energies of the forward and backward reactions are 15 kcal/mol and 20 kcal/mol. Then the change in ΔH is –   1

    (A)   5 kcal/mol

    (B)   – 35kcal/mol

    (C)   15 kcal/mol

    (D)   25 kcal/mol

15. Ethanol and dimethyl ether form a pair of functional isomers. The boiling point of ethanol is higher than that of dimethyl ether, due to the presence of –   1

    (A)   H-bonding in dimethyl ether

    (B)   H-bonding in ethanol

    (C) CH_3CH_2 group of ethanol

    (D) CH_3 group of dimethyl ether

16. A coordination compound is colourless due to –   1

    (A)   the absence of ligand

    (B)   loss of water molecules

    (C)   d-d transtition of the electron

    (D)   energy of crystal field splitting energy

17. Formalin is an aqueous solution of –   1

    (A) formic acid

    (B) formaldehyde

    (C) ethanol

    (D) acetic acid

Question Nos. 18-27 are Short Answer (SA-II) types and each carries 2 marks.

18. Man should take water soluble vitamines regularly. Give reason.   2

19. State Faraday's laws of electrolysis.   2

20. The preparation of ether by acid catalysed dehydration of secondary or tertiary alcohol is not a suitable method. Give reasons.   2

21. Why $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral ? (Atomic number of Ni=27)   2

22. Explain the following observations :   2

    (i)   The basic character of aniline or other aromatic amines are less than that of ammonia.

    (ii) The molecular weights of $C_4H_9NH_2$ and $(C_2H_5)_2NH$ are same whereas the boiling points of $C_4H_9NH_2$ and $(C_2H_5)_2NH$ are different.

23. Define collision frequency and effective collisions.   2

24. What are nucleic acids? Name the bond holding –CO and –NH –groups to give α – helix and β – pleated sheet structure of proteins.   2

25. Compare the chemistry of actinoids with that of lanthanoids with reference to their (i) electronic configuration and (ii) oxidation state.   2

26. What are colligative properties? Give an example.   2

27. Chlorobenzene reacts with methyl chloride in presence of anhydrous aluminium chloride to form two products. Identify the major product and give its IUPAC name. 2

Question Nos. 28 – 33 are Short Answer (SA-I) types and each carries 3 marks.

28. **Either**

(a) On the basis of crystal field theory, write the electronic configuration of d^4 in terms of t_{2g} and e_g in an octahedral field when

(i) $\Delta o < P$ and (ii) $\Delta o > P$

(b) What is the value of crystal field splitting energy for high spin d^4 octahedral complex ? 2+1=3

Or

(c) Write the formula of dichloridobis (ethane −1, 2-diammine) cobalt(III)chloride.

(d) Draw the geometrical isomer of this coordination compound which is optically active.

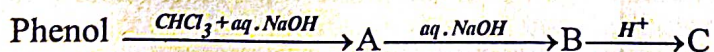(e) Give the coordination number of the metal ion. 1+1+1=3

29. **Either**

Give two general methods for preparation of ammine. 3

Or

Convert aniline to benzoic acid. 3

30. **Either**

In the following sequence of reactions 1+1+1=3

Phenol $\xrightarrow{CHCl_3 + aq.NaOH}$ A $\xrightarrow{aq.NaOH}$ B $\xrightarrow{H^+}$ C

Identify A, B and C.

2 Chm (T) 17/2 5 P.T.O.

Or

Convert phenol to salicylaldehyde. 3

30. **Either**

The half-life period of a first order reaction is independent of initial concentration of the reactant. Justify the statement. 3

Or

A catalyst increases the rate reaction without itself undergoing any permanent chemical change. Explain this phenomenon. 3

31. **Either**

(a) Give reasons for the following observations. 1+1+1=3

(i) Propan-2-ol is an achiral molecule.

(ii) The treatment of alkyl chloride with aq. KOH gives alcohol but in presence of alc. KOH form alkene as major product.

(iii) 2-chloropropane undergoes faster reaction towards SN_1 than 1-chloro propane.

Or

(b) Haloarenes are much less reactive than haloalkanes towards nucleophilic reactions. Give reason. 3

33. **Either**

Phenol in water partially associates to give dimer molecule. 0.94 g C_6H_5OH dissolved in 50 g water freezes at $-0.21°C$. Calculate van't Hoff factor (molal freezing point of water is 1.86°C) of the solution. 3

Or

H_2SO_4 used in lead storage cell is 38% by weight and its density is 1.30 gcm^{-3}. Calculate the molality of the H_2SO_4 solution.   3

Question Nos. 34 - 36 are Essay (E) types and each carries 5 marks.

Either

34.

(a) Describe the preparation of potassium permanganate from pyrolusite ore. Write the chemical equation for one reaction to show the oxidising nature of potassium permanganate.   4+1=5

Or

5

(b) Explain the following :

  (i)   the effect of increasing pH on a solution of potassium dichromate.

  (ii)   Manganese shows maximum number of oxidation states in 3d series of transition metals.

Either

35.

Establish a relation between concentrations of the electrolytes and cell potential of a cell.   5

Or

Discuss the variations of molar and equivalent conductances with dilution.   5

Either

36.

(a) An organic compound [A] with molecular formula $C_9H_{10}O$ forms an orange precipitate [B] with 2,4-DNP reagent. Compound [A] gives yellow precipitate [C] on heating with iodine in presence of sodium hydroxide along with a colourless compound [D].The compound [A] does not reduce Tollen's reagent or Fehling's reagent nor it decolorise bromine water. On drastic

oxidation with chromic acid, compound [A] gives a carboxylic acid [D] having molecular formula $C_7H_6O_2$. Deduce the structures of the compounds [A] to [D]. 5

Or

(b) Predict the product when carboxylic acid reacts with the following reagents :

    (i)   Alcohols in presence of mineral acids

    (ii)   Ammonia at high temperatures

    (iii) P_2O_5 at high temperatures

    (iv) Na metal

    (v)   Thionyl chloride   5

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