HAND BOOK
For success in EXAMINATION

II PUC
Chemistry

Model Question Papers with Answers

As per NCERT Syllabus

A **HAND BOOK** for Success in **EXAMINATION**
II PUC Chemistry - Model Question Papers with Answers

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* * *

Chapter/ Content domain/ Unit/ Theme	Number of hours	Marks	Remember (≈ 40%)				Understand (≈ 30%)				Apply (≈ 15 TO 20%)				HOTS (≈ 10 TO 15%)			
			VSA (01 Mark)	SA (02 Marks)	SA (03 Marks)	LA	VSA (01 Mark)	SA (02 Marks)	SA (03 Marks)	LA	VSA (01 Mark)	SA (02 Marks)	SA (03 Marks)	LA	VSA (01 Mark)	SA (02 Marks)	SA (03 Marks)	LA
Physical Chemistry																		
Solutions	14	13	1	-	1 (T)	-	-	-	-	-	1	1	1 (NP)	-	-	-	1 (NP)	-
Electrochemistry	14	14	1	-	1 (T)	-	-	-	1 (T)	-	1	-	-	-	1	-	2 (NP)	-
Chemical Kinetics	14	13	1	-	1 (T)	-	1	1	-	-	-	-	1 (NP)	-	-	-	1.(NP)	-
Inorganic Chemistry																		
The d & f - Block Elements	12	11	1	-	1	-	-	-	1	1	-	-	1	-	1	-	-	-
Coordination Compounds	12	12	-	-	2	-	1	1	1	-	-	-	-	-	-	-	-	-
Organic Chemistry																		
Haloalkanes and Haloarenes	10	09	1	-	-	-	1	-	-	1	-	1	-	-	-	-	-	-
Alcohols, Phenols and Ethers	12	12	1	-	-	1	1	-	-	1	-	-	-	1	-	-	-	-
Aldehydes, Ketones and Carboxylic Acids	14	14	1	1	-	1	1	-	-	-	-	-	-	1	1	-	-	-
Amines	08	08	1	-	-	-	1	-	-	1	-	-	-	-	1	-	-	-
Biomolecules	10	09	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-
Total Teaching Hours & Marks	120	115	09	04	18	15	07	04	09	15	01	04	09	05	03	00	12	00
			46				35				19				15			
Total Questions		49	09	02	06	03	07	02	03	03	01	02	03	01	03	00	04	00

1. Weightage = Total marks/Number of teaching hours = 115/120 = 0.96 (i.e., 0.96 marks for each hour)
2. Choice = out of 49 Questions only 35 Questions are to be answered.

Note: T = Theory;   NP = Numerical Problems;   VSA = Very Short Answer (MCQ's and Fill in the Blanks); SA= Short Answer; LA = Long Answer

SUBJECT: CHEMISTRY-34   BLUE PRINT   CLASS: II PUC

Question Paper Part	Question Type	Number of Questions	Marks
PART - A	MCQ's	15/15	15/15
PART - A	Fill in the blanks	05/05	05/05
PART -B	Short Answer (SA = 02 Marks)	03/06	06/12
PART - C	Short Answer (SA = 03 Marks) Inorganic Chemistry	03/06	09/18
PART - C	Short Answer (SA = 03 Marks) Physical Chemistry	02/04	06/12
PART- D	Long Answer (LA = 05Marks)	04/07	20/35
PART - E	Short Answer (SA = 03Marks) **Numerical problems**	03/06	09/18
	Total	**35/49**	**70/115**

WEIGHTAGE

Objectives	Number of Questions	Marks	Percentage
Remember	20	46	40%
Understanding	15	35	30%
Apply	07	19	17%
Hots	07	15	13%
Total	**49**	**115**	**100%**

DEPARTMENT MODEL QUESTION PAPER
II PUC - CHEMISTRY(34)

Time: 3 Hrs. 15 Mints. (Total No. of questions: 49)   **Max. Marks : 70**

Instructions:

1. *Question paper has FIVE parts. All parts are compulsory.*
2. *a) Part-A carries 20 marks. Each question carries 1 mark. b) Part-B carries 06 marks. Each question carries 2 marks. c) Part-C carries 15 marks. Each question carries 3 marks. d) Part-D carries 20 marks. Each question carries 5 marks. e) Part-E carries 09 marks. Each question carries 3 marks.*
3. *In Part-A questions, first attempted answer will be considered for awarding marks.*
4. *Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.*
5. *Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.*
6. *Use log tables and simple calculator if necessary (Use of scientific calculators is not allowed.)*

PART-A

I Select the correct option from the given choices: **1 × 15 = 15**

1. Aquatic species are more comfortable in cold water rather than in warm water. This is due to
   a) solubility of oxygen is more in warm water.
   b) solubility of oxygen is more in cold water.
   c) solubility of gases increases with decrease of temperature.
   d) both (b) and (c).

2. Which of the following cell was used in Apollo space programme?
   a) Mercury cell   b) Daniel cell
   c) H_2–O_2 Fuel cell   d) Dry cell

3. During electrolysis of aqueous solution of NaCl, the reaction preferred at anode is

   a) $2H_2O_{(l)} \rightarrow Og_{(g)} + 4H^+_{(aq)} + 4e^-$ b) $2H_2O_{(l)} + e^- \rightarrow \frac{1}{2}H_{2(g)} + OH^-$

   c) $Cl^-_{(aq)} \rightarrow \frac{1}{2}Cl_{2(q)} + e^-$ d) $\frac{1}{2}Cl_{2(g)} + e^- \rightarrow Cl^-_{(aq)}$

4. Order of a reaction is determined by
   a) balanced chemical equation   b) unbalanced chemical reaction
   c) experimental rate expression   d) thermo-chemical equation

5. Ionic character decreases in the following oxides.

   a) $Mn_2O_7 > MnO_2 > MnO$ b) $MnO > MnO_2 > Mn_2O_7$

   c) $Mn_2O_7 > MnO > MnO_2$ d) $MnO > Mn_2O_7 > MnO_2$

6. The oxidation state of Fe in $[Fe(CO)_5]$ is

   a) + 2   b) 0   c) + 3   d) + 5

7. The gases liberated when primary alcohols react with thionyl chloride are

   a) SO_2 and H_2 b) H_2 and HCl   c) SO_2 and HCl   d) NO_2 and H_2

8. Phenol molecule is less stable than phenoxide ion because

   a) phenol resonance structures have charge separation but not in phenoxide ion.

   b) phenoxide ion resonance structures have charge separation but not in phenol.

   c) both Phenoxide ion and phenol resonance structures have charge separation

   d) both Phenoxide ion and phenol resonance structures do not have charge separation

9. Glycerol is an example for

   a) dihydric alcohol   b) dihydric phenol

   c) trihydric phenol   d) trihydric alcohol

10. Tollen's reagent is a

    a) silver nitrate solution   b) ammonical silver nitrate solution

    c) ammonium nitrate solution   d) silver chloride solution

11. Carboxylic acids exists in dimeric form even in vapour phase due to

    a) Hydrogen bond   b) peptide bond

    c) ionic bond   d) metallic bond

12. The state of hybridization of orbitals of Nitrogen atom in amines is;

    a) sp^2 b) sp^3 c) sp   d) dsp^2

13. Benzene diazonium chloride reacts with phenol to form p-hydroxy azobenzene in

    a) acidic medium   b) neutral medium

    c) basic medium   d) both acidic and neutral medium

14. Thiamine is a chemical name of;

    a) Vitamin A   b) Vitamin B1   c) Vitamin C   d) Vitamin K

15. The nitrogenous base adenine form hydrogen bonding with

    a) Thymine   b) Cytosine

    c) Guanine   d) None of the above

II Fill in the blanks by choosing the appropriate word from those given in the brackets: 5 × 1 = 5

[phosgene, tin, hydrogen, molecularity, zinc, cellulose acetate]

16. The semi permeable membrane used in the reverse osmosis is _____.

17. The number of molecules taking part in the elementary reaction is called _____.

18. The non-transitional metal present in brass is _____.

19. The poisonous gas formed when chloroform is exposed to air and light is _____.

20. Solubility of ethylamine in water is due to formation of _____ bonding with water.

PART-B

III. Answer any three of the following. Each question carries two marks.

3 × 2 = 06

21. How does the boiling point of solvent varies, when a non-volatile solute is dissolved in it? Give reason.

22. Define order of a reaction. For which order reaction the unit of rate of reaction and rate constant is same?

23. What are chelate ligands? Give an example.

24. Write the general equation for Finkelstein reaction. What is the role of dry acetone in this reaction?

25. Complete the equation and name the reaction: $R - \overset{\displaystyle O}{\overset{\|}{C}} - CH_3 \xrightarrow{\text{NaOX}}$

26. Name two hormones which regulate the glucose level in the blood.

PART - C

IV. Answer any three of the following. Each question carries three marks. 3 × 3 = 09

27. Calculate the spin only magnetic moment of $M^{3+}_{(aq)}$ ion. (Z = 24)

28. Explain the structure of dichromate ion $(Cr_2O_7^{2-})$.

29. What is Lanthanoid contraction? Mention two of its consequences.

30. Write the IUPAC names and the type of isomerism for the following complexes

(a) $[Co(NH_3)_5 Br] SO_4$ and (b) $[Co(NH_3)_5 SO_4] Br.$

31. Using Valence Bond Theory [VBT], explain geometry, hybridisation and magnetic property of $[CoF_6]^{-3}$ ion. [Atomic number of Cobalt is 27].

32. Draw the energy level diagram for the crystal field splitting in tetrahedral complexes. Write the relation between Δ_0 and Δ_t for the complexes having same metal, the same ligand and metal-ligand distances.

V. Answer any two of the following. Each question carries three marks.

$$2 \times 3 = 06$$

33. Write any three differences between ideal and non-ideal solutions.

34. State Kohlrausch's law of independent migration of ions. Mention two applications of it.

35. Explain the experimental determination of conductance of electrolytic solution by using Wheatstone bridge.

36. Derive integrated rate equation for first order gas phase reaction.

PART - D

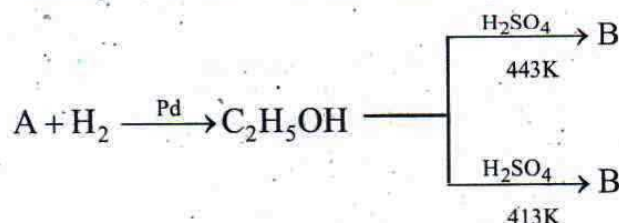**VI Answer any four of the following. Each question carries five marks.**

$$4 \times 5 = 20$$

37. a) Write the mechanism involved in the following reaction:

$$(CH_3)_3\, CBr + O^{H-} \rightarrow (CH_3)_3\, COH + Br^-$$

   Identify the reactant on which rate of reaction depends.

   b) Define stereocenter? How many asymmetric carbon atoms are there in 2, 3-dichlorobutane?   (3+2)

38. a) Identify A, B and C in the following reaction:

$$A + H_2 \xrightarrow{\text{Pd}} C_2H_5OH \quad \begin{cases} \xrightarrow[443K]{H_2SO_4} B \\ \xrightarrow[413K]{H_2SO_4} B \end{cases}$$

   b) Describe the manufacture of methanol from water gas.   (3+2)

39. a) An aromatic hydrocarbon 'A' having molecular formula C_9H_{12} is oxidised in the presence of air gives compound 'B'. The compound 'B' is treated with dilute acid gives two organic compounds 'C' and 'D'. The compound 'C' forms white precipitate 'E' with bromine water. Write the chemical reactions with names of A, B, C and E.

b) Give an example for unsymmetrical (mixed) ether. (4+1)

40. a) Write the chemical equation for the reaction whenbenzaldehyde is slightly heated with acetophenone in the presence of dilute alkali. Give the IUPAC name of the product.

b) Explain Rosenmund reduction with an example.

c) Alpha (α)-Hydrogens of aldehydes and ketones are acidic. Give reason. (2+2+1)

41. a) A Grignard reagent 'X' reacts with CO_2 (dry ice) followed by acid hydrolysis gives ethanoic acid. Write the chemical equation. Namethe compound 'X'?

b) Between methanoic acid and ethanoic acid, which is more acidic? Give reason. (3+2)

42. a) Write the chemical name and structure of Hinsberg's reagent. 3°- amines do not react with Hinsberg's reagent. Give reason.

b) Explain Carbylamine reaction with an example. (3+2)

43. a) (i) The penta-acetate of glucose does not react with Hydroxylamine. What does it indicate?

(ii) Write chemical reaction to show the open chain structure of D-glucose which contains six carbon atom the straight chain.

b) What is Zwitter ion of an amino acid? Give its general structure.

c) Name the hormone responsible for the hypothyroidism? (2+2+1)

PART – E (PROBLEMS)

VII Answerany three of the following. Each question carries three marks.

$$3 \times 3 = 09$$

44. 100 g of liquid 'A' (molar mass 140gmol^{-1}) was dissolved in 1000g of liquid 'B' (molar mass 180 gmol^{-1}). The vapour pressure of liquid 'B' was found to be 500 torr. Calculate the vapour pressure of pure liquid 'A' if the total vapor pressure of the solution is 475 torr.

45. The boiling point of benzene is 353.23K. When 1.8g of non-volatile solute was dissolved in 90g of benzene, the boiling point is raised to 354.11K. Calculate the molar mass of the solute. (Given Kb for benzene is 2.53K kg mol^{-1}).

46. At 298K, the EMF of the cell: Mg(s) | Mg^{2+}(Q) || Ag^{+}(0.01) |Ag (s) is 3.022V. Calculate the value 'Q'. ($E^0_{Mg2+/Mg}$ $= -2.37V$ and $E^0_{Ag+/Ag}$ $= 0.80V$)

47. The resistance of 0.01M acetic acid solution is found to be 2220Ω, when measured in a cellhas two electrodes of area of cross section 3.85 cm^2 placed 10.5 cm apart. Calculateconductivity.

48. For a first order reaction, the half-life period is 120 min. Calculate the time required to complete 90% of the reaction.

49. The rate constants of a reaction are $2 \times 10^{-2} s^{-1}$ at 300K and $8 \times 10^{-2} s^{-1}$ at 320 K. Calculate the energy of activation of the reaction. (Given: R = 8.314JK^{-1}mol^{-1}).

* * *

ANSWERS TO
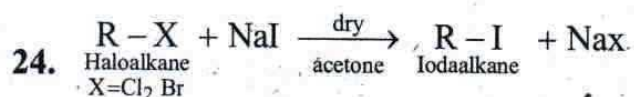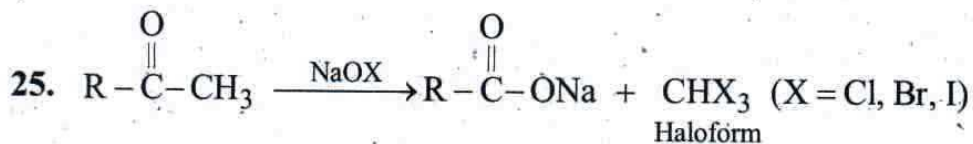# DEPARTMENT MODEL QUESTION PAPER

PART-A

I 1. d   2. c   3. c   4. c   5. b
    6. b   7. c   8. a   9. d   10. b
    11. a   12. b   13. c   14. b   15. a

II 16. cellulose acetate   17. molecularity   18. zinc
     19. phosgene   20. hydrogen

PART-B

IV 21. Boiling point of solvent increases. Because vapour pressure of solvent decreases by adding non volatile solute.

22. The sum of powers of the concentration of the reactants in the rate law expression is called order of the reaction.

Zero order.

23. A di or poly dentate ligand that uses two or more donar atoms to bind a single metal ion is called chalating ligand. Example: EDTA.

24.
$$R-X + NaI \xrightarrow[\text{acetone}]{\text{dry}} R-I + Nax$$
$$\underset{\substack{\text{Haloalkane} \\ X=Cl_2\,Br}}{} \qquad \underset{\text{Iodaalkane}}{}$$

NaCl or NaBr formed is precipitated in dry to prevent the backward reaction. It facilitates the forward reaction accordign to Le Chatelier's principle.

25.
$$R-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3 \xrightarrow{NaOX} R-\overset{\overset{\displaystyle O}{\|}}{C}-ONa + \underset{\text{Haloform}}{CHX_3} \;(X=Cl, Br, I)$$

Name of the reaction – Haloform reaction

26. i) Insulin
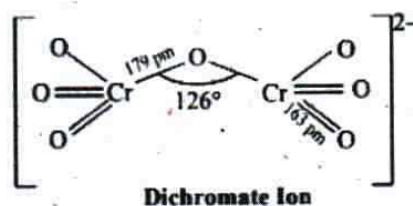   ii) Glucagon

PART-C

IV 27. $Z = 24,$ $\qquad [Ar]^{18}\, 3d^4\, 4s^2$

For M^{3+} ion: $\quad [Ar]^{18}\, 3d^3\, 4s^0$

$\therefore$ n = 3 (number of unpaired electrons)

$$\mu = \sqrt{n(n+2)}$$
$$= \sqrt{3(3+2)} = \sqrt{15} = 3.873 \text{ B M}$$

28. The dichromate ion consists of two tetrahedra sharing one corner with Cr–O–Cr bond angle of 126°.


Dichromate Ion

29. The overall decrease in atomic and ionic radii from lanthanum to lutitium is called lanthanoid contraction.

    i) Due to lanthanoid contraction the atomic radii of Zr (160 pm) and Hf (159 pm) is almost same.

    ii) Covalent character of cations increases.

30. a) Pentaamminebromidocobalt(III) sulphate

    b) Pentamminesulphatocobalt(III) bromide

    Ionisation isomerism

31. In this complex, the oxidation state of Co is +3. The electronic configuration of cobalt in +3 oxidation state is [Ar] $3d^6 4s^0$.
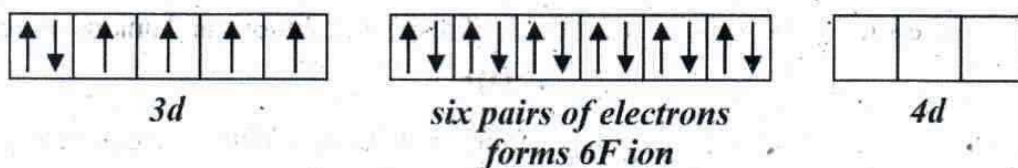
    Orbitals of Co^{3+} ion are represented as
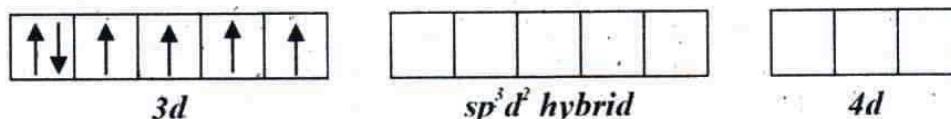
    Since F^- ion provides a weak ligand field, one 4s, three 4p and two outer 4d-orbitals hybridised to yield six sp^3d^2 hybrid orbitals pointing towards the six corners of an octahedron.

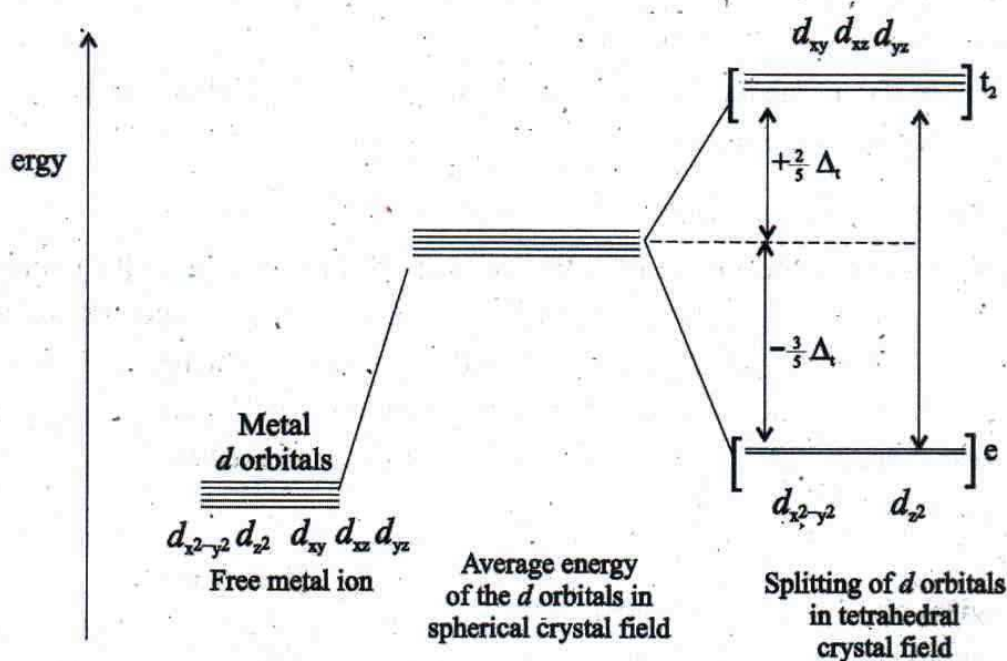 $Sp^3 d^2$ hybridised orbitals of Co^{3+} are as shown below.

∴ [CoF]³⁻ complex is

3d

six pairs of electrons
forms 6F ion

4d
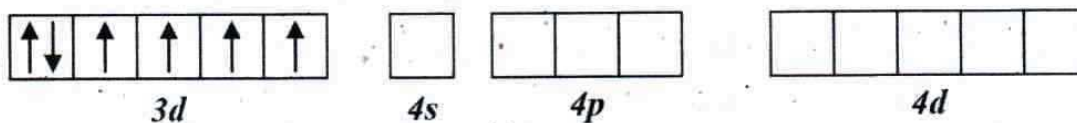
Therefore the type of hybridization is sp^3d^2. The complex has octahedral geometry. This complex is paramagnetic because of the presence of unpaired electrons.

32.

Relation between Δ_0 and $\Delta_t = \Delta t = \frac{9}{4}\Delta_0$.

V.   Answer any two of the following. Each question carries three marks.

$2 \times 3 = 06$

33.	Sl No.	Ideal Solution	Non-ideal Solution
	i)	They obey Raoult's law.	They do not obey Raoult's law.
	ii)	$\Delta V_{mix} = 0$	$\Delta V_{mix} \neq 0$
	iii)	$\Delta H_{mix} = 0$	$\Delta H_{mix} \neq 0$

34. It states that the molar conductance of an electrolyte at infinite dilution is equal to the sum of the ionic conductances of respective cations and anions of electrolyte.

<div align="center">**OR**</div>

It states that the limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte.

Applications: Kohlrauch's law is used

a) to determine the molar conductivity of a weak electrolyte which cannot be determined experimentally.

b) to determine the degree of dissociation '∞' and the dissociation constant K_a for a weak electrolyte.

35. The determination involves the following two steps.

Step 1: Determination of cell constant of conductivity cell : Conductivity cell of suitable design is filled with KCl solution of known specific conductance (κ). It is connected to Wheatstone bridge as shown in the figure. R_1 is a variable resistance, R_2 be the resistance of conductivity cell, R_3 and R_4 are two fixed resistances. P is the detector. The bridge is connected to an A.C. source of power as shown in figure.

The variable resistance is adjusted such that the detector shows no current in the circuit and the bridge is balanced. At this condition the resistance of the conductivity cell is given by,

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

$$\therefore R2 = \frac{R_1 R_4}{R_3}$$
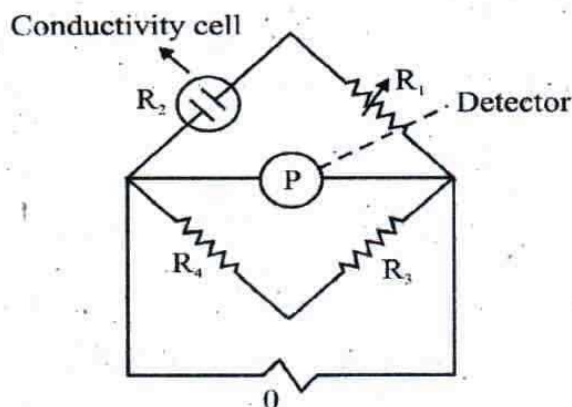
Arrangement for measurement of resistance of a solution of an electrolyte

The cell constant of the conductivity cell is calculated using the relation

$$G^* = R_2 \kappa \quad (\kappa \text{ is known.})$$

Step 2: Determination of specific conductance of the given electrolyte solution : The conductivity cell is now filled with given electrolytic solution. It is

connected to the Wheatstone bridge and the experiment is repeated. The resistance R_2 of the electrolytic solution is determined. Specific conductance of the electrolytic solution is calculated using the relation,

$$\kappa = \frac{G^*}{R_2}$$

36. Consider a first order gas phase reaction of the type

$$A(g) \longrightarrow B(g) + C(g)$$
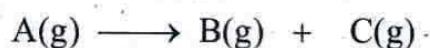
At $t = 0$ p_i 0   0

At time t, $p_i - x$ x x

Where 'x' is the decrease in pressure of reactant A at time t and increase in pressure of products B and C. p_i is the initial pressure at time $t = 0$.

After a time t, total pressure
$$p_t = (p_i - x) + x + x$$
$$p_i = p_i + x$$
$$x = p_t - p_i$$

But at a time t, $p_A = p_i - x$
$$p_A = p_i - (p_t - p_i)$$
$$p_A = pi - pt + pi$$
$$p_A = 2p_i - p_t$$

In gas phase reactions, first order rate equation can be written by replacing concentration terms with pressures of gaseous reactants as follows:

$$k = \frac{2.303}{t} \log \frac{p_i}{p_A}$$

$$k = \frac{2.303}{t} \log \frac{p_i}{2p_i - p_t}$$

PART - D

**VI   Answer any four of the following. Each question carries five marks.**

$$4 \times 5 = 20$$

37. a) **Mechanism:** It is $S_N 1$ mechanism and involves two steps. It follows first order kinetics.

I Step: (slow step): Tertiary butyl bromide ionizes slowly to give sp^2 hybridised planar tertiary butyl carbocation and bromide ion.


Tertiary butyl bromide   Tertiary butyl carbocation
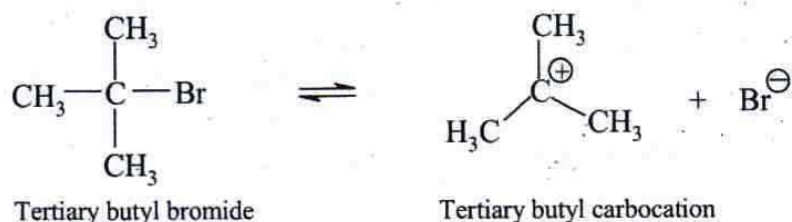
II Step: (Fast step): The nucleophile OH⁻ from aqueous NaOH attacks planar carbocation on either side to give tertiary butyl alcohol.

Tertiary butyl alcohol
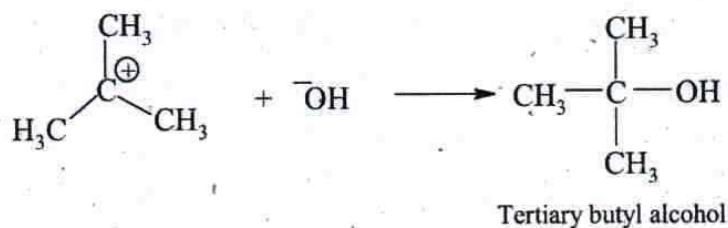
The product tertiary butyl alcohol obtained is a racemic mixture. Rate of reaction depends on concentration of tertiary butyl bromide.
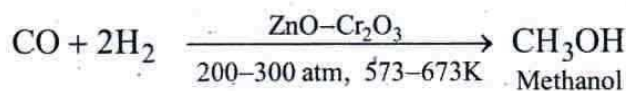
b) A carbon atom bonded to four different atoms or groups is called chiral carbon atom or stereo centre.

$$CH_3-\overset{\overset{\displaystyle Cl}{|}}{C}-\overset{\overset{\displaystyle Cl}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-CH_3$$
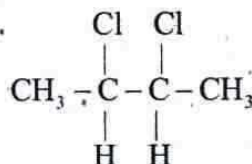
Number of asymmetric carbon atoms = 2

38. a) $A = CH_3CHO$ | $B = CH_2 = CH_2$ | $C = C_2H_5-O-C_2H_5$
        Acetaldehyde | Ethane | Diethyl ether

b) Carbon monoxide gas is mixed with hydrogen (Water gas) and passed over zinc oxide and chromium trioxide $(ZnO-Cr_2O_3)$ catalyst at 573K to 673K and 200 to 300atm to give methanol (wood spirit).

$$CO + 2H_2 \xrightarrow[\text{200--300 atm, 573--673K}]{\text{ZnO--Cr}_2\text{O}_3} \underset{\text{Methanol}}{CH_3OH}$$

39. a)

Cumene (Isopropyl benzene) (A) → O_2 → Cumene hydroperoxide (B) → H^+ / H_2O → Phenol (C) + Acetone (D)
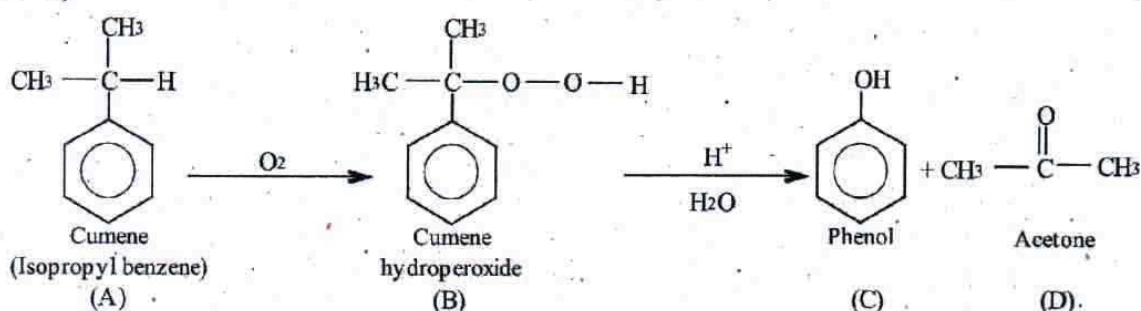
Phenol reacts with bromine water to give white precipitate of 2,4,6- tribromophenol.

Phenol (C) + $3Br_2$ → H_2O → 2, 4, 6 -Tribromo phenol (E) + $3HBr$
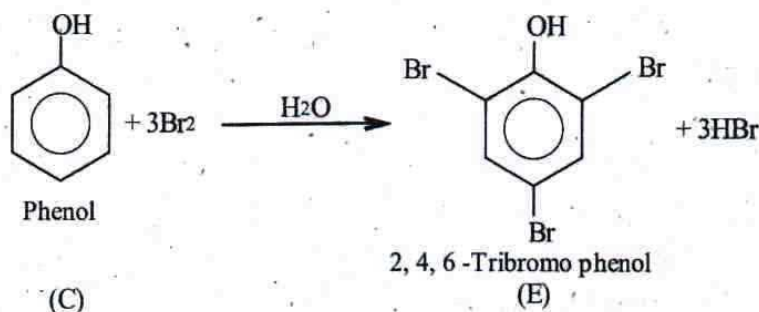
b) Ethyl methyl ether ($C_2H_5-O-CH_3$) or Methoxy ethane.

40. a)

Benzaldehyde + Acetophenone → Dilute NaOH 293 K → Ketol → $-H_2O$ → *Trans-chalcone* (Benzal acetophenone)

IUPAC name : 1, 3-Diphenylprop-2-en-1-one
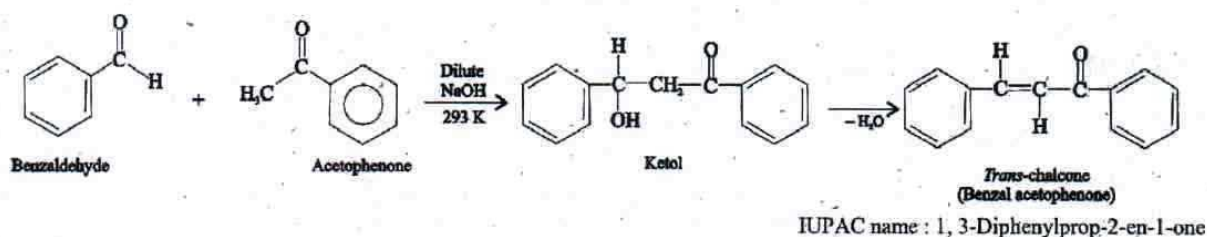
b) Acid chlorides on reduction with H_2 in presence of palladium catalyst supported by barium sulphate give aldehydes. This reaction is called Rosenmund's reduction.

$$R-\overset{O}{\underset{}{C}}-Cl + H_2 \xrightarrow[\text{(Boiling in xylene)}]{Pd, BaSO_4} R-\overset{O}{\underset{}{C}}-H + HCl$$

Acidchloride → Aldehyde

Example:

Benzoyl chloride $+$ H_2 $\xrightarrow[\text{(Boiling in xylene)}]{\text{Pd, BaSO}_4}$ Benzaldehyde $+$ HCl
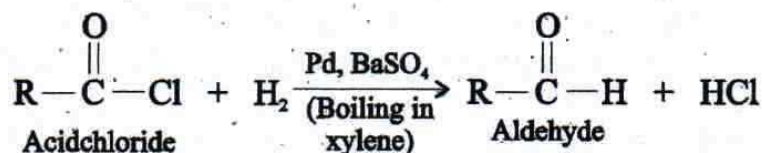
c) The acidity of α-hydrogens in carbonyl compounds is due to the strong electron withdrawing effect of the carbonyl group and resonance stabilization of the conjugate base.

41. a)

CH_3—MgBr + C (Methyl magnesium bromide) $\longrightarrow$ [CH_3—C (OMgBr)] $\xrightarrow{H_3O^+}$ CH_3—COOH + Mg(OH)Br (Acetic acid)
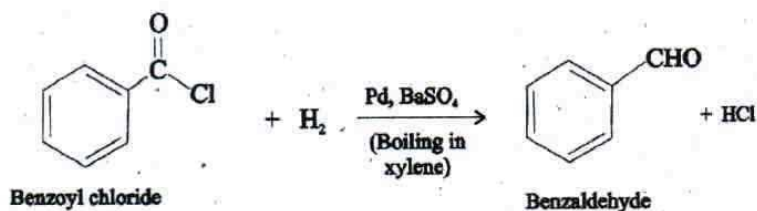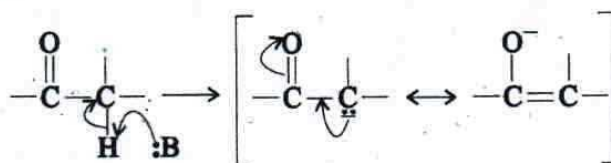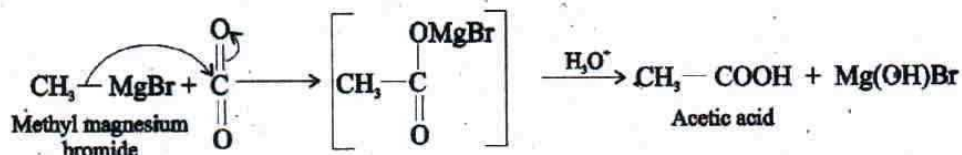
b) Methanoic acid (H–COOH) is stronger acid than ethanoic acid. (CH_3COOH) Because, in ethanoic acid, methyl group causes +I effect and decreases the stability of carboxylate ion and hence acidity decreases.

42. a)   Benzene sulphonyl chloride
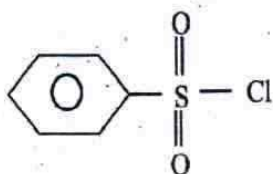
Due to absence of H-atom on N of 3° amines, they do not react with Hinsberg reagent.

b) When a primary amine is heated with chloroform and alcoholic KOH gives isocyanides called carbylamines. This reaction is called carbylamine reaction.

$$R-NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta} R-NC + 3KCl + 3H_2O$$
1° amine   Chloroform (Alcoholic)   iso cyanide

Example: $CH_3-NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta} CH_3-NC + 3KCl + 3H_2O$
Methanamine   Chloroform (Alcoholic)   Methyl isocyanide
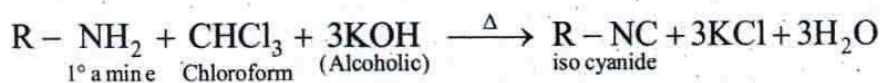
43. a) i) Indicates the absence of free aldehyde group in glucose.

ii) Glucose on heating with HI and red phosphorus gives n-hexane. This shows that glucose contains 6 carbon atoms in a straight chain.

$$C_6H_{12}O_6 \xrightarrow[\text{Red P}]{\text{HI } \Delta} CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$$
Glucose   (n–Hexane)
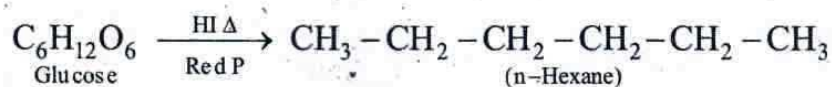
b) In aqueous solution, the carboxyl group of amino acid donates a proton and amino group (–NH$_2$) can accept a proton giving rise to a dipolar ion known as Zwitter ion.

(Zwitter ion)
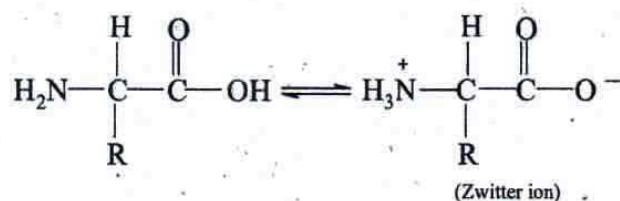
c) Thyroxine

PART – E (PROBLEMS)

VII **Answer any three of the following. Each question carries three marks.**

$$3 \times 3 = 09$$

44. $n_A = \dfrac{100}{140} = 0.7143 \text{ mol}, \qquad n_B = \dfrac{1000}{180} = 5.555 \text{ mol}$

$$x_A = \frac{n_A}{n_A + n_B} = \frac{0.7143}{0.7143 + 5.555} = \frac{0.7413}{6.2963} = 0.1139$$

$$x_A + x_B = 1$$
$$x_B = 1 - x_A$$
$$= 1 - 0.1139 = 0.8861$$

$$P = p_A^0 \, x_A + p_B^0 \, x_B$$
$$475 = p_A^0 \times 0.1139 + 500 \times 0.8861$$
$$p_A^0 \times 0.1139 = 475 - 443.05$$
$$p_B^0 \times 0.1139 = 31.95$$
$$p_A^0 = \frac{31.95}{0.1139} = 280.51 \text{ torr}$$

45. $M_B = \dfrac{K_b \times w_B \times 1000}{\Delta T_b \times w_A}$

$\Delta T_b = T_b - T_b^0 = 354.11 - 313.23 = 0.88\, K$

$M_B = \dfrac{2.53 \times 1.8 \times 1000}{0.88 \times 90} = 57.5\, g\, mol^{-1}$

46. $Mg(s)\,|\,Mg^{2+}\,(Q)\,\|\,Ag^+\,(0.01)\,Ag(s)$

$Mg \longrightarrow Mg^{2+} + 2e^-$

$\underline{2Ag^+ + 2e^- \longrightarrow 2\,Ag}$

$Mg + 2\,Ag^+ \longrightarrow Mg^{2+} + 2\,Ag$

$\therefore\, n = 2$

$E^0_{cell} = E^0_{Ag^+/Ag} - E^0_{Mg^{2+}/Mg}$
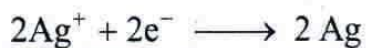
$\qquad = 0.80\, V - (-2.37)$

$\qquad = 3.17 V$

$E^0_{cell} := E^0_{cell} - \dfrac{0.0591}{n} \log \dfrac{[Mg^{2+}]}{[Ag+]^2}$

$\therefore\, 3.022 = 3.17 - \dfrac{0.0591}{2} \log \dfrac{Q}{(0.01)^2}$

$\dfrac{0.0591}{2} \log Q \times 10^{+4} = 3.17 - 3.022$

$\log Q \times 10^{+4} = \dfrac{0.148 \times 2}{0.0591}$

$Q \times 10^{+4} = Anti\log\,(5.0084)$

$Q \times 10^{+4} = 1.020 \times 10^5$

$Q = \dfrac{1.020 \times 10^5}{10^{+4}} = 1.020 \times 10^1 = 10.20\, M$

47. $R = 2220\,\Omega,\quad A = 3.85\, cm^2,\quad \ell = 10.5$

Cell constant $(G^*) = \dfrac{\ell}{A} = \dfrac{10.5}{3.85} = 2.7272\, cm^{-1}$

$$\text{Conductivity } (\kappa) = \frac{G^*}{R} = \frac{2.7272}{2220} = 0.001228 \text{ S cm}^{-1}$$

48. $k = \dfrac{0693}{t_{1/2}} = \dfrac{0.693}{120} = 0.005775 \text{ min}^{-1}$

$$t = \frac{2.303}{k} \log \frac{[R]_0}{[R]}$$

$[R]_0 = 100\%, \quad [R] = 100 - 90 = 10\%$

$$t = \frac{2.303}{0.005775} \log \frac{100}{10}$$

$$t = \frac{2.303}{0.005775} \log 10$$

$$t = \frac{2.303}{0.005775} \times 1$$

$$t = 398.78 \text{ min}$$

49. $\log \dfrac{k_2}{k_1} = \dfrac{E_a}{2.303R} \left[\dfrac{T_2 - T_1}{T_1 T_2} \right]$

$$\log \frac{8 \times 10^{-2}}{2 \times 10^{-2}} = \frac{E_a}{2.303 \times 8.314} \left[\frac{320 - 300}{300 \times 320} \right]$$

$$\log 4 = \frac{E_a \times 20}{2.303 \times 8.314 \times 300 \times 320}$$

$$0.6021 = \frac{E_a \times 20}{2.303 \times 8.314 \times 300 \times 320}$$

$$E_a = \frac{0.6021 \times 2.303 \times 8.314 \times 300 \times 320}{20}$$

$$= 55336.77 \text{ J} = 55.336 \text{ kJ}$$

* * *

MODEL QUESTION PAPER-1
II PUC - CHEMISTRY(34)

Time: 3 Hrs. 15 Mints. (Total No. of questions: 49)   **Max. Marks : 70**

Instructions:

1. *Question paper has FIVE parts. All parts are compulsory.*
2. *a) Part-A carries 20 marks. Each question carries 1 mark. b) Part-B carries 06 marks. Each question carries 2 marks. c) Part-C carries 15 marks. Each question carries 3 marks. d) Part-D carries 20 marks. Each question carries 5 marks. e) Part-E carries 09 marks. Each question carries 3 marks.*
3. *In Part-A questions, first attempted answer will be considered for awarding marks.*
4. *Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.*
5. *Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.*
6. *Use log tables and simple calculator if necessary (Use of scientific calculators is not allowed.)*

PART-A

I   Select the correct option from the given choices: **1 × 15 = 15**

1. Solubility of a substance is depends on

    a) Nature of solute   b) Temperature   c) Pressure   d) All the above

2. Quantity of electricity required for the reduction of 1 mole of Mg^{2+} ion, is

    a) $2 \times 96,500$ C   b) 95,500 C   c) 9650 C   d) 96.5 C

3. In lead storage battery electrolyte used is

    a) 78% H_2SO_4 b) 38% H_2SO_4 c) 32% HCl   d) 84% HCl

4. For which reaction rate does not decreases with time

    a) First-order   b) Zero-order

    c) Fractional order   d) None of the above

5. Cu^{2+} is paramagnetic in nature because,

    a) It has one unpaired electron in 3d orbital

    b) It has two unpaired electron in 3d orbital

    c) It has one paired electron in 3d orbital

    d) It has two paired electron in 3d orbital

6. IUPAC name of $K_3[Cr(C_2O_4)_3]$ is

    a) Potassium oxalatechromate(III)   b) Potassium trioxalatechromate(IV)

    c) Potassium oxalatetrichloromate (II)   d) Potasium trioxalatechromate(III)

7. Compounds which are non-superimposable on their mirror images are called
   a) Meso compound
   b) Enantiomer
   c) Diastereomer
   d) Glycol

8. Which of the following has the lowest boiling point?
   a) n-Butyl alcohol
   b) sec-Butyl alcohol
   c) Isobutyl alcohol
   d) tert-Butyl alcohol

9. On boiling with concentrated hydrobromic acid, methyl phenyl ether will yield:
   a) Phenol and methyl bromide
   b) Bromobenzene and methanol
   c) Phenol and methane
   d) Bromobenzene and methane

10. Which of the following presents the correct order of the acidity in the given compounds?

    a) $FCH_2CH_2COOH > ClCH_2CH_2COOH > BrCH_2CH_2COOH > CH_3CH_2COOH$

    b) $CH_3CH_2COOH > BrCH_2CH_2COOH > ClCH_2CH_2COOH > FCH_2CH_2COOH$

    c) $FCH_2CH_2COOH > CH_3CH_2COOH > BrCH_2CH_2COOH > ClCH_2CH_2COOH$

    d) $BrCH_2CH_2COOH > ClCH_2CH_2COOH > FCH_2CH_2COOH > CH_3CH_2COOH$

11. The product formed when hydroxylamine condenses with a carbonyl compound is called
    a) hydrazide
    b) oxime
    c) hydrazine
    d) hydrazone

12. An example for primary amine is,
    a) ter. butyl amine
    b) sec. butyl amine
    c) iso. butyl amine
    d) All the above

13. Carbylamine test is used in the detection of
    a) Aliphatic secondary amine
    b) Aliphatic primary amine
    c) Aromatic primary amine
    d) Both aliphatic and aromatic primary amines

14. Denaturation of proteins leads to loss of its biological activity by
    a) Formation of amino acids
    b) Loss of primary structure.
    c) Loss of both secondary and tertiary structure
    d) Loss of both primary and secondary structures.

15. Cheilosis and digestive disorders are due to the deficiency of
    a) Vitamin A
    b) Riboflavin
    c) Thiamine
    d) ascorbic acid

II Fill in the blanks by choosing the appropriate word from those given in the brackets: **5 × 1 = 5**

[inversely, cerium, directly, molal concentration, diazotisation, free iodine]

16. Elevation on boiling (ΔT_b) is directly proportional to _____ to the solute in the solution.

17. Molarity varies _____ with temperature.

18. Member of the lanthanoid series which exihibit +4 oxidation state is _____.

19. Antiseptic properties of iodoform are due to liberation of _____ .

20. The conversion of primary aromatic amines into diazonium salts is known as

_____ .

PART-B

III. Answer any three of the following. Each question carries two marks.

3 × 2 = 06

21. State Raoult's law of liquid solutions.

22. What is temperature co-efficient?

23. What is linkage isomerism? Give example.

24. How do you convert Alkyl halide to Alkyl Isocyanides? Write equation.

25. Aldehydes are generally more reactive than ketones for nucleophilic addition reactions. Give reasons.

26. Write the Haworth's structure of Lactose.

PART - C

IV. Answer any three of the following. Each question carries three marks.

3 × 3 = 09

27. Calculate the magnetic moment of sc^{3+}. ($Z = 21$)

28. How is potassium dichromate prepared from chromite ore?

29. Write any three consequences of lanthanoid contractions.

30. Give (state) any three postulates of Werner theory of Co-ordination compounds.

31. Using VBT, explain the hybridisation, geometry and magnetic property of $[Co(NH_3)_6]^{3+}$ (hexaaminecobalt(III)ion).

32. Write the energy level diagram for d-orbital splitting in octahedral complex.

V. Answer any two of the following. Each question carries three marks.

$$2 \times 3 = 06$$

33. What is reverse osmosis? Mention its use.

34. Explain the construction and working of a Standard Hydrogen Electrode.

35. Explain the variation of specific conductance (κ) and molar conductivity λ_m with concentration of solution or dilution.

36. Derive integrated rate equation for the first order reaction.

PART - D

VI Answer any four of the following. Each question carries five marks.

$$4 \times 5 = 20$$

37. a) Explain S_N2 mechanism or explain the mechanism involved in the conversion of chloromethane (methyl chloride) into methanol (methyl alcohol).   (3)

    b) Give the preparation of Grignard reagents from alkyl halides.   (2)

38. a) Explain hydroboration-oxidation reaction with an example.   (2)

    b) How do you prepare aspirin from salicylic acid?   (2)

39. a) Explain the mechanism of dehydration of ethanol to ethene.   (3)

    b) Explain Williamson's synthesis of ethers? Give an example.   (2)

40. a) An organic compound (A) with molecular formula C_8H_8O forms an orange-red precipitate with 2, 4-DNP reagent and gives yellow precipitate on heating with iodine in the presence of sodium hydroxide. It neither with iodine in the presence of sodium hydroxide. It neither reduces Tollens' or Fehlings' reagent, nor does it decolourise bromine water or Baeyer's reagent. On drastic oxidation with chromic acid, it gives a carboxylic acid (B) having molecular formula $C_7H_6O_2$. Identify the compounds (A) and (B) and explain the reactions involved.   (3)

    b) Explain the preparation of benzoic acid from toluene.   (2)

41. a) Explain Hell-Volhard-Zelinsky reaction (Halogenation) with equation.   (2)

    b) Explain how do you convert acetic acid to acetamide and benzoic acid to benzamide.   (2)

    c) Benzoic acid not gives Friedle-crafts reaction. Give reason.   (1).

42. a) How do you convert aniline into sulphanilic acid?   (3)

    b) Explain carbyl amine reaction with an example.   (2)

43. a) How does glucose reacts with hydroxyl amine. OR How do you confirm presence of carboxyl group ($>C=0$) group in Glucose.   (2)

    b) What are non-reducing sugars? Give example.   (2)

    c) Mention the water soluble component of starch.   (1)

PART – E (PROBLEMS)

VII   Answerany three of the following. Each question carries three marks.

$$3 \times 3 = 09$$

44. Vapour pressure of chloroform ($CHCl_3$) and dichloromethane (CH_2Cl_2) at 298K are 200mm Hg and 415mm Hg respectively. Calculate the vapour pressure of the solution prepared by mixing 25.5g of $CHCl_3$ and 40g of CH_2Cl_2 at 298K.

45. A solution containing 18g of non-volatile non-electrolyte solute is dissolved in 200g of water freezes at 272.07K. Calculate the molecular mass of solute. Given $K_f = 1.86$ K Kg/mol and freezing point of water = 273K.   (3)

46. $Mg(s) + 2Ag^+(0.0001M) \rightarrow Mg^{2+}(0.0130M) + 2Ag(s)$. Calculate its $E_{(cell)}$ if $E^0_{(cell)} = 3.17V$.

47. The cell in which the following reactons occurs: $2\,Fe^{3+}_{(aq)} + 2I^-_{(aq)} \rightarrow 2\,Fe^{2+}_{(aq)} + I_{2(s)}$. Calculate the standard free energy change and the equillibrium constant of the cell reaction.

48. 75% of a first-order reaction was completed in 32 minutes, calculate the time taken to complete 50% of the reaction.

49. 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 values of E_a and A.

* * *

ANSWERS TO MODEL QUESTION PAPER-1

PART-A

I 1. d   2. a   3. b   4. b   5. a

6. d   7. b   8. d   9. a   10. a

11. b   12. d   13. d   14. c   15. b

II 16. molal concentration   17. inversely   18. cerium

19. Free iodine   20. diazotisation

PART-B

IV 21. It states that in a solution of volatile liquids, the partial vapour. Pressure of each component of the solution is directly proportional to its mole fraction.

Consider a solution containing two volatile components 1 and 2.

Then, for component Δ p_1 α x_1 or $p_1 = p_1^0 x_1$

where p_1^0 = vapour pressure of the pare component 1

p_1 = partial vapour pressure component 1.

x_1 = mole function of the component 1.

Similarly, For component 2,

$p_2 = p_2^0 x_2$

$\therefore$ $P_{total} = p_1^0 x_1 + p_2^0 x_2$

[This is the mathematical form of Raoult's law for solution containing two liquids.]

22. Temperature co-efficient $= \dfrac{\text{Rate constant at } (T + 10^\circ)}{\text{Rate constant at } T^\circ} \approx 2$ (twice) or 3 (thrice)

i.e. Temperature co-efficient $= \dfrac{K_T + 10}{K_T} \approx 2$ (twice) or 3 (thrice)

23. Linkage isomerism arises in the co-ordination compound containing **ambidentate ligand.** [Differ with donar atoms in same ligand.]
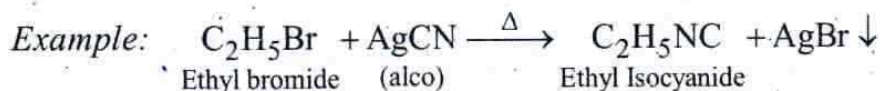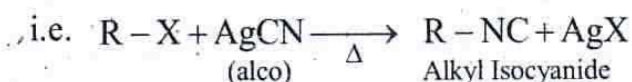
For *example:* $[Co(NH_3)_5 ONO]^{2+}$ and $[Co(NH_3)_5 NO_2]^{2+}$
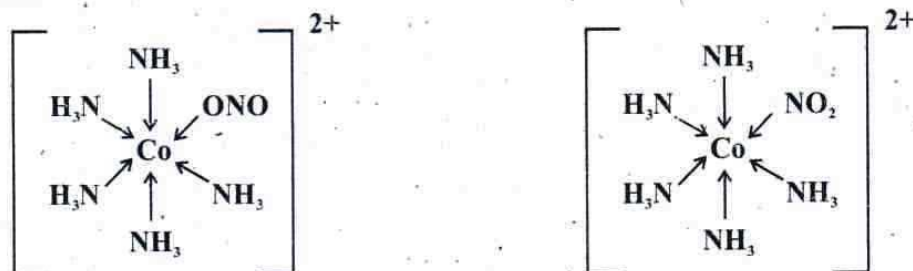
In the first complex 'o' of NO_2 is linked to cobalt and in second complex 'N' is linked to cobalt metal.

Example: $[Cr(H_2O)_5 SCN]^{2+}$ and $[Cr(H_2O)_5 (NCS)]^{2+}$

Here $Cr \leftarrow SCN^-$ Here $M \leftarrow NCS^-$

24. Alkyl halide heating with alcoholic silver cyanide gives Alkyl isocyanides.

.i.e. $R-X+AgCN \xrightarrow[\text{(alco)}]{\Delta} \underset{\text{Alkyl Isocyanide}}{R-NC}+AgX$

Example: $\underset{\text{Ethyl bromide}}{C_2H_5Br} + \underset{\text{(alco)}}{AgCN} \xrightarrow{\Delta} \underset{\text{Ethyl Isocyanide}}{C_2H_5NC} +AgBr\downarrow$

25. Ketones are less reactive than aldehyde due to steric and electronic effect.

Steric effect: The presence of two large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes.

Electronic effect: Two alkyl groups of ketones reduce the electrophilocity of the carobonyl carbon than in aldehydes.

26. $\underset{\text{Lactose}}{C_{12}H_{22}O_{11}}+H_2O \longrightarrow \alpha-D(+) \text{ Glucose } +\beta-(D)+ \text{ Galactose}$

β– D – Galactose   *β– D – Glucose*
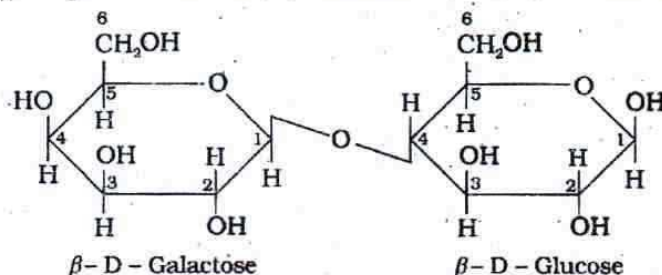
PART-C

IV 27. $\mu = \sqrt{n(n+2)}$

$\mu = 21-3-18$

$\mu = 0$

28. Potassium dichromate is prepared from the ore called Chromite. or Chromite ore. $FeO.Cr_2O_3$. The steps are
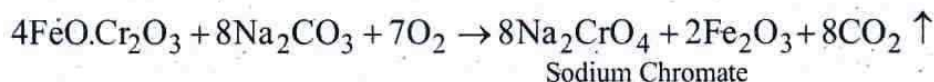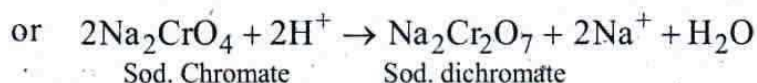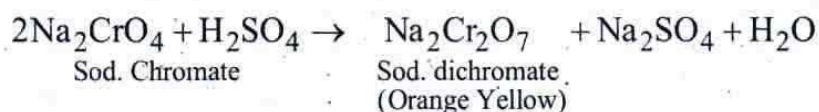
1) Powdered ore heated with sodium carbonate in excess air to form sodium chromate.

$$4FeO.Cr_2O_3 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2 \uparrow$$
<div align="center">Sodium Chromate</div>

2) The yellow solution of sodium chromate is filtered and acidified with sulphuric acid to form orange yellow sodium dichromate solution.

$$2Na_2CrO_4 + H_2SO_4 \rightarrow \quad Na_2Cr_2O_7 \quad + Na_2SO_4 + H_2O$$
Sod. Chromate   Sod. dichromate
(Orange Yellow)

or $\quad 2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$
     Sod. Chromate   Sod. dichromate

3) Hot and concentrated sodium chromate solution treated with calculated amount of potassium chloride to get potassium dichromate (orange red crystals)

$$Na_2Cr_2O_7 + 2KCl \rightarrow \quad K_2Cr_2O_7 \quad + 2NaCl$$
<div align="center">Pot. dichromate
(Orange-red)</div>
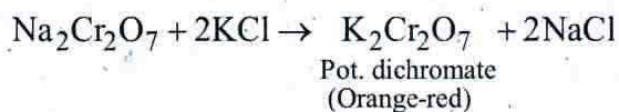
29. i) Due to lanthanoid contraction the atomic radii of Zr (160 pm) and Hf (159 pm) is almost same. So they occur together. Hence it is difficult to separate them.

ii) Covalent character of cations increases.

iii) Electronegativitivity of trivalent ions increases slightly.

iv) Basicity decreases from $Ce(OH)_3$ to $Lu(OH)_3$.

v) Standard electrode potential ($E°$) values increases.

30. The main postulates of this theory are :

i) Metal atom or ion in a co-ordination compound posses two type of valencies.
a) Primary valency   b) Secondary valency (linkages)

ii) Primary valencies are ionisable and oxidation state of the metal atom. They are satified by -ve ions only.

iii) Secondary valencies are non-ionizable, fixed and satisfied by neutral molecules Or negative ions (Ligands).

iv) Secondary valencies gives definite geometry to the complex because they are directed towards fixed positions in space around the metal atom.

v) The number of secondary valencies in the complex is called Co-ordination number of the metal atom/ion.

31. The oxidation state of cobalt in $[Co(NH_3)_6]^{3+}$ is $+3$

The electronic configuration in the ground state is $[Ar]^{18}3d^7 4s^2$.

Hence $Co(z = 27)$ =
| ↑↓ | ↑↓ | ↑ | ↑ | ↑ | | ↑↓ | | | | |
3d   4s   4p

EC of Co^{3+} =
| ↑↓ | ↑↓ | ↑ | ↑ | | □ | | | | |
3d   4s   4p

NH_3 is a strong ligand pairs up unpaired d-electrons

i.e. EC of Co^{3+} =
| ↑↓ | ↑↓ | ↑↓ | | | □ | | | | |
3d   4s   4p

Two 3d, one 4s and three 4p orbitals undergo d^2sp^3 hybridisation and to form 6 d^2sp^3 hybrid orbitals giving **octahedral shape.**

d^2sp^3 hybridised orbitals of Co^{3+} =
| ↑↓ | ↑↓ | ↑↓ | | | | | | | |
$3d^6$ d^2sp^3 hybrid orbitals

Formation of $[Co(NH_3)_6]^{3+}$ =
| ↑↓ | ↑↓ | ↑↓ | | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑↓ |
3d   six electron pairs donated by six NH_3 ligands

Hybridisation = d^2sp^3 (inner orbital complex).
Geometry = octahedral
Magnetic property = diamagnetic (due to absence of unpaired electrons)
= Low spin or Spin paired complex

32. The orbitals $d_{x^2-y^2}$ and d_{z^2} are point towards the axis experience more repulsion and raised in energy and form e_g set.

Energy

$d_{x^2-y^2}$ d_{z^2} d_{xy} d_{xz} d_{yz} Average energy of the *d* orbitals in spherical crystal field   Splitting of d orbitals in octahedral crystal field

Free metal ion

The d_{xy}, d_{yz} and d_{xz} orbitals are away from the ligands, experience less repulsion and forms lower energy set called t_{2g}. Thus d-orbitals splits into two set i.e. e_g and t_{2g}.

V 33. It is the flow of pure solvent molecules from the solution through semipermeable membrane by applying pressure higher than osmotic pressure is called reverse osmosis. In this the direction of osmosis is reversed.

OR

The process of reversing the direction of osmosis by applying the pressure higher than the osmotic pressure to the solution of higher concentration is called reverse osmosis.

It is used in desalination of sea water.
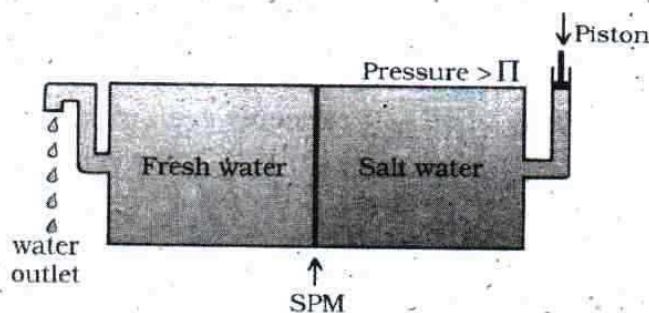
34. Hydrogen gas at a pressure of 1 atm in contact with H^+ ions concentration 1M of 298 K is called Standard Hydrogen electrode (OR) SHE.

Construction: SHE consists of a platinum foil coated with carbon black (final powdered) welded a copper wire and is kept ina vessel containing. 1M HCl solution, pure hydrogen gas at a pressure of 1 atm is passed, a part of hydrogen gas get absorbed on the foil and excess hydrogen gas escaped in the form of bubbles.
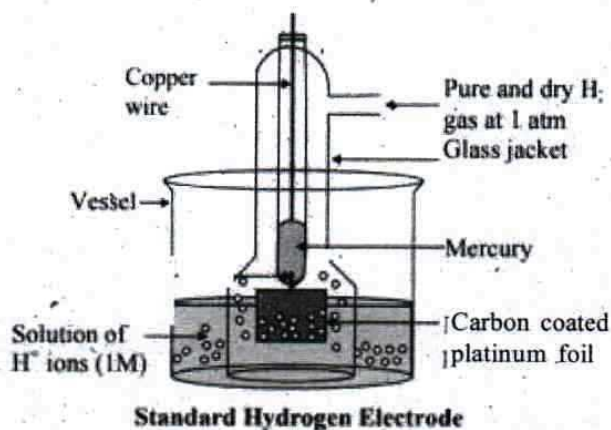
Standard Hydrogen Electrode

An equilibrium established between hydrogen gas on the foil and H^+ ions in the solution and the equilibrium is

$$H_{2\,(1\,atm)} \xrightarrow{\text{Oxidation}} 2H^+_{(1M)} + 2e^-$$
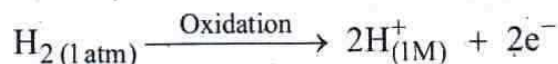
SHE: is represented symbolically.

Anode: Platinum, H_2(1 atm) | H^+ (1M) at 248 K.

Cathode: H^+ (1M) | H_2 (1 atm). pt(s)

SHE is used as reference electrode and its potential is taken as $\pm 0.00V$.

$$[E^0_H = \pm 0.00V]$$

The potential of other electrodes are determining by combining them with SHE.

Limitations of SHE (Standard Hydrogen Electrode) :

1. It is difficult to maintain 1 atm pressure pure and dry H_2 gas.

2. The active mass of H^+ (1M) or unity is difficult.

3. Platinum is costly and platinised platinum is difficult to prepare.

35. Variation of specific conductance (κ) and molar conductivity λ_m with concentration of solution specific conductance decreation with the (decrease in concentration) increase in dilution, in the case of both strong and weak electrolyte due to decrease in the number of ions per unit volume.

But in the case of molar conductivity, the variation with dilution is different for strong and weak electrolyte.

For strong electrolytes, molar conductivity increases very slowly with dilution but in case of weak electrolytes the molar conductivity increases steeply (more) with dilution as shown as shown in the graph alongside.
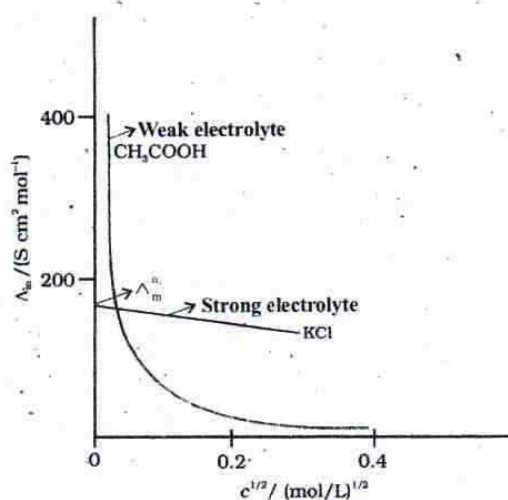
36. Consider a first order reaction,

$$R \xrightarrow{} Products$$

According to Rate law, $Rate = -\dfrac{d[R]}{dt} = k[R]$

$$\frac{d[R]}{dt} = -k.[R]$$

On rearranging, $\quad \dfrac{d[R]}{[R]} = -kdt$

On Integration, $\quad \int \dfrac{d[R]}{[R]} = -k\int dt + I$

(I is constant of Integration)

$$\ln [R] = -kt + I \qquad \dots (1)$$

To find the values of I

When t = 0, $[R]=[R]_0$ Where $[R]_0$ = Initial concentration of the reactant.

$$\therefore \quad \ln [R]_0 = -k(0) + I$$

$$\sim I = \ln [R]_0 \qquad \dots (2)$$
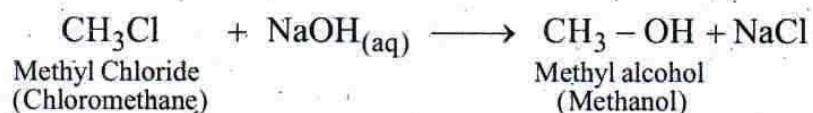
Substitute the value of I in equation (1)

$$\ln [R] = -kt + \ln [R]_0 \ \dots (3)$$

$$\ln \frac{[R]}{[R]_0} = -kt$$

$$k = \frac{1}{t} \ln \frac{[R]_0}{[R]} \qquad k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

PART-D

VI 37. a) Primary alkyl halides udergo S_N2 reaction. S_N2 reaction follows second order kinetics. Methyl chloride reacts with aqueous NaOH to give methyl alcohol.

$$\underset{\substack{\text{Methyl Chloride}\\\text{(Chloromethane)}}}{CH_3Cl} + NaOH_{(aq)} \longrightarrow \underset{\substack{\text{Methyl alcohol}\\\text{(Methanol)}}}{CH_3 - OH} + NaCl$$

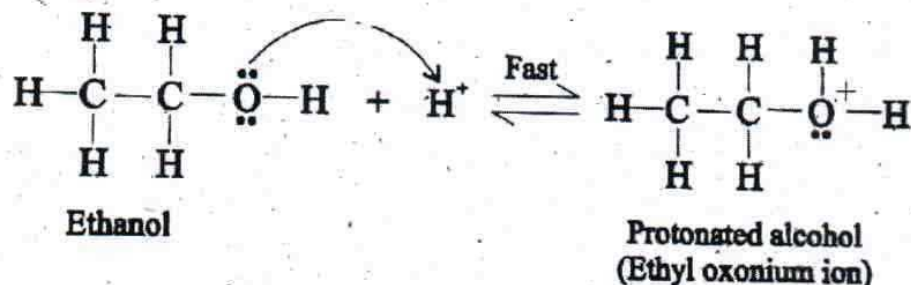Rate $= k\big[CH_3Cl\big]\big[OH^-\big] \quad \therefore$ order = 2

Mechanism: The nucleophile OH– attacks electron deficient carbon atom from the rear side (back side) of the carbon atom to form a transition state. It is unstable. In the transition state a partial (HO–C) bond is formed and

partial C–Cl bond is broken. The product methyl alcohol obtained has inversion configuration.

The relative configuration of the atoms/groups around a chiral centre in the product is opposite to that in the reactant is called Inversion of configuration.

HO⁻ **Incoming nucleophile** (*Reactant*) — Methyl chloride (*Reactant, alkyl halide*) → Transition state → Methanol (*Product*) + Cl⁻ **Outgoing nucleophile** (*Leaving group*)

b) These are prepared by the reaction of haloalkane with Magnesium metal in presence of dry ether.

i.e. $R - X + Mg \xrightarrow{\text{dry ether}} R - Mg - X$

Example: i) $\underset{\text{Methyl Iodide}}{CH_3 - I} + Mg \xrightarrow{\text{dry ether}} \underset{\text{Methyl Magnesium Iodide}}{CH_3 - Mg - I}$

ii) $C_2H_5 - Br + Mg \xrightarrow{\text{dry ether}} \underset{\text{Ethyl Magnesium Bromide}}{CH_3CH_2 - Mg - Br}$

38. a) Alkenes react with diborane to give trialkyl borane, which on oxidation with hydrogen peroxide in alkali give alcohol. The reaction is called hydroboration-oxidation.

Ex: $CH_3 - CH = CH_2 + BH_3 \xrightarrow{\text{THF}} CH_3 - \underset{\underset{H}{|}}{CH} - \underset{\underset{BH_2}{|}}{CH_3}$

$\Big\downarrow CH_3 - CH = CH_2$

$(CH_3 - CH_2 - CH_2)_3 \, B \xleftarrow{\quad CH_3 - CH = CH_2 \quad} (CH_3 - CH_2 - CH_2)_2 \, BH$

$3H_2O_2 \Big\downarrow OH^-, H_2O$

$CH_3 - CH_2 - CH_2 - OH + B(OH)_3$
        Propan-1-ol

b) Salicylic acid reacts with acetic anhydride in the presence of concentrated sulphuric acid to give aspirin (acetyl salicylic acid).
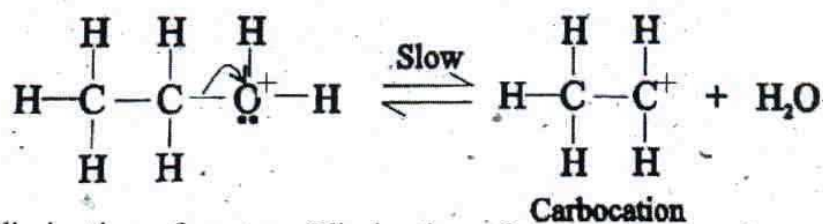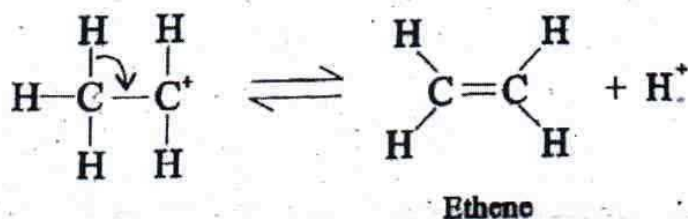
For *example*:

Salicylic acid $+ (CH_3CO)_2O$ $\overset{H^-}{\rightleftharpoons}$ Aspirin (Acetyl salicylic acid) $+ CH_3COOH$
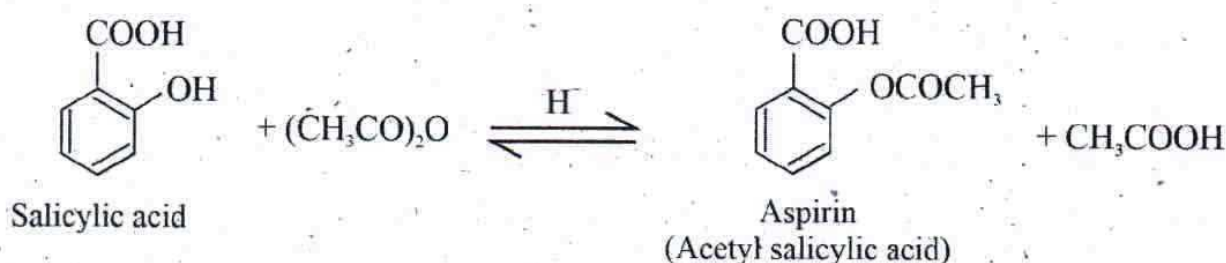
39. a) Step 1: Formation of protonated alcohol

Ethanol $+$ H^+ $\overset{Fast}{\rightleftharpoons}$ Protonated alcohol (Ethyl oxonium ion)

Step 2: Formation of carbocation: Protonated alcohol loses the water molecule to form the carbocation. It is the slowest step and hence, the rate determining step of the reaction.
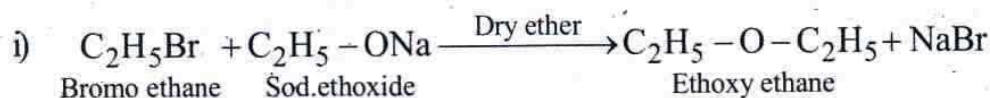

$\overset{Slow}{\rightleftharpoons}$ $+$ H_2O

Carbocation

Step 3: Elimination of proton: Elimination of proton from carbocation to form an alkene.

Ethene

**b)** On treating alkyl halide with sodium ethoxide gives ethers.

i.e. $\underset{\text{Alkyhalide}}{R'-X} + \underset{\text{Soda.alkoxide}}{R-O-Na} \xrightarrow[\Delta]{\text{Dry ether}} \underset{\text{Ether}}{R-O-R'} + Nax$

Example :

i) $C_2H_5Br + C_2H_5 - ONa \xrightarrow{\text{Dry ether}} C_2H_5 - O - C_2H_5 + NaBr$

   Bromo ethane   Sod.ethoxide   Ethoxy ethane

ii) $CH_3Br + CH_3ONa \xrightarrow{\text{Dry ether}} CH_3 - O - CH_3 + NaBr$

   Bromo methane   Sod.methoxide   Methoxy methane

iii)

$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\overset{-}{\ddot{O}}\overset{+}{Na} + CH_3-Br \longrightarrow H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\ddot{O}-CH_3 + NaBr$$
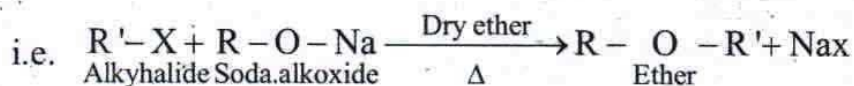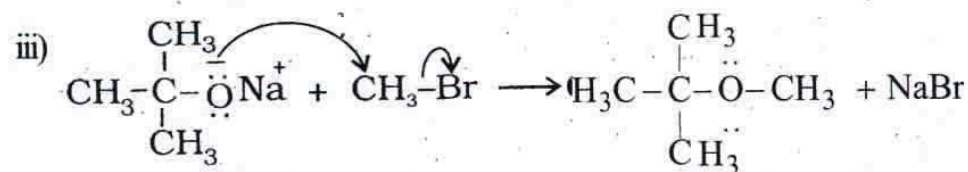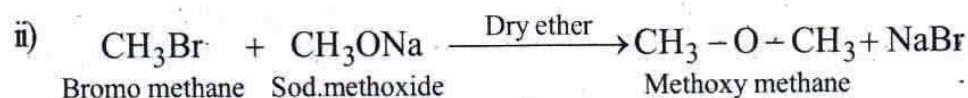
40. a) (A) forms 2,4-DNP derivative. Therefore, it is an aldehyde or a ketone. Since it does not reduce Tollen's of Fehling reagent, (A) must be a ketone. (A) responds to iodoform test. Therefore, it should be a methyl ketone. The molecular formula of (A) indicates high degree of unsaturation, yet it does not decolourise bromine water or Baeyer's reagent. This indicated the presence of unsaturation due to an aromatic ring.

Compound (B), being an oxidation product of a ketone should be a carboxylic acid. The molecular formula of (B) indicates that it should be beznoic acid and compound (A) should, therefore, be a monosubstituted aromatic methyl ketone. The molecular formula of (A) indicates that it should be phenyl methyl ketone (acetophenone).
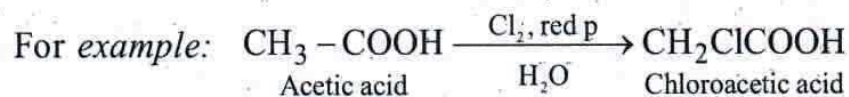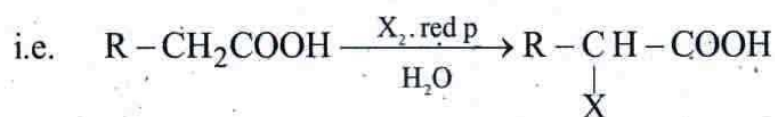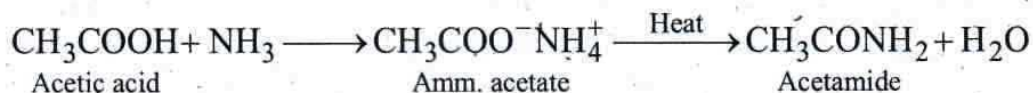
Reactions are as follows:

(A)

C_8H_6O 2, 4-Dinitrophenylhydrazine   2, 4-DNP derivative

(B)

$C_7H_6O_2$ (A)
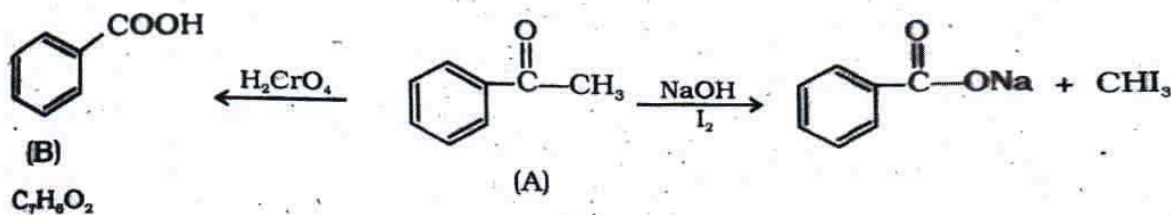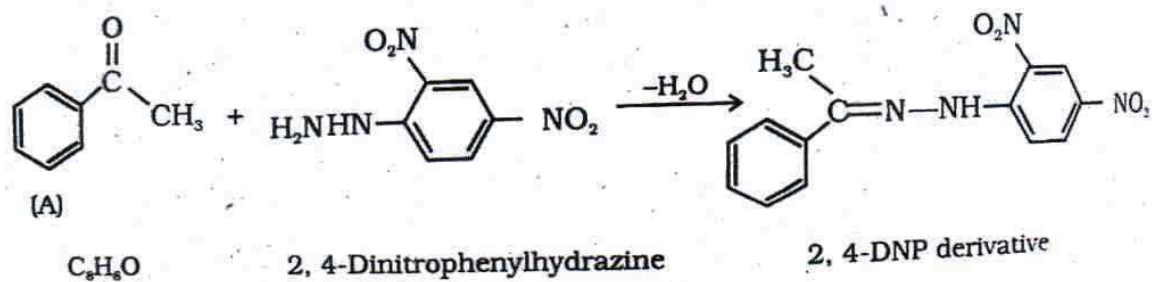
b) Toluence on oxidation with alkaline $KMnO_4$ followed by hydrolysis gives benzoic acid.
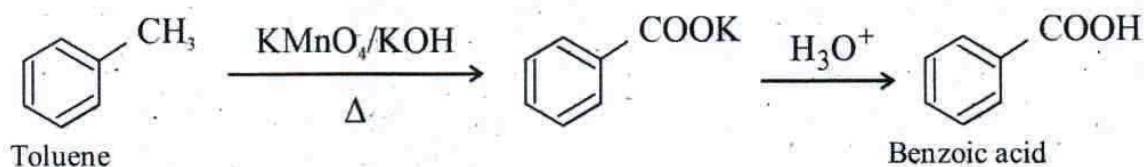

41. a) Carboxylic acids (except HCOOH) react with chlorine or Bromine in the presence of small quantities of red phosphorous to give α-halo(chloro or Bromo) carboxylic acids.

i.e. $R - CH_2COOH \xrightarrow[H_2O]{X_2, \text{red p}} R - \underset{\underset{X}{|}}{C}H - COOH$

For *example*: $\underset{\text{Acetic acid}}{CH_3 - COOH} \xrightarrow[H_2O]{Cl_2, \text{red p}} \underset{\text{Chloroacetic acid}}{CH_2ClCOOH}$

b) **Acetamide :** Acetic acid heated with ammonia gives ammonium salt which is decomposed to acetamide by heating.

$\underset{\text{Acetic acid}}{CH_3COOH} + NH_3 \longrightarrow \underset{\text{Amm. acetate}}{CH_3COO^-NH_4^+} \xrightarrow{\text{Heat}} \underset{\text{Acetamide}}{CH_3CONH_2} + H_2O$

Benzamide: Benzoic acid heated with ammonia gives benzamide.
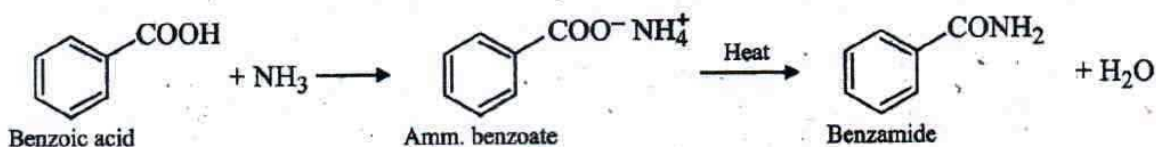
c) Because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group and forms the complex salt.

42. a) **Conversion of Aniline to Sulphanilic acid -Sulphonation :** Aniline reacts with Con. H_2SO_4 to form Anilium hydrogen sulphate which on heating with sulphuric acid at 455-475K gives P–aminobenzene sulphonic acid known as Sulphanilic acid.

Anilinium
hydrogensulphate   Sulphanilic acid   Zwitter ion

b) When an aliphatic or aromatic primary amine is heated with chloroform and alcoholic KOH, isocyanides are formed. This reaction is called carbylamine reaction.

$$R - NH_2 + CHCl_3 + 3\,KOH \xrightarrow{\Delta} R - NC + 3\,KCl + 3H_2O$$

Example: $CH_3 - NH_2 + CHCl_3 + 3\,KOH \xrightarrow{\Delta} CH_3NC + 3\,KCl + 3H_2O$
              Methyl amine   Methyl isocyanide

43. a) The formation of oxime by glucose with hydroxyl amine shows that glucose contains carbonyl group. i.e.

Glucose oxime

b) Carbohydrates which does not reduce Felhings solution and Tollen's reagent are called Non-reducing sugars.

Example: Sucrose

These do not have free aldehydic or Ketonic groups **OR** they are bonded.

Example: Starch, Glycogen; Cellulose etc.

c) Amylose.

PART-E (PROBLEMS)

44. Molar mass of $CH_2Cl_2 = 12 \times 1 + 1 \times 2 + 35.5 \times 2 = 85g\ mol^{-1}$

Molar mass of $CHCl_3 = 12 \times 1 + 1 \times 1 + 35.5 \times 3 = 119.5g\ mol^{-1}$

$$\text{Moles of CH}_2\text{Cl}_2 = \frac{40g}{85g\ mol^{-1}} = 0.47\ mol$$

$$\text{Moles of CHCl}_3 = \frac{25.5g}{119.5g\ mol^{-1}} = 0.213\ mol$$

Total number of moles $= 0.47 + 0.213 = 0.683\ mol$

$$x_{CH_2Cl_2} = \frac{0.47\ mol}{0.683\ mol} = 0.688\ ; \quad x_{CHCl_3} = 1.00 - 0.688 = 0.312$$

Using equation $P_{total} = p_1^0\ x_1 + p_2^0\ x_2$

$$p_1^0 + (p_2^0 - p_1^0)\ x_2 = 200 + (415 - 200) \times 0.688$$
$$= 200 + 147.9 = 347.9\ mm\ Hg$$

45. $W_2 = 18\ g;\ W_1 = 200\ g;\ T_f^o = 273\ K;\ T_f = 272.07\ K;\ K_f = 1.86\ K\ Kg/mol.$

$$M_2 = \frac{K_f \times W_2 \times 1000}{\Delta T_f \times W_1}$$

$$= \frac{1.86\,K\,Kg/mol \times 18g \times 1000}{(273 - 272.07) \times 200} \Rightarrow \frac{33480}{186} = 180\,g/mol.$$

46. The cell can be written as $Mg\ |\ Mg^{2+}(0.130M)\ ||\ Ag+(0.0001M)\ |\ Ag$

$$E_{(cell)} = E_{(cell)}^0 - \frac{RT}{2F}\ln\frac{\left[Mg^{2+}\right]}{\left[Ag^+\right]^2}$$

$$= 3.17V - \frac{0.059V}{2}\log\frac{0.130}{(0.0001)^2}$$

$$= 3.17V - 0.21V$$

$$= 2.96V$$

47. Here, $n = 2,\ E_{cell}^0 = 0.236V,\ T = 298K$.

We know that, $\Delta_r G^0 = -nFE_{cell}^0$

$$= -2 \times 96487 \times 0.236$$

$$= -45541.864\ J\ mol^{-1}$$

$$= -45.54\ kJ\ mol^{-1}$$

Again, $\Delta_1 G^0 = -2.303 \, nRT \log K$

$$\Rightarrow \log K_c = -\frac{\Delta_1 G^0}{2.303 \, RT}$$

$$= \frac{-45.54 \times 10^3}{2.303 \times 8.314 \times 298}$$

$$= 7.981$$

$$\therefore K_c = anti \log (7.981) = 9.57 \times 10^7$$

48. $k = \frac{2.303}{32} \log \frac{[R]_0}{[R]}$　　where where, $[R]_0 = 100$; $[R] = 100 - 75 = 25$

$$k = \frac{2.303}{t_{75\%}} \log \frac{100}{25}$$

$$k = \frac{2.303}{32} \log 4$$

$$k = \frac{2.303}{32} \times 0.6020$$

$$k = 0.0433$$

$$k = \frac{2.303}{t} \log \frac{100}{50}$$　　where, $[R]_0 = 100$; $[R] = 100 - 50 = 50$

$$0.0433 = \frac{2.303}{t_{50\%}} \log 2$$

$$0.0433 = \frac{2.303}{t_{50\%}} \times 0.3010$$

$$t_{50\%} = \frac{2.303 \times 0.3010}{0.0433}$$

$$t_{50\%} = 16 \, min$$

49. $\log \dfrac{k_2}{k_1} = \dfrac{E_a}{2.303\,R}\left[\dfrac{T_2-T_1}{T_1T_2}\right]$

$\log \dfrac{0.07}{0.02} = \left(\dfrac{E_a}{2.303 \times 8.314\,JK^{-1}\,mol^{-1}}\right)\left[\dfrac{700-500}{700 \times 500}\right]$

$0.544 = E_a \times 5.714 \times 10^{-4}/19.15$

$E_a = 0.544 \times \dfrac{19.15}{5.714} \times 10^{-4} = 18230.8\,J$

Since, $\quad k = Ae^{-\dfrac{E_a}{RT}}$

$0.02 = Ae^{-\dfrac{18230.8}{8.314 \times 500}} = \dfrac{0.02}{0.012} = 1.61$

* * *

MODEL QUESTION PAPER-2
II PUC - CHEMISTRY(34)

Time: 3 Hrs. 15 Mints. (Total No. of questions: 49)   **Max. Marks : 70**

Instructions:

1. *Question paper has FIVE parts. All parts are compulsory.*
2. *a) Part-A carries 20 marks. Each question carries 1 mark. b) Part-B carries 06 marks. Each question carries 2 marks. c) Part-C carries 15 marks. Each question carries 3 marks. d) Part-D carries 20 marks. Each question carries 5 marks. e) Part-E carries 09 marks. Each question carries 3 marks.*
3. *In Part-A questions, first attempted answer will be considered for awarding marks.*
4. *Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.*
5. *Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.*
6. *Use log tables and simple calculator if necessary (Use of scientific calculators is not allowed.)*

PART-A

I   Select the correct option from the given choices: $1 \times 15 = 15$

1. Which of the following shows –ve deviation from Raoult's law
    a) Ethanol + Acetone   b) Acetone + Chloroform
    c) Phenol + Aniline   d) Both b) and c)

2. The cell reaction is spontaneous, when
    a) E^0_{red} is negative   b) $E^0_{reduction}$ is positive
    c) $\Delta G°$ is negative   d) both b) and c)

3. The amount of substance deposited by the passage of one ampre of current for one second is equal to
    a) Equivalent mass   b) Molecular mass
    c) Electrochemical equivalent   d) Specific equivalent

4. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, express the rate expression in terms of formation of ammonia.

    a) $r = -\dfrac{d[NH_3]}{dt}$ b) $r = \dfrac{1}{2}\dfrac{d[NH_3]}{dt}$

    c) $r = -\dfrac{1}{2}\dfrac{d[NH_3]}{dt}$ d) $r = \dfrac{d[NH_3]}{dt}$

5. Actinide contraction is greater from element to element compared to lanthanides due to

    a) More shielding effect of 5f electrons

    b) Comparable energies of 5f and 6d orbitals

    c) Poor shielding effect of 5f electrons

    d) Magnetic property

6. Complex used in the treatement of lead poisoning is,

    a) EDTA   b) $[Au(CN)_2]^-$ c) $[Ni(CO)_4]$ d) DMG

7. Antiseptic properties of iodoform are due to liberation of _____.

    a) HI   b) I_2 c) H_2O d) CHI_3

8. Which of the following will give phenol with CaO and NaOH ?

    a) Salicylic acid   b) Picric acid   c) Benzoic acid   d) Amino acid

9. The IUPAC name of wood spirit is   *(June-2023)*

    a) methanol   b) ethonol   c) methanal   d) ethanal

10. Ethanoic acid is soluble in water due to

    a) Low molecular weight   b) Intermolecular hydrogen bonding

    c) Dissociation into ions   d) Easy hydrolysis

11. Which of the following compound will have the smallest pK_a value?

    a) Formic acid   b) Benzoic acid

    c) Acetic acid   d) Phenylacetic acid

12. Aniline on treatment with acetic anhydride gives

    a) Phenyl acetate   b) Benzanilide   c) Acetanilide   d) Acetamide

13. Which of the following is the strongest base?

    a) Ammonia   b) Methylamine   c) Dimethylamine d) Aniline

14. What are the hydrolysis products of sucrose?

    a) Fructose + Fructose   b) Glucose + Glucose

    c) Glucose + Galactose   d) Glucose + Fructose

15. Adenosine is an example of

    a) Purine base   b) Pyrimidine base

    c) Nucleoside   d) Nucleotide

II Fill in the blanks by choosing the appropriate word from those given in the brackets: **5 × 1 = 5**

[N,N-Dimethyl methanamine, positive, H_2 gas, phosgene, neagative, Henry's]

16. Increase in the solubility of CO_2 in soft drinks is the application of _____ law.

17. A solution of acetone in Ethanol shows _____ deviation from Raoult's law.

18. _____ gas liberated when lanthanoide react with dilute acids.

19. Chloroform when slowly oxidized by air _____ is formed.

20. The IUPAC name of $(CH_3)_3N$ is _____.

PART-B

III Answer any three of the following. Each question carries two marks.

3 × 2 = 06

21. Draw the graph of vapour pressure with temperature to show depression in freezing point of solvent and solution.

22. What is a Pseudo first order reaction? Give example.

23. Based on CFT, explain the colours of co-ordination compounds.

24. Arrange R – Cl, R – I, R – Br, R – F as directed
    i) Increasing order of density
    ii) Increasing order of boiling points.

25. What is Etard's reaction? Explain.

26. Explain denaturation of proteins.

PART - C

IV Answer any three of the following. Each question carries three marks.

3 × 3 = 09

27. Explain the variation of ionisation enthalpies in d-block elements.

28. How is potassium permanganate prepared from MnO_2. Give equation.

29. a) Study of actinide elements is difficult. Give two reasons.

    b) Actinoid contraction is greater from element to element than lanthanoid contraction. Why?

30. Using VBT, explain the hybridisation, geometrical shape and magnetic property of $[CoF_6]^{3-}$ (hexafluoridocobaltate(III)ion).

31. Amongst the following ions which one has the highest magnetic moment value?

     i) $[Cr(H_2O)_6]^{3+}$ ii) $[Fe(H_2O)_6]^{2+}$ iii) $[Zn(H_2O)_6]^{2+}$

32. Write energy level diagram for d-orbitals splitting in tetrahedral crystal field.

V Answer any two of the following. Each question carries three marks.

$$2 \times 3 = 06$$

33. a) What is the effect of

     i) increase in temperature on the solubility of a gas in liquid.

     ii) increase in pressure on the solubility of a gas in liquid.

     b) State Henry's law. Write its Mathematical expression.   (3+2)

34. Explain the construction and working of a Daniell cell.

35. Write the difference between metallic conductor and electrolytic conductor.

36. Derive Integrated rate equation for rate constant of Zero order reaction.

PART - D

VI Answer any four of the following. Each question carries five marks.

$$4 \times 5 = 20$$

37. a) Explain the mechanism of S_N1 reaction or explain the mechanism involved in the conversion of tertiary butyl bromide into tertiary alcoho.   (4)

     b) What is a stereocentre or Chiral carbon or Asymmetric carbon atom Give an example.   (1)

38. a) What is Lucas reagent? How does it is used to distinguish primary alcohols and tertiary alcohols?   (3)

     b) What is the effect of electron-donating group on the acidity of phenols?(2)

39. a) How do you convert phenols to methoxybenzene (anisole) ?
     Give the reaction.   (2)

     b) What happens when diethyl other heated with

     i) Limited amount of HI , ii) Excess of HI?   (2)

     c) Write the IUPAC name of Diethyl Ether.   (1)

40. a) Explain mechanism of addition of HCN to aldehyde or ketone.   (2)
    b) What is cannizzaro's reaction? Give an example.   (2)
    c) Mention the carboxylic acid used in the manufacture of nylon 6-6. (1)

41. a) What is the Wolff-kishner reduction? Give an example.   (2)
    b) Explain the addition of alcohols to aldehydes with an example.   (2)
    c) Benzoic acid not gives Friedle-crafts reaction. Give reason.   (1)

42. a) Explain how do you reduce nitriles to primary amines. Give Equation. (2)
    b) Explain Gabriel pthalimide synthesis to prepare primary amines. Give the chemical equation.   (3)

43. a) What are disaccharides? Give examples.   (2)
    b) How does glucose reacts with acetic anhydride? OR How do you show that glucose contains 5–OH groups.   (2)
    c) What is an invert sugar?   (1)

PART – E (PROBLEMS)

VII   Answerany three of the following. Each question carries three marks.

$$3 \times 3 = 09$$

44. 45g of ethylene glycol ($C_2H_6O_2$) is mixed with 600 g of water. Calculate (a) the freezing point deprssion and (b) the freezing point of the solution.

45. 0.6 mL of acetic acid (CH_3COOH), having density 1.06 g ML^{-1}, is dissolved in 1 litre of water. The deprssion in freezing point observed for this strength of acid was 0.0205°C. Calculate the vant' Hoff factor and the dissociation constant of acid.

46. The standard electrode potential for Daniell cell is 1.1V. Calculate the standard Gibbs energy for the reaction: $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(ag) + Cu(s)$.

47. In the button cells widely used in watches and other devices the following reaction takes place: $Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$

    Determine ΔG^0 and E^0 for the reactive.

48. A reaction follows 2nd order if the concentration of reactant is (i) doubled, (ii) how the rate of reactions varies of reduced to half.

49. The rate of a reaction increases by 4 times when the temperature of the reaction is raised from 340K to 360K. Calculate the energy of activation of the reaction. Given R = 8.314 J/K/mol.
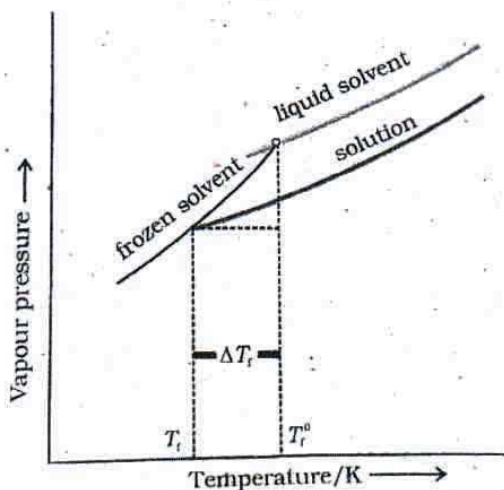
* * *

ANSWERS TO MODEL QUESTION PAPER-2

PART-A

I 1. d   2. d   3. c   4. b   5. c
   6. a   7. d   8. a   9. a   10. b
   11. a   12. c   13. c   14. d   15. a

II 16. Henry's   17. positive   18. H_2 gas
   19. Phosgene   20. N, N – Dimethylmethanamine

PART-B

IV 21.

22. High molecularity reactions which follows first order kinetics are called Pseudo first order reactions.

OR

Higher order reactions are converted into first order reactions by taking all the reactants in large excess except one are called Pseudo first order reactions.

For example: **1. Acid hydrolysis of ethyl acetate.**

$$CH_3COOC_2H_5 + H_2O \xrightarrow{\ H^+\ } CH_3COOH + C_2H_5OH$$
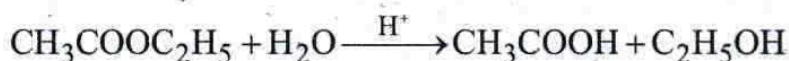
$$Rate = k\,[CH_3COOC_2H_5]^1\,[H_2O]^0$$

$$\therefore \quad Rate = k\,[CH_3COOC_2H_5]^1 \qquad \therefore Order = 1$$

2. Inversion of cane sugar,

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

Glucose   Fructose
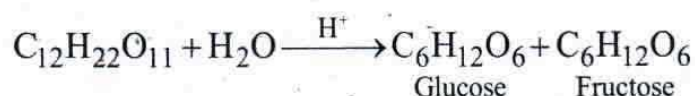
$$\text{Rate} = k[C_{12}H_{22}O_{11}]^1 [H_2O]^0$$

$\therefore \quad \text{Rate} = k[C_{12}H_{22}O_{11}]^1$

$\therefore \quad \text{Order} = 1$

23. When white light is passed passed through the sample (solution of tranition metal complex) the solution absorbs certain wavelength of white light and mixture of remaining wave lengths are transmitted as complementary colours.

   Example: Ti $(H_2O_6)^{3+}$ absorbs blue green light and emits violet colour (complementary to blue green or violet).

24. i) $R - F < R - Cl < R - Br < R - I$

   ii) $R - F < R - Cl < R - Br < R - I$

25. Toluene on oxidation with chromyl chloride (CrO_2Cl_2) gives chromium complex, which on hydrolysis gives benzaldehyde.

Toluene   Benzaldehyde
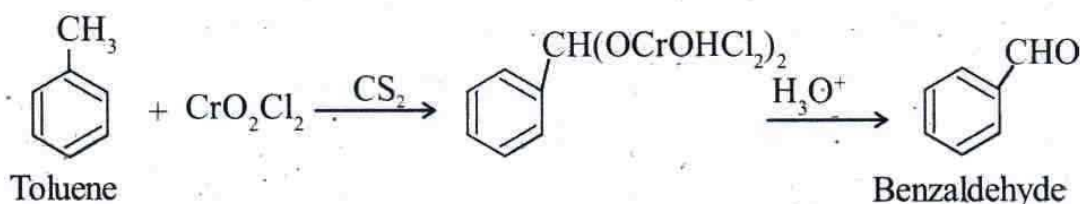
26. When native proteins subjected to change in temperature or change in P^H (Chemical change) loses its biological activity is called Denaturation of Proteins.

   Example: Coagulation of egg on boiling.

   Native protein: Proteins present in the biological system have three dimensional structure and biological activity is called Native proteins.

   During denaturation of proteins 2° and 3° structure are destroyed and 1° structure remains intact.

PART-C

IV 27. The ionisation enthalpy of 3d series increase as we move across a period. This is due to incrase in effective nuclear charge which accompanies the filling of the inner d-orbitals. The second ionisation energies of the 3d series also increases with the increase in atomic number. But this trend is not regular and there are some irregular variations.

1. Second ionization enthalpy of Cr and Cu are sufficiently higher than their neighbouts. This is due to their stable electronic configuration (d^5 in Cr and d^{10} in Cu).

2. The first ionisation enthalpy of chromium is lower because removal of one electron produces extra stable d^5 configuration and that of zinc is higher because the removal of electron takes place from fully filled 4s orbital.

$$Cr = 3d^5 \, 4s^1 \longrightarrow Cr^+ = 3d^5$$
$$Zn = 3d^{10} \, 4s^2 \longrightarrow Zn^{2+} = 3d^{10}$$
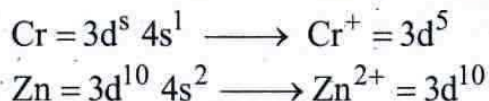
3. The second ionization enthalpy of Zn is less than second ionization enthalpy of Cu. This is because removal of second electron in Zn produces stable d^{10} configuration while the removal of second electron in Cu disrupts the d^{10} configuration with a considerable loss in exchange energy to form less stable d^9 configuration.

4. Second ionization enthalpy of Mn ($Z = 25$) is less than that of Fe ($Z = 26$). This is because removal of second electron in Mn produces half filled d^5 configuration with a considerable loss in exchange energy to form less stable d^9 configuration.

5. Third ionisation enthalpy of Mn is more than that of Fe. This is because removal of third electron from Mn disrupts stable d^5 configuration but in Fe removal of third electron forms stable d^5 configuration.

6. Third ionisation energy of copper, nickel and zinc is very high. Because it is difficult to obtain oxidation state greater than two for these elements.

28. 1) Potassium permanganate is prepared from the mineral Pyrolusite MnO_2. The powdered pyroluscite fused with potassium hydroxide and on oxidising agent KNO_3/air to form dark green potassium manganate.

i.e. $2MnO_2 + 4KOH + O_2 \xrightarrow{\Delta} 2K_2MnO_4 + 2H_2O$
Pot. Manganate
(Green)
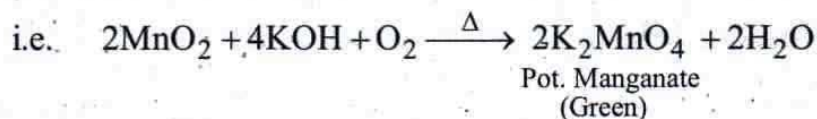
2) Potassium manganate undergoes disporportion in acidic or neutral solution to form permanganate.

i.e. $3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$
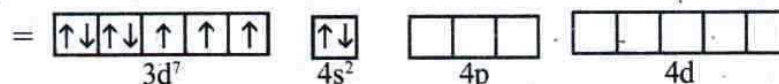   (Violet)
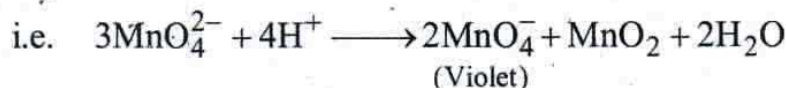
29. a) i) Actinides are radioactive elemens.

ii) Half life of actinides are very short (3 min - 24 hours).

iii) They could be prepared in nanograms.

b) This is because 5f electrons will be less effectively shielded from the nuclear charge than the 4f electrons of the corresponding lanthanides.

30. Oxidation State of cobalt in $[CoF_6]^{3-}$ is +3 and E.C. is $[Ar]^{18}3d^74s^2$.

E.C. Co atom (z = 27)
in ground state   = $\boxed{\uparrow\downarrow|\uparrow\downarrow|\uparrow|\uparrow|\uparrow}$ $\boxed{\uparrow\downarrow}$ $\boxed{\ |\ |\ }$ $\boxed{\ |\ |\ |\ }$
                        $3d^7$ $4s^2$ 4p   4d

E.C. Co^{3+} ion   = $\boxed{\uparrow\downarrow|\uparrow|\uparrow|\uparrow|\uparrow}$ $\boxed{\ }$ $\boxed{\ |\ |\ }$ $\boxed{\ |\ |\ |\ }$
                        $3d^6$ 4s   4p   4d
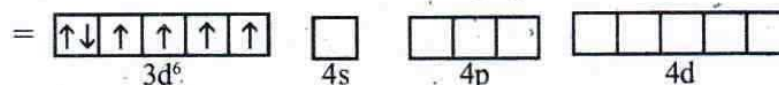
F^- is a weak ligand does not pairs up. One 5s, three 4 p and Two 4d orbitals undergo sp^3d^2 hybridisation forms 6 sp^3d^2 hybrid orbitals give octahedral shape.

sp^3d^2 hybridised
orbitals of Co^{3+} ion   = $\boxed{\uparrow\downarrow|\uparrow|\uparrow|\uparrow|\uparrow}$ $\boxed{\ |\ |\ |\ |\ |\ }$
                            $3d^6$ Six empty sp^3d^2 hybrid orbitals

Formation of $[CoF_6]^{3-}$ = $\boxed{\uparrow\downarrow|\uparrow|\uparrow|\uparrow|\uparrow}$ $\boxed{xx|xx|xx|xx|xx|xx}$
                            $3d^6$ Six electron pairs donated by six F ligand
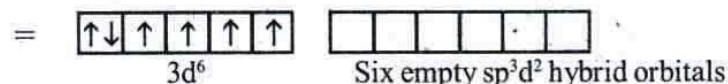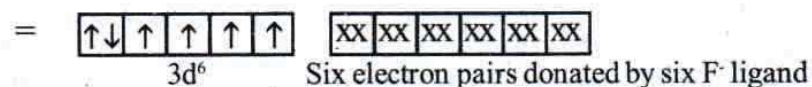
Hybridisation   = sp^3d^2 (outer orbital complex)
geometrical shape   = Octahedral
Magnetic property   = Paramagnetic due to the presence of unpaired electrons.

                          High spin or spin free complex.

31. i) No. of unpaired electrons in $[Cr(H_2O)_6]^{3+}$ = 3

Then, Magnetic moment = $\sqrt{n(n+2)}$ = $\sqrt{3(3+2)}$ = $\sqrt{15}$ ≃ 4.89 BM

ii) No. of unpaired electrons in $[Fe(H_2O)_6]^{2+} = 4$

Then, Magnetic moment $= \sqrt{4(4+2)} = \sqrt{24} \cong 5.79$ BM

iii) No. of unpaired electrons in $[Zn(H_2O)_6]^{2+} = 0$

Hence, $[Fe(H_2O)_6]^{2+}$ has the highest magnetic moment value.

32. In tetrahedral complexes, the central metal ion is surrounded by 4 ligands. In presence of ligands the d-orbitals splits into 2 sets namely - lower energy 'e' orbitals containing $d_{x^2-y^2}$ and d_{x^2} and higher energy t_2, orbitals containing d_{xy}, d_{yz}, d_{xz} orbitals.
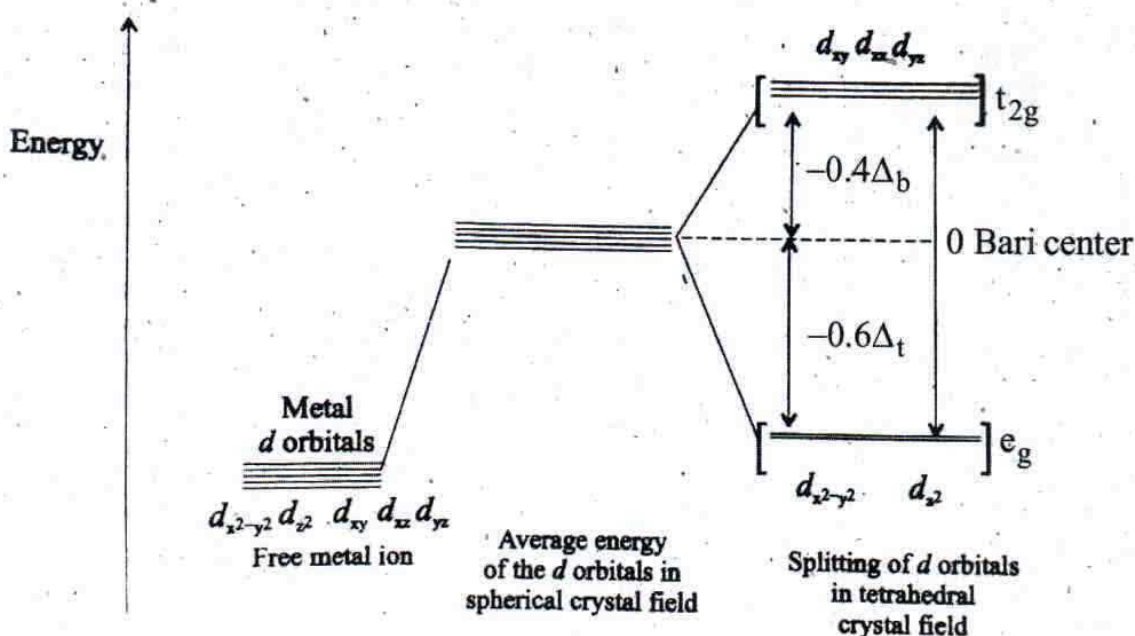
In tetrahedral field, the crystal field splitting energy is Δ_t. In tetrahedral complexes, the splitting of d-orbitals is inverted when compared to the octahedral complexes.

V 33. a) i) The solubility of a gas decreases with increase in temperature and increases with decrease in temperature. i.e. Solubality of a gas $\alpha \dfrac{1}{\text{Temperature}}$

ii) Solubility of a gas is directly proportional to pressure. Solubility increases with increase in pressure.

b) At constant temperature the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas present over the liquid or solution.

OR

The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution.

i.e. $P_{gas} = K_H \cdot \chi_{gas}$

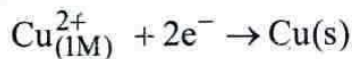K_H = Henry's law constant.

χ = Mole fraction of a gas.

34.

$$Zn(s) \rightarrow Zn^{2+}_{(1M)} - 2e^-$$
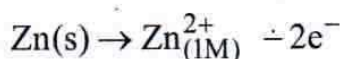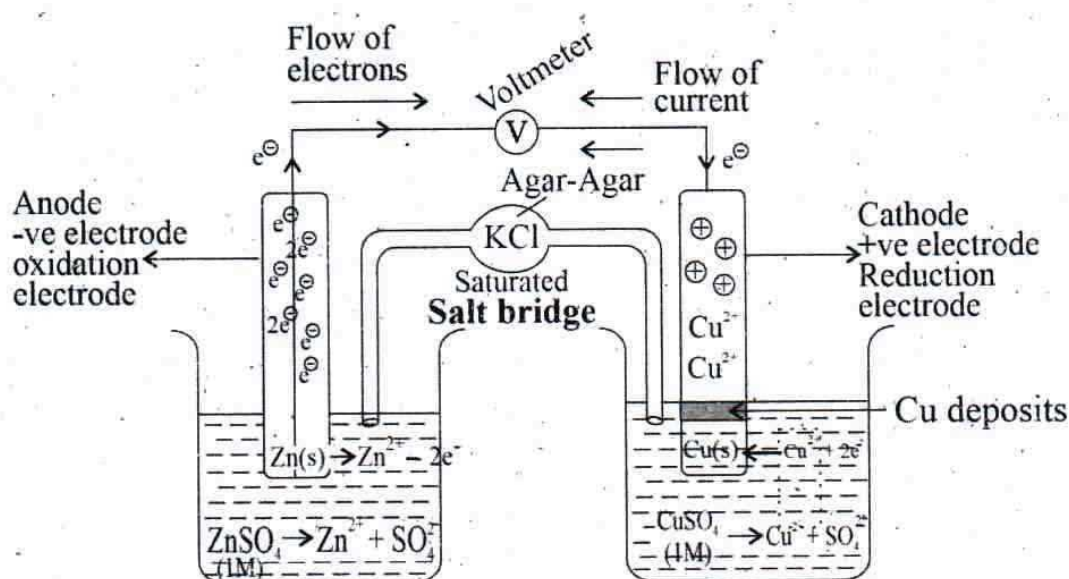
Oxidation

Zinc electrode

Zinc Half cell

$$Cu^{2+}_{(1M)} + 2e^- \rightarrow Cu(s)$$

Reduction

Copper electrode

Copper Half cell

$$Zn(s) / Zn^{2+}_{(1M)} \parallel Cu^{2+}_{(1M)} / Cu(s)$$

Construction: It is combination of zinc half cell and copper half cell. A zinc rod dipped in 1 M $ZnSO_4$ solution acts as zinc electrode. A copper rod placed in 1M $CuSO_4$ solution acts as a copper electrode, the two half-cells are inter connected by a salt bridge. The two electrodes are connected externally through a voltmeter and a switch.

Working: Zinc electrode shows tendency to under go oxidation and acts as anode. While, copper electrode undergoes recuction acts as a cathode, electrons liberated at anode moved to cathode through external wire, electricity flows from cathode to anode.

Cell reaction: At anode $Zn_{(s)} \xrightarrow{\text{oxidtion}} Zn^{2+}_{(1M)} - 2e^{(-)}$

At cathode $Cu^{2+}_{(1M)} + 2e^{(-)} \xrightarrow{\text{Reduction}} Cu(s)$

Overall reaction $Zn_{(s)} + Cu^{2+}_{(1M)} \rightleftarrows Zn^{2+}_{(1M)} + Cu_{(s)}$
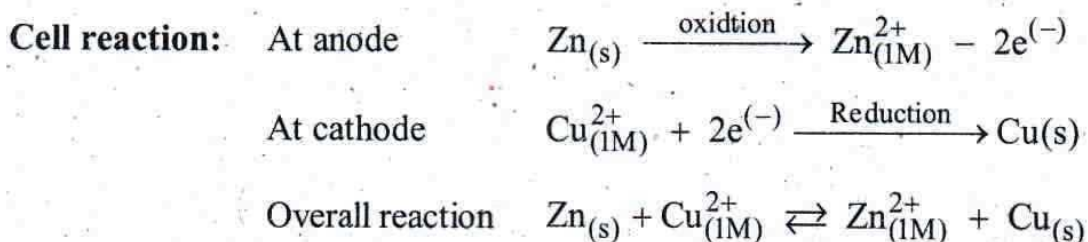
The cell represented by, $Zn_{(s)} \mid Zn^{2+}_{(1M)} \parallel Cu^{2+}_{(1M)} \mid Cu(s)$

EMF of the cell is calculated by, $E^0_{Cell} = E^0_{cathode} - E^0_{anode}$

$$= E^0_{cu^{2+}/Cu} - E^0_{Zn/2n^{2+}}$$

$$= +0.34 - (-0.76V) \quad = +1.10 \text{ volts}$$

	Metallic conductor	Electrolytic conductor
35.	i) The conductivity is due to movement of electrons.	The conductivity is due to the movement of ions.
	ii) They conduct electricity in solid state.	They conduct electricity in fused state or solution state.
	iii) No chemical changes takes place.	Chemical change takes place.
	iv) Conductivity decreases with increase in temperture.	Conductivity increases with increase in temperature.
	v) Metals do not decompose.	Electrolytes decomposes into ions.
	vi) No transfer of matter takes place. *Examples:* Cu, Al, Pt, etc.	Transfer of matter takes place. *Examples:* HCl, NaOH, etc.

36. Consider a zero order reaction, $R \rightarrow P$

According to rate expression, Rate $\alpha \ [R]^0$

$$\frac{-d[R]}{dt} \ \alpha \ [R]^0$$

$$\frac{-d[R]}{dt} = k[R]^0$$

Where k = Rate Constant / Velocity Constant/spacific rate constant.

$$-\frac{d[R]}{dt} = k \times 1$$

$$-\frac{d[R]}{dt} = k \qquad \ldots (1)$$

On Rearranging the equation, we get,

$$-d[R] = k \times dt$$

$$d[R] = -k \times dt$$

On integration

$$\int d[R] = -k \int dt + I$$

$$[R] = -k \times t + I \qquad \ldots (2)$$

Where I = Integration constant

To find I, When $t = 0$, $[R] = [R_0]$ the initial concentration of the reactant. Substitute the value of R and t in Equation (2)
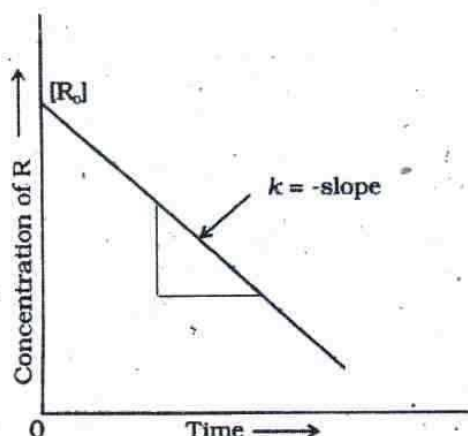
$$\therefore \quad [R]_0 = -k(0) + I$$

$$\therefore \quad I = [R]_0 \qquad \ldots (3)$$

Put $I = [R]_0$ in equation (2) We get

$$[R] = -kt + [R]_0$$

$$kt = [R]_0 - [R]$$

$$\therefore \quad k = \frac{[R]_0 - [R]}{t}$$

PART-D

VI 37. Tertiary alkyl halide, undergo S_N1 reaction and it follows first order kinetics.

Example: Tertiary butyl bromide on hydrolysis with aqueous NaOH gives tertiary butyl alcohol.
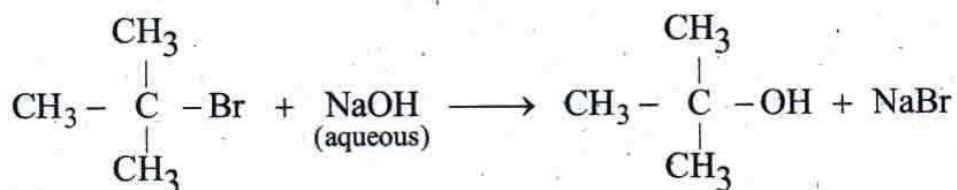
Rate equation is given by rate $= k\left[(CH_3)_3 C - Br\right]$

Mechanism: S_N1 mechanism involves two steps.

I Step : Tertiary butyl bromide ionizes slowly to give Sp^2 hybridised planar tertiary butyl carbocation and bromide ion.
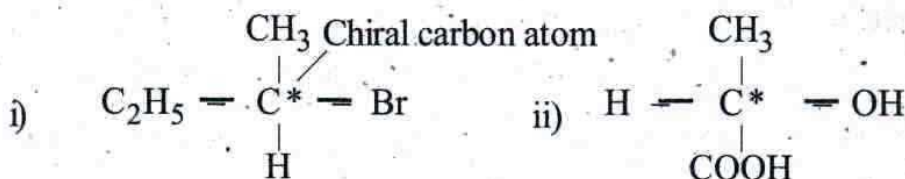
$$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - Br \xrightleftharpoons{\text{slow}} \underset{\underset{CH_3}{\diagdown} \quad \underset{CH_3}{\diagup}}{C^+} + Br^-$$
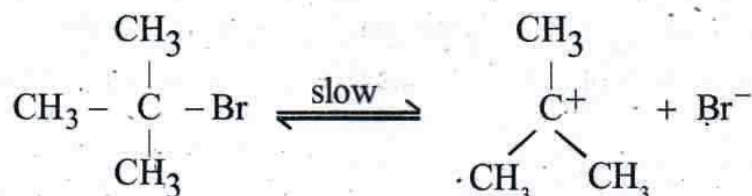
It is a rate defermining step.

II Step : The nucleophile OH^- from aqueous NaOH attacks planar carbocation on either side to give tertiary butyl alcohol.

$$\underset{CH_3 \quad CH_3}{\overset{\overset{CH_3}{|}}{C^+}} + OH^- \longrightarrow CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - OH + HO - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3$$

$$\text{d-isomer} \qquad \qquad l\text{-isomer}$$
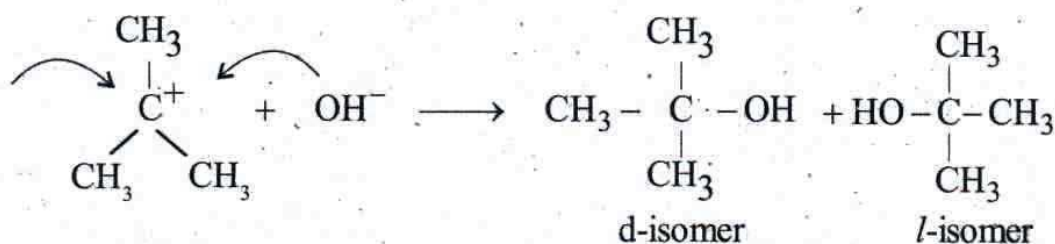
The product obtained is a racemic mixture.

b) A carbon atom bonded to four different atoms or groups is called chiral carbon atom.

Examples:

i) $$C_2H_5 - \underset{\underset{H}{|}}{\overset{\overset{CH_3 \text{ Chiral carbon atom}}{|}}{C^*}} - Br$$

ii) $$H - \underset{\underset{COOH}{|}}{\overset{\overset{CH_3}{|}}{C^*}} - OH$$

38. a) A mixture of anhydrous zinc chloride and concentrated hydrochloric acid is called Lucas reagent.

The time taken for the appearance of turbidity with Lucas reagent is different in three types of alcohols is used to distinguish 1°, 2° and 3° alcohols.

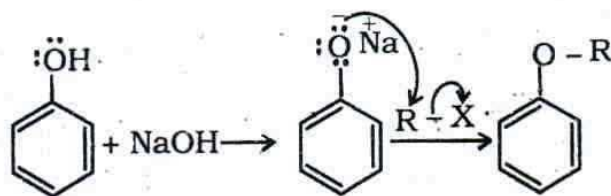**Primary alcohols** (1°) does not give turbidity withLucas reagent at room temperature give turbidity only on heating.

Secondary alcohols (2°) give turbidity after 5 minutes.

Tertiary alcohols (3°) give turbidity with Lucas reagent immediately.

b) Electron donating groups like $-CH_3(R)$ or $-NH_2$ or $-OH$ etc. donates electrons increases the negative charge on 'O' atom destabilises the phenoxide ion with respect to phenol and thus decreases the acidic strength.
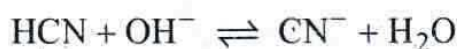

unstable, Acidity decreases
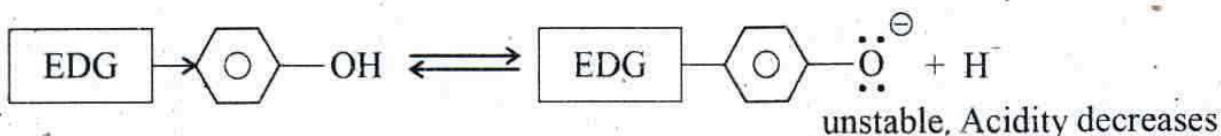
39. a) On treating phenol with alkali NaOH to form Sodium phenoxide which on treating with alkyl halide gives Anisole (methoxybenzene).

b) i) $C_2H_5-O-C_2H_5 + \underset{\text{Limited}}{HI} \xrightarrow{\Delta} C_2H_5OH + C_2H_5I$

ii) $C_2H_5-O-C_2H_5 + \underset{\text{Excess}}{HI} \xrightarrow{\Delta} 2C_2H_5-I + H_2O$

c) Ethoxy ethane

40. a) HCN reacts with a base to give cyanide ion (CN^- ion).

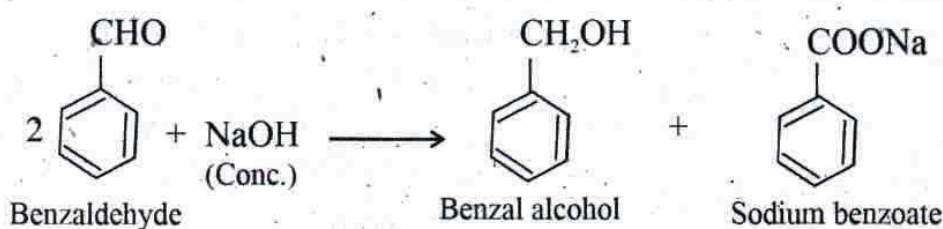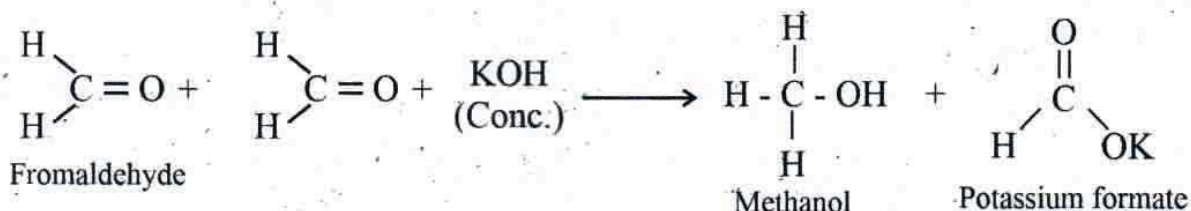$HCN + OH^- \rightleftharpoons CN^- + H_2O$

CN^- attacks the carbonyl carbon to form tetrahedral intermediate followed by protonation to give cyanohydrin.

cyanodydrin
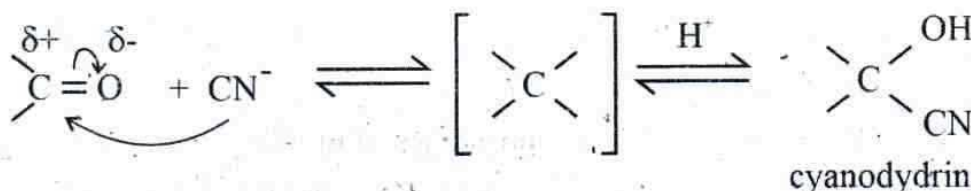
b) Two molecules of aldehydes which do not contain α-hydrogen atom react with strong alkali and undergo disprofortionation reaction to produce a primary
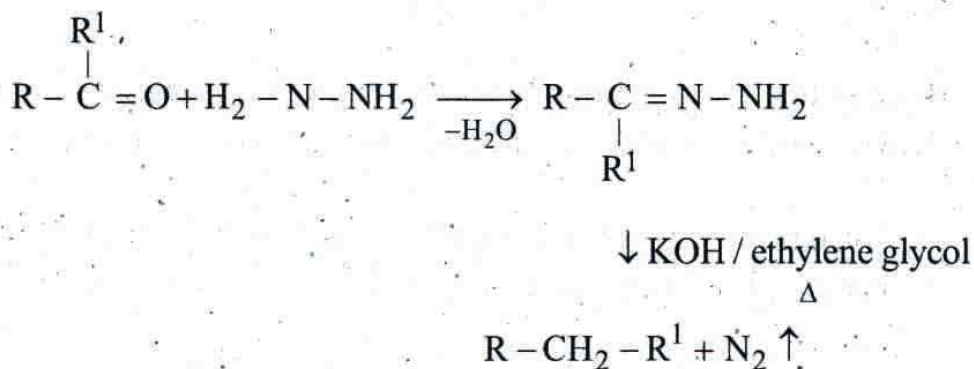
alcohol and a salt of carboxylic acid. This reaction is called cannizzaro's reaction.
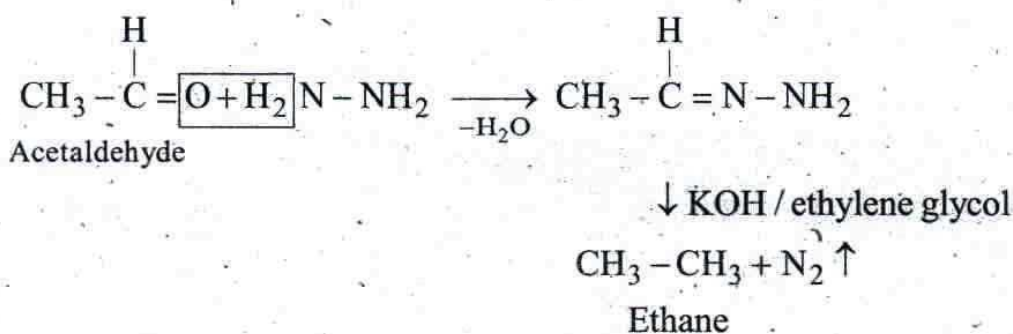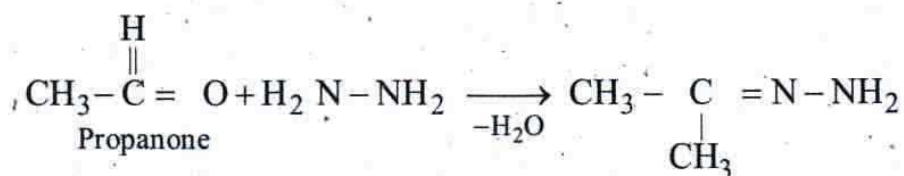
Example:

$$\underset{\text{Fromaldehyde}}{\underset{H}{\overset{H}{>}}C=O} + \underset{H}{\overset{H}{>}}C=O + \underset{\text{(Conc.)}}{KOH} \longrightarrow \underset{\text{Methanol}}{H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-OH} + \underset{\text{Potassium formate}}{\overset{\overset{\displaystyle O}{\|}}{\underset{H}{C}}\diagdown OK}$$

$$2\underset{\text{Benzaldehyde}}{\overset{CHO}{\bigcirc}} + \underset{\text{(Conc.)}}{NaOH} \longrightarrow \underset{\text{Benzal alcohol}}{\overset{CH_2OH}{\bigcirc}} + \underset{\text{Sodium benzoate}}{\overset{COONa}{\bigcirc}}$$

c) Hexanediodic acid. $HOOC–(CH_2)_4 – COOH$

41. a) The reduction of aldehyde and ketones into corresponding hydrocarbons by heating with a mixture of hydrazine and strong base like KOH in ethylene glycil is called Wolff-kishner reduction.
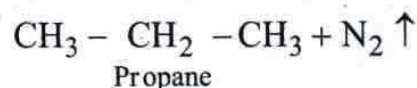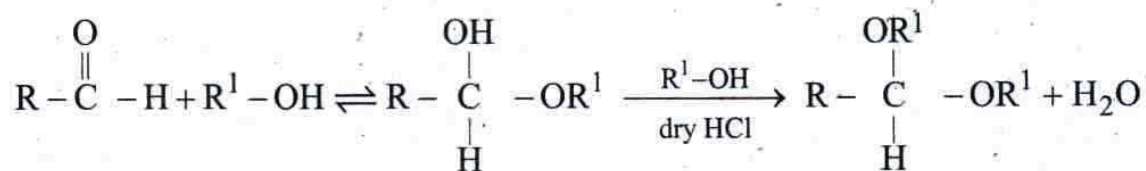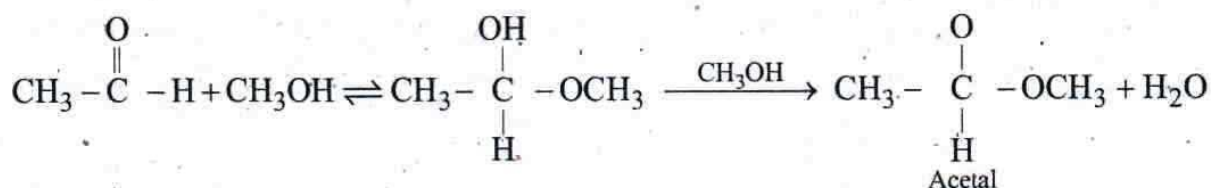
$$R-\overset{\overset{\displaystyle R^1}{|}}{C}=O+H_2-N-NH_2 \xrightarrow[-H_2O]{} R-\overset{\overset{\displaystyle}{C}}{\underset{\underset{\displaystyle R^1}{|}}{}}=N-NH_2$$

$$\downarrow KOH / \text{ethylene glycol}$$
$$\Delta$$

$$R-CH_2-R^1 + N_2 \uparrow$$

Example:

$$\underset{\text{Acetaldehyde}}{CH_3-\overset{\overset{\displaystyle H}{|}}{C}=\boxed{O+H_2}N-NH_2} \xrightarrow[-H_2O]{} CH_3-\overset{\overset{\displaystyle H}{|}}{C}=N-NH_2$$

$$\downarrow KOH / \text{ethylene glycol}$$

$$\underset{\text{Ethane}}{CH_3-CH_3 + N_2 \uparrow}$$

$$\underset{\text{Propanone}}{CH_3 - \overset{\overset{\displaystyle H}{\|}}{C} = O} + H_2 N - NH_2 \xrightarrow{-H_2O} \underset{\underset{\displaystyle CH_3}{|}}{CH_3 - C} = N - NH_2$$

$$\downarrow KOH / \text{ethylene glycol}$$

$$\underset{\text{Propane}}{CH_3 - CH_2 - CH_3} + N_2 \uparrow$$

b) Aldehydes react with alcohols in the presence of dry HCl gas to from intially hemicaletal with molecule of alcohol and acetal with two molecules of alcohol.
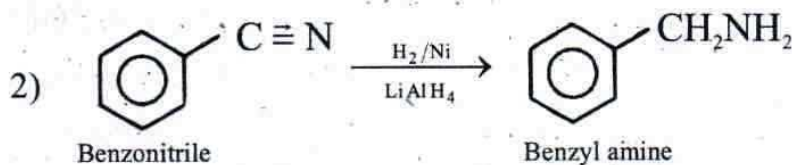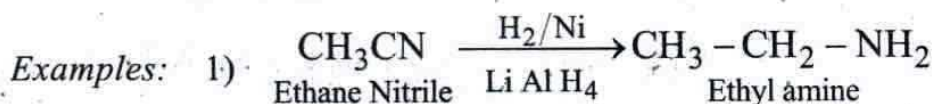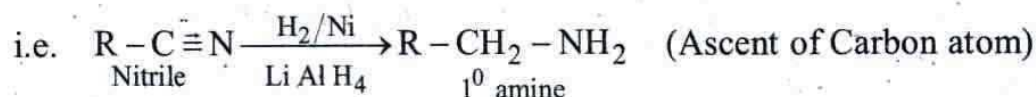
$$R - \overset{\overset{\displaystyle O}{\|}}{C} - H + R^1 - OH \rightleftharpoons R - \underset{\underset{\displaystyle H}{|}}{\overset{\overset{\displaystyle OH}{|}}{C}} - OR^1 \xrightarrow[\text{dry HCl}]{R^1 - OH} R - \underset{\underset{\displaystyle H}{|}}{\overset{\overset{\displaystyle OR^1}{|}}{C}} - OR^1 + H_2O$$

Example:

$$CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - H + CH_3OH \rightleftharpoons CH_3 - \underset{\underset{\displaystyle H}{|}}{\overset{\overset{\displaystyle OH}{|}}{C}} - OCH_3 \xrightarrow{CH_3OH} CH_3 - \underset{\underset{\displaystyle \underset{\text{Acetal}}{H}}{|}}{\overset{\overset{\displaystyle O}{|}}{C}} - OCH_3 + H_2O$$

c) Because the carboxyl group is deactivating and the catalyst aluminium chloride (Lewis acid) gets bonded to the carboxyl group and forms the complex salt.

42. a) Nitriles are reduced to primary amines by heating with lithium aluminium hydride (LiAlH$_4$) or by H$_2$/Ni or Sodium amalgam in ethanol.

i.e. $\underset{\text{Nitrile}}{R - C \equiv N} \xrightarrow[\text{Li Al H}_4]{H_2/Ni} \underset{1^0 \text{ amine}}{R - CH_2 - NH_2}$ (Ascent of Carbon atom)

Examples: 1) $\underset{\text{Ethane Nitrile}}{CH_3CN} \xrightarrow[\text{Li Al H}_4]{H_2/Ni} \underset{\text{Ethyl amine}}{CH_3 - CH_2 - NH_2}$

2)

Benzonitrile   Benzyl amine

b) . Pthalimide on treating with alcoholic potash gives N-Pot. Pthalimide which on heating with alkyl halide gives N-alkyl phthalimide this on hydrolysis with alkali forms Primary amine.

Phthalimide

N-Alkylphthalimide

$+ R - NH_2$

(1^0 amine)
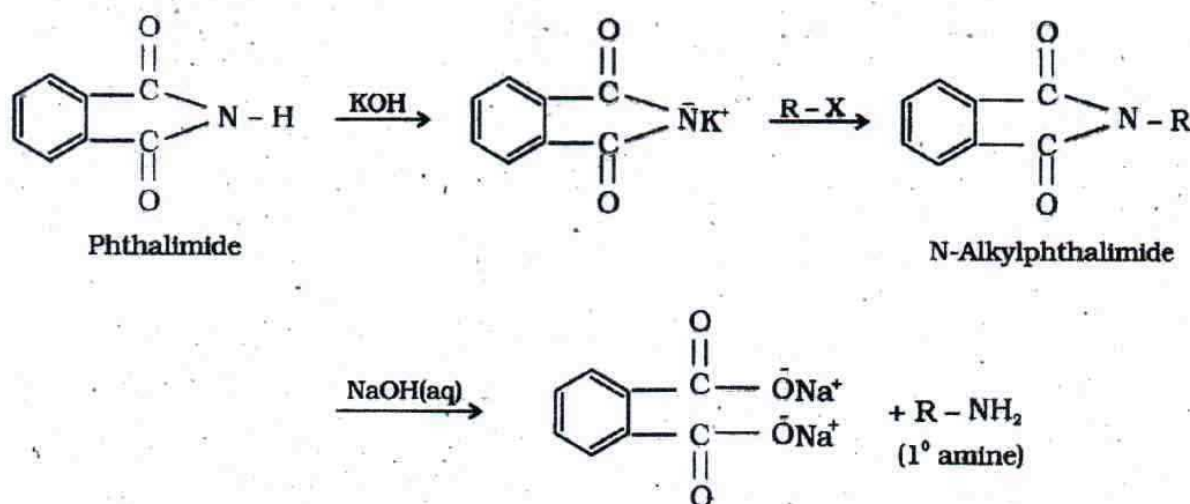
43. a) Oligosaccharides which on hydrolysis gives two monosaccharides are called disaccharides. *Examples:*

i) Sucrose $(C_{12}H_{22}O_{11})$ on hydrolysis gives one glucose molecule and one fructose molecule.

ii) Maltose $(C_{12}H_{22}O_{11})$ on hydrolysis gives 2 glucose molecules.

b) Glucose (1mole) on acetylation with acetic anhydride gives glucose pentacetate. This contains the presence of 5 –OH groups in glucose.

Glucose

Glucose pentaacetate*
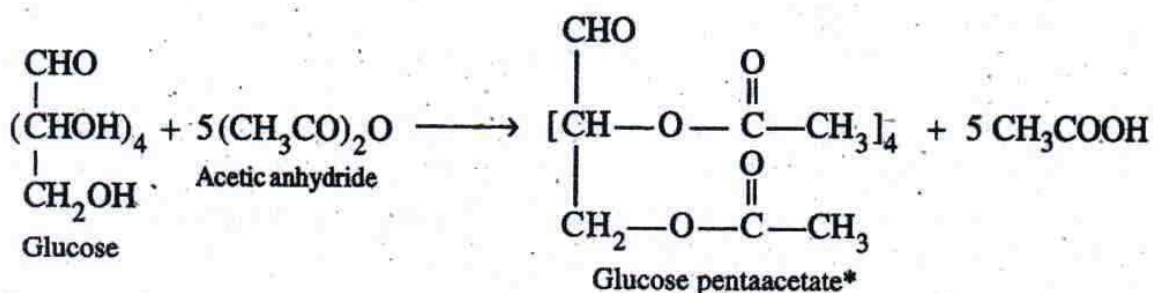
c) Sucrose after hydrolysis gives equimolar mixture of $\alpha - D(+)$ Glucose and $\beta - D(-)$ Fructose is called Invert sugar.

PART-E (PROBLEMS)

44. Depression in freezing point is related to the molality, therefore, the molality of the solution with respect to ethylene glycol $= \dfrac{\text{moles of ethylene glycol}}{\text{mass of water in kilogram}}$

Moles of ethylene glycol $= \dfrac{45\,g}{62\,g\,mol^{-1}} = 0.73\,mol$

Mass of water in kg $= \dfrac{600\,g}{1000\,g\,kg^{-1}} = 0.6\,kg$

Hence, molality of ethylene glycol $== \dfrac{0.73\,mol}{0.60\,kg} = 1.2\,mol\,kg^{-1}$

Therefore, freezing point depression, $\Delta T_f = 1.86\,K\,kg\,mol^{-1} \times 1.2\,mol\,kg^{-1}$

$$= 2.2K$$
$$= 270.95\,K$$

45. Number of moles of acetic acid $= \dfrac{0.6\,mL \times 1.06g\,mL^{-1}}{60g\,mol^{-1}} = 0.0106\,mol = n$

Molality $= \dfrac{0.0106\,mol}{1000\,mL \times 1g\,mL^{-1}} = 0.0106\,mol\,kg^{-1}$

Using equation, $\Delta T_f = 1.86\,K\,kg\,mol^{-1} \times 0.0106\,mol\,kg^{-1} = 0.0197\,K$

vant Hoff Factor (i) $= \dfrac{\text{Observed freezing point}}{\text{Calculated freezing point}} = \dfrac{0.0205\,K}{0.0197\,K} = 1.041$

Acetic acid is a weak electrolyte and will dissociate into two ions: acetate and hydrogen ions per molecule of acetic acid. If x is the degree of dissociation of acetic acid, then we would have n (1 – x) moles of undissociated acetic acid, nx molex of CH_3COO^- and nx moles of H^+ ions,

$$CH_3COOH \rightleftharpoons H + CH_3COO^-$$

n mol   O   O

n(1−x)   nx mol   nx mol
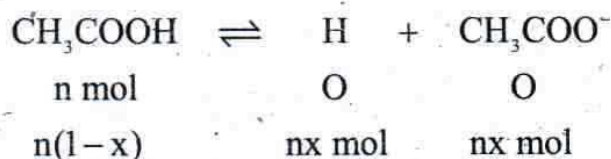
Thus, total moles of particles are: $n(1 – x + x + x) = n(1+x)$

$$i = \dfrac{n(1+x)}{n} = 1+x = 1.041$$

Thus, degree of dissociation of acetic acid $= x = 1.041 - 1.000 = 0.041$
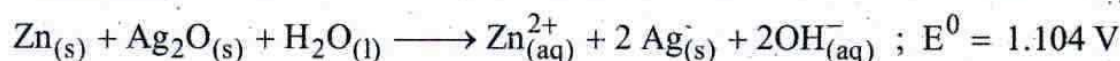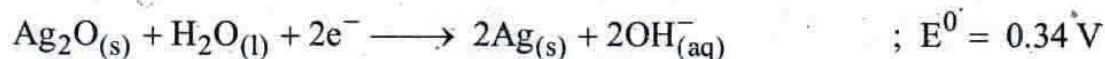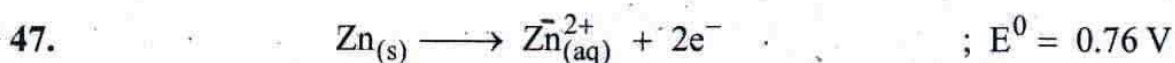
Then, $[CH_3COOH] = n(1-x) = 0.0106(1-0.041)$

$[CH3CCO^-] = nx = 0.0106 \times 0.041$, $[H^+] = nx = 0.0106 \times 0.041$

$$K_a = \frac{[CH_2COO^-][H^+]}{[CH_3COOH]} = \frac{0.0106 \times 0.041 \times 0.0106 \times 0.041}{0.0106(1.00 - 0.041)} = 1.86 \times 10^{-5}$$

46. $\Delta_r G^0 = -nF E^0_{(cell)}$

'n' in the above equation is 2, $F = 96487$ C mol^{-1} and $E^0_{(cell)} = 1.1V$.

Therefore, $\Delta_r G^0 = -2 \times 1.1V \times 96487$ C mol^{-1}

$= -21227$ J mol^{-1}

$= -212.27$ kJ mol^{-1}

47.

$$Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + 2e^- \qquad ; E^0 = 0.76 \text{ V}$$

$$\underline{Ag_2O_{(s)} + H_2O_{(l)} + 2e^- \longrightarrow 2Ag_{(s)} + 2OH^-_{(aq)} \qquad ; E^0 = 0.34 \text{ V}}$$

$$Zn_{(s)} + Ag_2O_{(s)} + H_2O_{(l)} \longrightarrow Zn^{2+}_{(aq)} + 2 Ag_{(s)} + 2OH^-_{(aq)} ; E^0 = 1.104 \text{ V}$$

$\therefore E^0 = 1.104$ V

We know that, $\Delta G^0 = -nF E^0_{cell}$

$= -2 \times 96487 \times 1.04$

$= -213043.296$ J

$= -213.04$ kJ

48. i) Rate $= K [R]^2$

when [R] is doubled,

Rate $= K [2]^2$

Rate $= 4k$

$\therefore$ rate increases by 4 times.

ii)   Rate = $K[R]^2$

when [R] is reduced to half

then   Rate = $k\left[\dfrac{1}{2}\right]^2$

Rate = $\dfrac{k}{4}$ or $k.\dfrac{1}{4}$

Rate of reaction decreases by four times.

49. $\log\dfrac{k_2}{k_1} = \dfrac{E_a}{2.303R}\left(\dfrac{T_2 - T_1}{T_1 T_2}\right)$

$\log 4 = \dfrac{E_a}{2.303 \times 8.314}\left[\dfrac{360 - 340}{360 \times 340}\right]$

$0.6021 = \dfrac{E_a}{2.303 \times 8.314}\left[\dfrac{20}{122400}\right]$

$\therefore \; E_a \;=\; \dfrac{0.6021 \times 19.147 \times 122400}{20}$

$= 70554 \; J/mol \quad OR \quad 70.554 \; KJ/mol$

* * *

MODEL QUESTION PAPER-3
II PUC - CHEMISTRY(34)

Time: 3 Hrs. 15 Mints. (Total No. of questions: 49)   **Max. Marks : 70**

Instructions:

1. *Question paper has FIVE parts. All parts are compulsory.*
2. *a) Part-A carries 20 marks. Each question carries 1 mark. b) Part-B carries 06 marks. Each question carries 2 marks. c) Part-C carries 15 marks. Each question carries 3 marks. d) Part-D carries 20 marks. Each question carries 5 marks. e) Part-E carries 09 marks. Each question carries 3 marks.*
3. *In Part-A questions, first attempted answer will be considered for awarding marks.*
4. *Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.*
5. *Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.*
6. *Use log tables and simple calculator if necessary (Use of scientific calculators is not allowed.)*

PART-A

I   **Select the correct option from the given choices:** $1 \times 15 = 15$

1. Osmotic pressure is a colligative property because
   a) It depends on solvent
   b) It depends on number of solute particles
   c) It depends on concentration of solution
   d) It depends on volume of solution

2. An electrochemical cell can behaves as electrolytic cell when
   a) $E_{cell} = 0$ b) $E_{cell} > E_{ext}$ c) $E_{ext} > E_{cell}$ d) $E_{cell} = E_{ext}$

3. The process of zinc-plating on iron-sheet is knows as
   a) Annealing   b) Roasting   c) Galvanisation   d) Smelting

4. If $K = 2.3 \times 10^{-5} L\ mol^{-1}s^{-1}$, the order of the reaction is,
   a) Zero   b) First   c) Fractional   d) Second

5. Electronic configuration of outer orbital of Zn, Cd and Hg are represented by the general formula
   a) $(n-1)d^{1-10}\ ns^2$ b) $(n-1)d^{10}\ ns^1$
   c) $(n-1)d^{10}\ ns^2$ d) $(n-1)d^{1-10}\ ns^{1-2}$

6. Indicate the complex ion which shows geometrical isomerism.   (June-2023)

    a) $[Cr(H_2O)_4 Cl_2]^+$ b) $[Pt (NH_3)_3Cl]$

    c) $[CO(NH_3)_6]^{3+}$ d) $[CO(CN)_5(NC)]^{3-}$

7. Ethyl chloride on treatment with alcoholic KCN forms a compound X. The compound X is

    a) C_2H_5CN b) $C_2H_5NH_2$ c) C_2H_5NC d) C_2H_5OH

8. The acylation of salicylic acid with acetic anhydride gives:

    a) Aspirin   b) Salicylaldehyde

    c) Benzaldehyde   d) Benzoic acid

9. Phenol on reduction with Zn gives

    a) Benzene   b) Toluene   c) Cyclohexane   d) Cyclohexanol

10. IUPAC name of is,

    a) Benzene 1, 2 carbaldehyde   b) Benzene 2-aldehyde

    c) Benzene 1, 2,-dicarbaldehyde   d) Dicarbaldehyde benzene

11. Aldehyde which do not undergo aldol condensation reaction is,

    a) Benzaldehyde   b) Formaldehyde c) Propanal   d) Acetaldehyde

12. The correct order of the basic strength of methyl substituted amines in vapour phase is

    a) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$ b) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N$

    c) $(CH_3)_3N > CH_3NH_2 > (CH_3)_2 NH$ d) $(CH_3)_3 N < (CH_3)_2 NH > CH_3NH_2$

13. The source of nitrogen in Gabriel synthesis of amines is _____ .

    a) Sodium azide NaN_3 b) Sodium nitrite $NaNO_2$

    c) Potassium cyanide KCN   d) Potassium phthalimide $C_6H_4(CO)_{23}N^-K^-$

14. Amino acids exist as zwitter ions at

    a) acidic pH   b) basic pH   c) neutral pH   d) isoelectric pH

15. Which statement is not true for describing enzymes?

    a) They are polypeptides

    b) There are peptide linkages between the molecules

    c) They are not specific for a reaction

    d) They catalyse biological reactions

II Fill in the blanks by choosing the appropriate word from those given in the brackets: 5 × 1 = 5

[Radium-226, lanthanoids, mercury, palladium, methylamine, diphenyl]

16. Solution of hydrogen in _____ is an example for solid solutions.

17. Radon is obtained as a decay product of _____ .

18. The _____ compounds do not form OXO-cations.

19. Chlorobenzene reacts with sodium in dry ether to give _____ .

20. Carbyl amine test is given by _____ .

PART-B

III Answer any three of the following. Each question carries two marks.

3 × 2 = 06

21. How is the solubility of gases in water related with Henry's law constant at same temperature and same pressure?

22. Derive an expression for half life period of a first order reaction. OR Show that half life period of a first order reaction is independent of initial concentration.

23. What are Homoleptic complexes? Give example.

24. Haloalkanes react with KCN to form alkyl cyanides as main product while AgCN forms isocyanides as the chief product. Explain.

25. Give names of the reagents to bring about the following transformations:
    i) Hexan-1-ol to hexanal   ii) Cyclohexanol to cyclohexanone

26. Give the functions of the following Hormones.
    i) Insuline   ii) Glucagon

PART - C

IV Answer any three of the following. Each question carries three marks.

3 × 3 = 09

27. Give examples and suggest reasons for the following features of the transition metal chemistry:
    i) The lowest oxide of transition metal is basic, the highest is amphoteric/acidic.
    ii) A transition metal exhibits highest oxidation state in oxides and fluorides.

28. Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.

29. Which is the last element in the series of the actinoids? Write the electronic configuration of this element. Comment on the possible oxidation state of this element.

30. Write the IUPAC names for the following complexes.
    a) i) $[Co(NH_3)_5Cl]Cl_2$
        ii) $[Cr(H_2O)_4Cl_2]NO_3$
    b) Name the transition metal present in the vitamin B_{12}.

31. On the basis of VBT, explain the hybridisation, geometrical shape and magnetic property of $[Ni(CN)_4]^{2-}$, tetracyanidonickelate(II) ion.

32. What is a) Crystal field splitting, b) Crystal Field stabilisation energy, c) Spectrochemical series

V Answer any two of the following. Each question carries three marks.

$2 \times 3 = 06$

33. What are azeotropic mixtures? Give an example for minimum and maximum boiling azeotropes.

34. Explain hydrogen-oxygen fuel cell (H_2–O_2 fuel cell).

35. i)   What happens to conductance and specific conductivity of electrolytes on dilution.

    ii) Write Nernst equation for a general electrochemical reaction,

    $$aA + bB \xrightarrow{\ ne^-\ } cC + dD.$$

36. By using graphical representation, how to calculate the average rate of reaction with respect to reactants and products.

PART - D

VI Answer any four of the following. Each question carries five marks.

$4 \times 5 = 20$

37. a)   What are Benzylic halides? Give examples.   (2)
    b)   What is Swart's reaction? Give example.   (2)
    c)   What is a Racemic mixture?   (2)

38. a) Give the structures and IUPAC names oof the products expected from the following reactions:

     i) Catalystic reduction of butanal.

     ii) Hydration of propene in the presence of dilute sulphuric aicd.

     iii) Reaction of propanone with methylmagnesium bromide followed by hydrolysis.   (3)

   b) Arrange the following sets of compounds in order of their increasing boiling points:

     i) pentan-1-ol, butan-1-ol, butan-2-ol, ethanol, propan-1ol, methanol.

     ii) Pentan-1-ol, n-butane, pentanal, ethoxyethane.   (2)

39. a) What happens when phenol treated with conc. HNO_3? or How do you prepare pieric acid from phenol?   (2)

   b) What is Reimer-Tiemann's reaction? Explain.   (2)

   c) The boiling point of Ethers is lower than the boiling point of alcohols. Give reason.   (1)

40. a) With respect to structure of carbonyl group. Give the following (i) Hybridisation of carbonyl carbon atom (ii) σ and π bonds around it (iii) Geometry and bond angle.   (3)

   b) Identify the product name 'A' and give the name of the reaction.

$$C_6H_6 + CO + HCl \xrightarrow{\Delta} A$$ (2)

41. a) An organic compound 'A' heated with Acetylchloride in the presence of an hydrous $AlCl_3$ to give the product 'B' (major). Identify 'A' and 'B' and name the reaction.   (3)

   b) The P^{ka} values of formic acid, acetic acid, benzoic acid are 3.75, 4.76 and 4.19 respectively. Arrange them in the increasing order of acidic strength.(2)

42. a) i) What is Diazotisation?   (1)

     ii) Explain the preparation of Benzene diazonium Chloride.   (2)

   b) Give reasons: (2)

     i) Aliphatic amines of lower molecular mass soluble in water.

     ii) Solubility of aliphatic primary amines decreases with increase in molar mass of amines.

43. a) Mention the types of Vitamins? Give examples.   (2)

    b) Give the name of the sugar present in DNA and RNA.   (2)

    c) Name the hormone which contains iodine.   (1)

PART – E (PROBLEMS)

VII   Answerany three of the following. Each question carries three marks.

$$3 \times 3 = 09$$

44. If N_2 gas is bubbled through water at 293 K, how many millimoles of N_2 gas would dissolve in 1 litre of water? Assume that N_2 exerts a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48k bar.

45. The vapour pressure of pure Benzene at a certain temperature is 0.850bar. A non-volatile, non-electrolyte solid weighing 0.5g when added to 39.0g of Benzene (Molar mass 78g mol^{-1}). Vapour pressure of the solution then is 0.845bar. What is the molar mass of the solid substance?

46. Two electrolytic cells containing Silver nitrate solution and Copper sulphate solution are connected in series. A steady current of 2.5 ampere was passed through them till 1.078g of Ag were deposited. Calculate the time required to flow current and the mass of copper deposited at the electrodes.

47. Calculate the emf of the cell in which the following reaction takes place:

    $$Ni(s) + 2Ag^+ (0.002M) \rightarrow Ni^{2+} (0.160M) + 2Ag_{(s)}.$$

    Given that $= E^e_{(cell)} = 1.05V$

48. The decomposition of N_2O_5 in CCl_4 at 318K has been studied by monitoring the concentration of N_2O_5 in the solution. Initially the concentation of N_2O_5 is 2.33 mol L^{-1} and after 184 minuts. It is reduced to 2.08 mol L^{-1}. The reaction takes place according to the equation. $2N_2O_5(g) \rightarrow 4 NO_2(g) + O_2 (g)$

    Calculate the averate rate of this reaction in terms of hours, minutes and seconds. What is the rate of prdocution of NO_2 during this period.

49. Show that in a first order reaction, time required for completion of 99.9% is 10 times of half-life ($t_{1/2}$) of the reaction.

* * *

ANSWERS TO MODEL QUESTION PAPER-3

PART-A

I
1. b	2. c	3. c	4. d	5. c
6. a	7. a	8. a	9. a	10. c
11. a	12. b	13. d	14. d	15. c

II
16. palladium	17. Radium-226	18. lanthanoids
19. diphenyl	20. methylamine	

PART-B

IV 21. According to Henry's law, higher the value of K_H, lower is the solubility of the gas in the liquid at same pressure and temperature. $(P = K_H \cdot \chi)$

22. **Half life period ($t_{1/2}$) :** It is the time in which concentration of the reactants reduced to one half of its initial concentration.

Consider the first order integrated equation, $k = \dfrac{2.303}{t} \log \dfrac{[R]_0}{[R]}$

At $t_{1/2}$, $[R] = \dfrac{[R]_0}{2}$

$\therefore \quad k = \dfrac{2.303}{t_{1/2}} \log \dfrac{[R]_0}{\dfrac{[R]_0}{2}}$

$t_{1/2} = \dfrac{2.303}{k} \log \dfrac{2[R]_0}{[R]_0}$

$t_{1/2} = \dfrac{2.303}{k} \log 2$

$t_{1/2} = \dfrac{2.303}{k} \times 0.3010$ **OR** $t_{1/2} = \dfrac{0.693}{k}$

23. Complexes in which the central metal atom/ion is surrounded by only one type of ligands are called Homoleptic compounds.

Example: $[Ni(CO)_4]$, $[CoF_6]^{3-}$, $[Fe(CN)_6]^{4-}$ etc.

24. KCN is predominantly ionic and provides cyanide ions in solution. Although both carbon and nitrogen atoms are in a position to donate electron pairs, the attack takes places mainly through carbon atom and not through nitrogen atom since C–C bond is more stable than C–N bond. However, AgCN is mainly covalent in nature and nitrogen is free to donate electron pair forming isocyanide as the main product.

25. i) $C_5H_5NH^+CrO_3Cl^-$ (PCC)   ii) Anhydrous CrO_3

26. **Harmone**   **Functions**
    i) Insuline   Control the blood sugar level with in the narrow limit.
    ii) Glucagon   Increases the blood sugar level.

PART-C

IV 27. i)   In the case of a lower oxide of a transition metal, the metal atom has a low oxidation state. This means that some of the valence electrons of the metal atom are not involved in bonding. As a result, it can donate electrons and behave as a base.

On the other hand, in the case of a higher oxide of a transition metal, the metal atom has a high oxidation state. This means that the valence electrons are involved in bonding and so, they are unavailable. There is also a high effective nuclear charge. As a result, it can accept electrons and behave as an acid.

For *example*, MnO is basic and Mn_2O_7 is acidic.

ii) Oxygen and fluorine act as strong oxidising agents because of their high electronegativities and small sizes. Hence, they bring out the highest oxidation states from the transition metals. In other words, a transition metal exhibits higher oxidation states in oxides and fluorides.

For *example*, in OsF_6 and V_2O_5, the oxidation states of Os and V are +6 and +5 respectively.

28. Magnetic moment $\mu = \sqrt{n(n+2)}$ BM

$$= \sqrt{5(5+2)} = 5.92 \text{ BM}$$

[Z = 25   ∴ Mn its Ec = $[Ar]^{18}3d^5 4s^2$ Mn^{2+} (divalention) = $3d^5$ ∴ n = 5]

29. The last element in the actinoid series is lawrencium, Lr. Its atomic number is 103 and its electronic configuration is $[Rn]^{86} 5f^{14} 6d^1 7s^2$. The most common oxidation state displayed by it is +3; because after losing 3 electrons it attains stable f^{14} configuration.

30. a) i) $[Co(NH_3)_5Cl]Cl_2$ - Penta aminechloridocobalt(III) chloride

ii) $[Cr(H_2O)_4Cl_2]NO_3$ - Tetraaquadichlorido chromium (III) nitrate.

b) Cobalt.

31. Oxidation of Nickel in $[Ni(CN)_4]^{2-}$ is +2 and E.C. is $[Ar]^{18} 3d^8 4s^2$

E.C. Ni atom in ground state $=$ 3d 4s 4p

E.C. Ni^{2+} ion $=$ 3d 4s 4p

CN^- is a strong ligand forced unpaired d electrons to pair up.

i.e. Ni^{2+} ion $=$ 3d 4s 4p

One 3d, one 4s and two 4p orbitals undergo dsp^2 hybridisation forms 4dsp^2 hybrid orbitals gives square planar shape.

dsp^2 hybrid orbitals of Ni^{2+} $=$ 3d 4 vacant dsp^2 hybrid orbitals

Formation of $[Ni(CN)_4]^{2-}$ $=$ 3d 4 pairs of electrons from 4 CN^- ligands

Hybridisation $=$ dsp^2 (inner orbital compound)

Geometrical shape $=$ Square planar

Magnetic property $=$ diamagnetic (due to absence of unpaired electrons)

Low spin or spin paired complex.

32. a) The splitting of five degenerate d-orbitals of metal ion into two sets of d-orbitals under the influence of ligands of definite geometry is called Crystal field splitting.

b) The difference in energy between e_g and t_{2g} set of orbitals (d) after splitting is called crystal field stabilisation energy. It is represented by Δ_0. Different ligands gives different Δ_0 values.

Crystal field stabilisation energy for e_g orbitals = 0.6 Δ_0 and t_{2g} = 0.4 Δ_0

The average energy of e_g and t_{2g} orbitals is taken as zero and is called Bari centre.

c) The arrangement of the ligands in a series in the increasing order of their field strength values is called SPECTROCHEMICAL SERIES.

(Weak ligand)

i.e. $I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < NCS^-$
$< edta^{-4} < NH_3 < en < CN^- < CO$ (Strong ligand)

V 33. a) Binary liquid mixtures having the same composition in liquid and vapour phase and boil at constant temperture are called azeotropic mixtures.

Example: i) 95% Ethyl alcohol and 5% water by volume.
ii) 68% nitric acid and 32% water by mass.

b) i) The solutions which show large positive deviation from Raoult's law are called minimum boiling azeotropes.

Example: 95% Ethyl alcohol and 5% water by volume.

ii) Solutions which shows the large negative deviations from Raoult's law are maximum boiling azeotropes.

Example: 68% nitric acid and 32% water by mass.'

34. In H_2–O_2 fuel cell electrical energy produced by the combustion of hydrogen as a fuel.

Construction: In this cell hydrogen and oxygen are bubbled through a pairs carbon electrode into conc. NaOH(aq) or conc. KOH(aq). Catalyst like finely divided platinum or palladium metal are incorporated to the electrodes for increasing rate of electrode reactions. Hydrogen is passed into anode compartment where it is reduced and oxygen is passed into the cathode compartment where it is oxidized.

The electrode reactions are as shown below.

Anode : $2H_2(g) + 4OH^-_{(aq)} \longrightarrow 4H_2O(l) - 4e^-$

Cathode: $O_2(g) + 2H_2O(l) + 4e^- \longrightarrow 4OH^-(aq)$
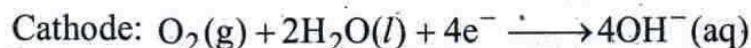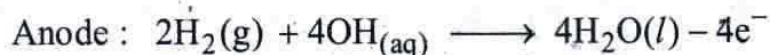
The overall cell reaction is

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$
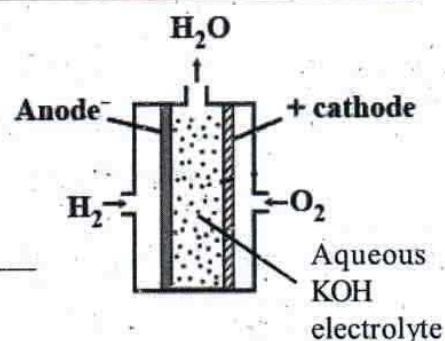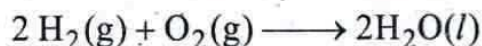
The cell runs continuously as long as the reactants are supplied. Fuel cells produce electricity with an efficiency of about 70% compared to the thermal plants whose efficiency is about 40%.

35. i) •   Conductance of a solution decreases with dilution (decrease in the concentration) because the number of ions per unit volume that carry the current in a solution decreases on dilution.

   •   Specific conductivity of an electrolyte decreases on dilution due to decrease in the number of ions per cm³ of the solution.

ii) $E_{cell} = E^o_{cell} - \dfrac{RT}{nF} \ln Q$

$$= E^o_{cell} - \dfrac{RT}{nF} \ln \dfrac{[C]^c [D]^d}{[A]^a [B]^b}$$

$$E_{cell} = E^o_{cell} - \dfrac{2.303 \, RT}{nF} \log_{10} \dfrac{[C]^c [D]^d}{[A]^a [B]^b}$$

36. **With respect to reactants:**
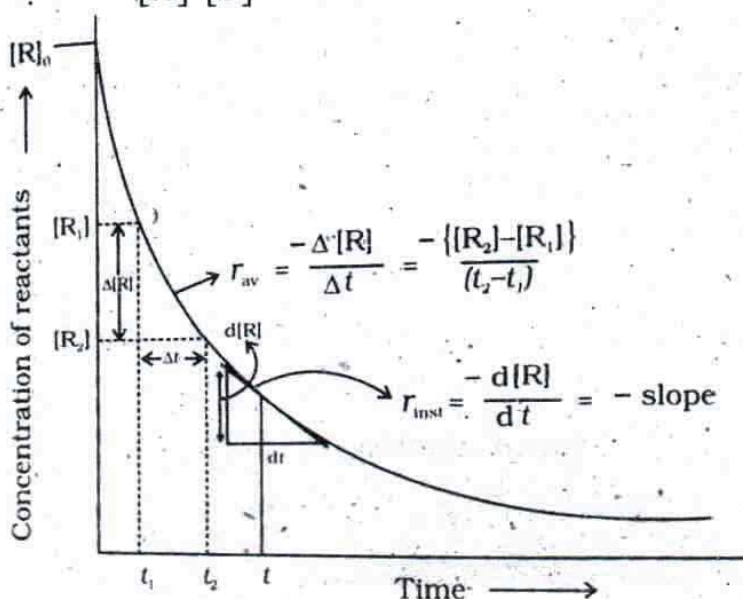
Consider R $\longrightarrow$ P

R = reactants, p = products.

$[R]_1$ and $[R]_2$ are concentrations of the reactant at time t_1 and t_2 respectively.

Rate of dissapearance of R $= -\dfrac{[R]_2 - [R]_1}{t_2 - t_1}$

Rate $= -\dfrac{\Delta [R]}{\Delta t}$

Negative sign indicates decrease in the concentration of reactants with time.

With respect to products:
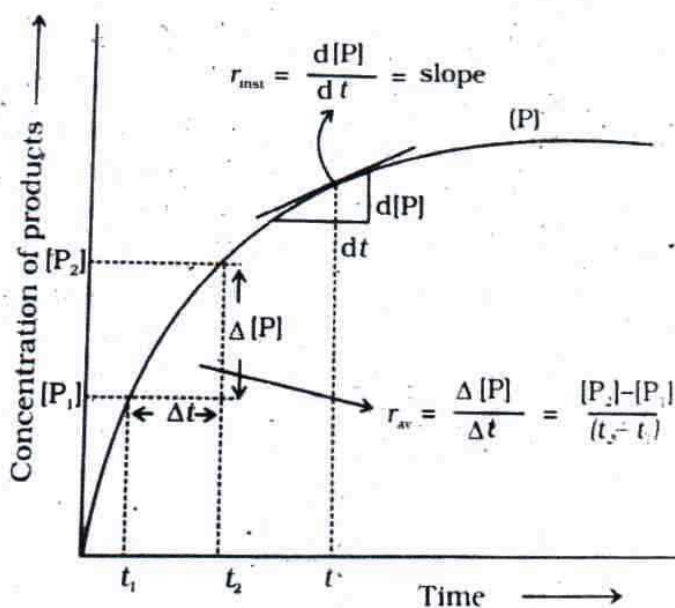
$[P]_1$ and $[P]_2$ be the concentration of the product P at time t_1 and t_2 respectively.

Rate of appearance P $= \dfrac{[P]_2 - [P]_1}{t_2 - t_1}$

Rate $= +\dfrac{\Delta [P]}{\Delta t}$

Positive sign indicates the increase in the concentration of product with time.

PART-D

VI 37. a) The Halogen atom attached to a sp^3 hybridised carbon atom present next to an aromatic ring carbon atom.
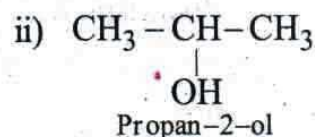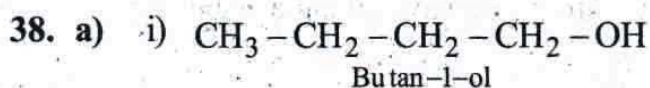
General formula -

Haloethene
(*Vinyl halide*)

or

1-Halocyclohex-1-ene (*A vinyl halide*)
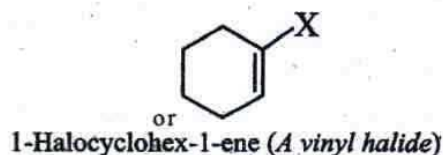
b) Alkyl chlorides or alkyl bromide on heating with metallic fluroides like AgF, Hg_2F_2, CoF_2 or SbF_3 gives alkyl fluoride. The reaction is called swart's reaction.

$$R-X + AgF \longrightarrow R-F + AgX$$

$$C_2H_5-Br + AgF \longrightarrow C_2H_5-F + AgBr$$

c) A mixture of equal amounts of d(+)–isomer and l(–) isomer is called Racemic mixture.

Example: dl or (±) Butan–2–o1.

38. a) i) $CH_3-CH_2-CH_2-CH_2-OH$
  Butan–1–ol

ii) $CH_3-\overset{\overset{\displaystyle |}{OH}}{CH}-CH_3$
  Propan–2–ol

iii)

$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}-OH$$

2–Methylpropan–2–ol
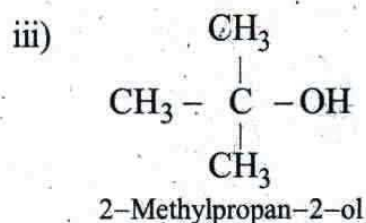
b) i) Methanol, ethanol, propan-1-ol, butan-2-ol, butal-1-ol, pental-1-ol

ii) n-Butane, ethoxyethane, pentanal and pentan-1-ol.

39. a) Phenol reacts with conc. HNO_3 in the presence of conc. H_2SO_4 to give 2, 4, 6-trinitro phenol called picric acid.

2,4,6 - Trinitro phenol (Picric acid)
A yellow crystalline solid
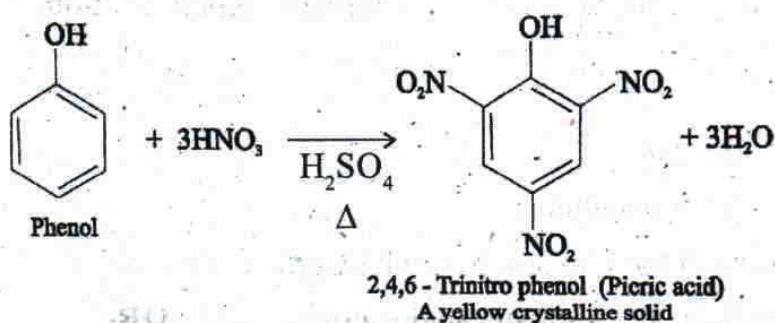
b) Phenol on heating with chloroform in the presence of sodium hydroxide at 340 K, followed by hydrolysis gives o-hydroxy benzaldehyde (salicylaldehyde). This reaction is known as Reimer-Tiemann reaction.

Salicylaldehyde
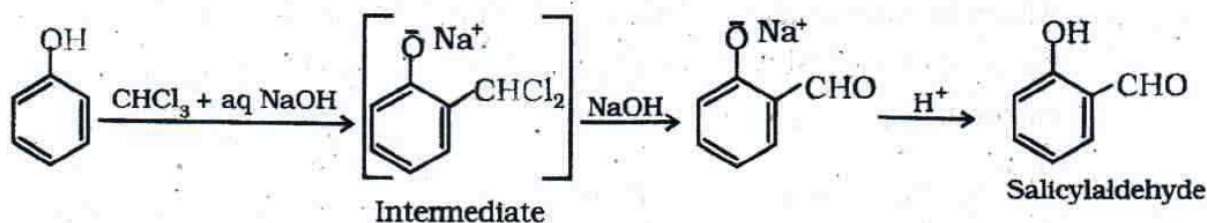
c) In ethers no-hydrogen bonding present as a result no association takes place.

40. a) i) Carbonyl carbon atom is sp^2 hybridised.

ii) Forms 2σ bonds with carbon atom of alkyl group (except-HCHO) and one sigma bond with oxygen atom. The $2p_z$ of carbonyl carbon overlaps with $2p_z$ of 'O' atom sideways giving a π bond.
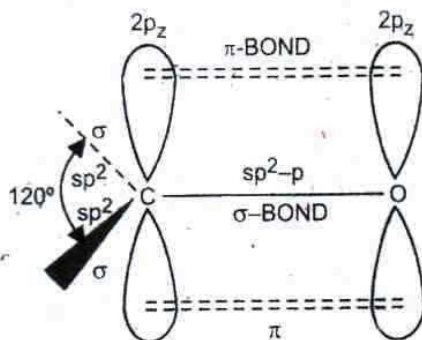
iii) 2-carbon atoms and one oxygen atom attached to carbonyl carbon lie in the same plane. Therefore geometry is trigonal coplanar with bond angle 120°.

b)

\- Benzaldehyde , Gatterman - Koch reaction.
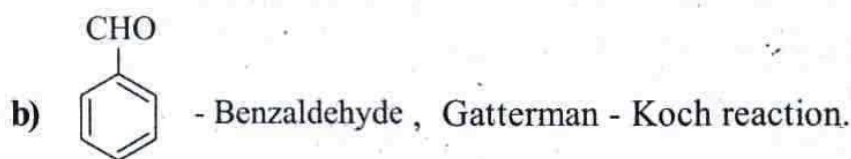
41. a) A - Benzene

B - Acetophenone

Name of the reaction is Friedel-Craffs acylation.

b) Acetic acid < Benzoic acid < Formic acid   **OR**

Formic acid > Benzoic acid > Acetic acid

Reason: In benzoic acid $-C_6H_5COO^-$ is stabilised by resonance due to $-I/$ $-R$ effect of phenyl group whereas in acetic acid $-CH_3$ group is a electron donating group due to $+I$ effect decreases the stability of CH_3COO^- ion.

Where in formic acid Hydrogen has the least +I effect.

Therefore formate ion more stabilised by resonance. Hence it is stronger acid than CH_3COOH & C_6H_5COOH.

42. a) i) The process of conversion of a primary aromatic amine into diazonium salt is called Diazotisation.

ii) Benzene diazonium Chloride is prepared by adding a cold aqueous solution of sodium nitrite to the solution of Aniline (a primary aromatic amine) in hydrochloric acid at 273K–278K.

$$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow[0°C]{273K-278K} C_6H_5N_2^+Cl^- + NaCl + 2H_2O$$

Benzene diazonium chloride
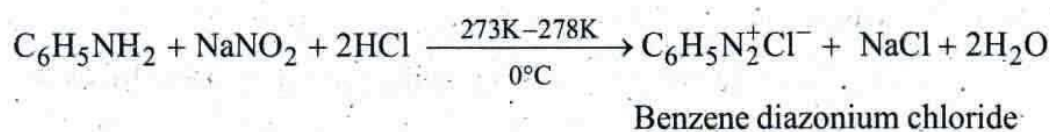
b) i) It is due to formation of intermolecular hydrogen bonding with water.

ii) It is due to increase in size of hydrophobic part.

43. a) i) Water soluble vitamins: Examples: Vitamin-C, Vitamin-B_6 and B_{12}.

ii) Fat soluble vitamins - *Examples:* Vitamin-A, D, E, K.

(These are stored in Adipose (fat storing tissues) tissues and liver.)

b) i) In DNA - 2, Deoxy - Ribose sugar

ii) In RNA - Ribose sugar

c) Thyroxine.

PART-E

VII44. The solubility of gas is related to the mole fraction in aqueous solution. The mole fraction of the gas in the solution is calculated by applying Henry's law. Thus,

$$x(\text{Nitrogen}) = \frac{p\,(\text{nitrogen})}{K_H} = \frac{0.987\,\text{bar}}{76,480\,\text{bar}} = 1.29 \times 10^{-5}$$

As 1 litre of water contains 55.5 mol of it, therefore if n represents number of moles of N_2 in solution.
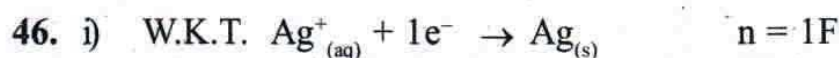
$$x(\text{Nitrogen}) = \frac{n\,\text{mol}}{n\,\text{mol}\,55.5\,\text{mol}} = \frac{n}{55.5} = 1.29 \times 10^{-5}$$

(n in denominator is neglected as it is $\ll 55.5$)

Thus, $n = 1.29 \times 10^{-5} \times 55.5 \, mol = 7.16 \times 10^{-4} \, mol$

$$= \frac{7.16 \times 10^{-4} \, mol \times 1000 \, mmol}{1 \, mol} = 0.716 \, mmol$$

45. $M_2 = \dfrac{P_1^0 \times W_2 \times M_1}{\left(P_1^0 - P_1\right) \times W_1} = \dfrac{0.850 \times 0.5 \times 78}{(0.850 - 0.845) \times 39}$

$\therefore M_2 = 170 \, g \, mol^{-1}$

46. i)   W.K.T. $Ag^+_{(aq)} + 1e^- \rightarrow Ag_{(s)}$ $n = 1F$

i.e.   1 mole (107.8 g) of Ag is deposited by 1F = 96487C.

$\therefore$ 1.078 g of Ag will be deposited by the electricity

$$= \frac{96487 \times 1.078}{107.8} = 965 \, C$$

Now $Q = I \times t$ or $t = \dfrac{Q}{I} = \dfrac{965}{2.5} = 386s$

ii)   W.K.T. electrode reaction : $Cu^{2+} + 2e^- \rightarrow Cu$

63.5g of Cu deposited by the charge

$$Q = nF = 2 \times 96487C = 192974C.$$

$\therefore$ 965C will deposit Cu $= \dfrac{63.5 \times 965}{2 \times 96487} = 0.3175g.$

47. Applying Nernst equation we have:

$$E_{(cell)} = E^0_{(cell)} - \frac{0.0591}{n} \log \frac{\left[Ni^{2+}\right]}{\left[Ag^+\right]^2}$$

$$= 1.05 - \frac{0.0591}{2} \log \frac{(0.160)}{(0.002)^2}$$

$$= 1.05 - 0.2955 \log \frac{0.16}{0.000004}$$

$$= 1.05 - 0.02955 \log 4 \times 10^4$$

$$= 1.05 - 0.02955 (\log 10000 + \log 4)$$

$$= 1.05 - 0.02955 (4 + 0.6021) \qquad = 0.914 \, V$$

48. Average rate $= \dfrac{1}{2}\left\{-\dfrac{\Delta[N_2O_5]}{\Delta t}\right\} = \dfrac{1}{2}\left[\dfrac{(2.08-2.33)\text{ mol L}^{-1}}{184\text{ min}}\right]$

$\qquad = 6.79 \times 10^{-4}\text{ mol L}^{-1}/\text{min}$

$\qquad = (6.79 \times 10^{-4}\text{ mol L}^{-1}\text{ min}^{-1}) \times 60\text{ min}/1\text{ h})$

$\qquad = 4.07 \times 10^{-2}\text{ mol L}^{-1}/\text{h}$

$\qquad = 6.79 \times 10^{-4}\text{ mol L}^{-1} \times 1\text{ min}/60\text{s}$

$\qquad = 1.13 \times 10^{-5}\text{ mol L}^{-1}\text{ S}^{-1}$

It may be remembered that,

$$\text{Rate} = \dfrac{1}{4}\left\{\dfrac{\Delta[NO_2]}{\Delta t}\right\}$$

$$\dfrac{\Delta[NO_2]}{\Delta t} = 6.79 \times 10^{-4} \times 4\text{ mol L}^{-1}\text{ min}^{-1} = 2.72 \times 10^{-3}\text{ mol L}^{-1}\text{ min}^{-1}$$

49. When reaction is completed 99.9%, $[R_0] = 100$; $[R] = 100 - 99.9 = 0.1$

$$k = \dfrac{2.303}{t}\log\dfrac{[R]_0}{[R]}$$

$$= \dfrac{2.303}{t}\log\dfrac{100}{0.1} = \dfrac{2.303}{t}\log_{10}10^3$$

$$= \dfrac{2.303}{t}3 \times \log_{10}10 = \dfrac{2.303}{t} \times 3$$

$$t_{99.9\%} = 6.909/k \qquad ...(1)$$

For half-life of the reaction,

$$t_{1/2} = 0.693/k \qquad ...(2)$$

$$\dfrac{Eq(1)}{Eq(2)} = \dfrac{t_{99.9\%}}{t_{1/2}} = \dfrac{6.909}{k} \times \dfrac{k}{0.693} = 10$$

* * *

MODEL QUESTION PAPER-4
II PUC - CHEMISTRY(34)

Time: 3 Hrs. 15 Mints. (Total No. of questions: 49)   Max. Marks : 70

Instructions:

1.   Question paper has FIVE parts. All parts are compulsory.
2.   a) Part-A carries 20 marks. Each question carries 1 mark. b) Part-B carries 06 marks. Each question carries 2 marks. c) Part-C carries 15 marks. Each question carries 3 marks. d) Part-D carries 20 marks. Each question carries 5 marks. e) Part-E carries 09 marks. Each question carries 3 marks.
3.   In Part-A questions, first attempted answer will be considered for awarding marks.
4.   Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.
5.   Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.
6.   Use log tables and simple calculator if necessary (Use of scientific calculators is not allowed.)

PART-A

I   Select the correct option from the given choices: $1 \times 15 = 15$

1. K_H values for $Ag_{(g)}$ $CO_{2(g)}$ $HCHO_{(g)}$ and $CH_{4(g)}$ are 40.39, 1.67, 1.83×10^{-5} and 0.413 respectively arranged in the order of their increasing solubility.

   a) $HCHO < CH_4 < CO_2 < Ar$ b) $HCHO < CO_2 < CH_4 < Ar$

   c) $Ar < CO_2 < CH_4 < HCHO$ d) $Ar < CH_4 < CO_2 < HCHO$

2.   In the fuel cell, which of the following can be used as a fuel?

   a) Nitrogen   b) Argon   c) Hydrogen   d) Helium

3.   Chemical composition of 'Rust' is

   a) $Fe_2O_3 . xH_2O$ b) FeO c) Fe d) Fe_2O_3

4.   Molecularity of the following reaction, $2NO + O_2 \rightarrow 2NO_2$

   a) 1   b) 2   c) 3   d) 4

5.   Spin-only magnetic moment of Zn^{2+} is zero because,

   a) no unpaired electrons   b) presence of unpaired electrons

   c) No d-d transition   d) None of the above

6.   The complex $[Ti (H_2O)_6]^{3+}$ is having the colour

   a) green   b) voilet   c) red   d) white

7. Alkyl chlorides are almost insoluble in water because
   a) They are covalent compounds
   b) They have low polarity
   c) They do not form hydrogen bonds with water
   d) They have tetrahedral geometry

8. The decreasing order of acidic nature of alcohol
   a) Primary > Secondary > Tertiary
   b) Primary < Secondary < Tertiary
   c) Primary < Secondary > Tertiary
   d) Primary > Secondary < Tertiary

9. Phenol on oxidation with chromic acid gives

   a)   b)   c)   d)
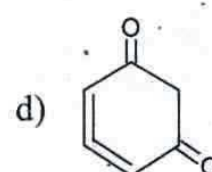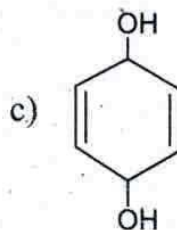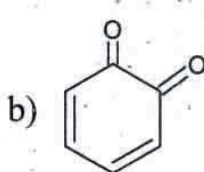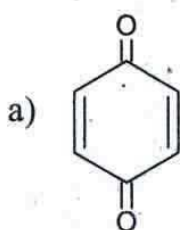
10. Under Wolff-Kishner reduction, the conversion brought about are
    a) propanone to propane
    b) benzaldehyde to benzyl alcohol
    c) cyclohexanone to cyclohexane
    d) cyclohexanone to cyclohexanol

11. The product of the reaction, $CH_3COOH \xrightarrow{P_2O_5}$ is :
    a) CO and H_2O
    b) Formic acid
    c) Ethanoic anhydride
    d) Ethylethanoate

12. Aniline can dissolve in
    a) Water
    b) alkali
    c) 5% NaCl solution
    d) dil. hydrochloric

13. The hybridised state of nitrogen in trimethylamine is   (June-2023)
    a) sp
    b) sp^2
    c) sp^3
    d) dsp^2

14. Which of the following is not a linear polymer?
    a) Amylopectin
    b) Glycogen
    c) Amylose
    d) Both (a) and (b)

15. Which of the following is a non-reducing sugar?
    a) Mannose
    b) Maltose
    c) Lactose
    d) Sucrose

II Fill in the blanks by choosing the appropriate word from those given in the brackets: **5 × 1 = 5**

[Exponentially, V_2O_5, Fe_2O_3, sp^2, solid solution, primary]

16. Amalgam of mercury with sodium is an example for _____ .
17. For a first-order reaction the concentration of the reaction decreases _____ with time.
18. _____ is amphoteric in nature.
19. The halogen atom in vinyl halide is attached to carbon atom with _____ hybridization.
20. Gabriel synthesis is used for the preparation of _____ amines.

PART-B

III Answer any three of the following. Each question carries two marks.
                                                                    3 × 2 = 06

21. Give reason:
    i) Naphthalene and anthracene dissolve readily in benzene but not sugar and sodium chloride.
    ii) Aquatic animals are more compatable in cold water than in warm water.

22. Mention the factors influencing the rate of a reaction.

23. Explain bonding in metal-carbonyls? OR What is synergic effect? What is the effect of M–CO bond in metal carbonyls?

24. Explain Fittig's reaction with example.

25. Explain esterification reaction. Give an example.

26. How does glucose reacts with hydrogen iodine ? OR How do you show that glucose contains 6 carbon atoms in a straight chain?

PART - C

IV Answer any three of the following. Each question carries three marks.
                                                                    3 × 3 = 09

27. Explain the catalystic properties of transition metals.

28. Give reason:
    i) Cu^+ ion is diamagnetic and Cu^{2+} ion is paramagnetic.
    ii) Along the period of each transition series, density increases.

29. i) What is Lanthanoid contraction?

    ii) What is the cause for lanthanide contraction?

30. i) Why is Cr^{2+} reducing and Mn^{3+} oxidising when both have d^4 configuration?

    ii) Why is the $E°$ value for the Mn^{3+}/Mn^{2+} couple much more positive than that for Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+}? Explain.

31. Using VBT, explain the hybridisation, geometrical shape and magnetic property of $[NiCl_4]^{2-}$ or tetrachloridonickel(II) ion.

32. What is crystal field splitting energy? How does the magnitude of Δ_0 decide the actual configuration of d-orbitals in a coordination entity?

V Answer any two of the following. Each question carries three marks.

$2 \times 3 = 06$

33. a) State Henry's law. Write its Mathematical expression. (2)

    b) What is the value of Van't Hoff factor for Ethanoic acid in Benzene (1)

34. a) Define Specific resistance OR Resistivity. Mention its SI unit. (1)

    b) State Faraday's First law of electrolysis. (2)

35. Predict the products of electrolysis in each of the following:

    i) An aqueous solution of $AgNO_3$ with silver electrodes.

    ii) An aqueous solution of $AgNO_3$ with platinum electrodes.

    iii) A dilute solution of H_2SO_4 with platinum electrodes.

36. i) Draw the energy distribution curve showing temperature dependence of rate of reaction and explain. (2)

    ii) Write Arrhenius Equation. (1)

PART - D

VI Answer any four of the following. Each question carries five marks.

$4 \times 5 = 20$

37. a) State Saytzeff's rule (Zaitsev) and give an example. (2)

    b) Explain Wurtz-Fittigs reaction? Give example. (2)

    c) Mention the uses and environmental effect of Freons. (1)

38. a) What happens when vapours of 1°, 2° and 3° alcohols passed over heated Cu at 573 K? Explain with an example. OR Explain dehydrogenation of alcohols. (3)

   b) Explain the commercial method of preparation of ethylalcohol (Ethanol).(2)

39. a) Give the structures and IUPAC names of the products expected from the following reactions:
   i) Catalytic reduction of butanal.
   ii) Hydration of propane in the presence of dilute sulphuric acid.
   iii) Reaction of propane with methylmagnesium bromide followed by hydrolysis. (3)

   b) Give reason:
   i) Nitrophenol are more acidic than phenol.
   ii) Phenols are stronger acids than alcohols. (2)

40. a) Explain Gatterman-Koch reaction. Give example. OR How would you convert Benzene to Benzaldehyde. Give equation. (2).

   b) Give the reactions for the conversion of toluene to benzaldehyde by side chain chlorination. (2)

   c) Arrange the following compounds in the increasing order of their boiling points. CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$

41. a) Explain how do you convert acetic acid to acetamide and benzoic acid to benzamide. (4)

   b) Which type of aldehydes undergo cannizzaro reaction? (1)

42. a) Explain Hoffmann bromamide degradation method to prepare primary amines. (2)

   b) Give reasons. (2)
   i) Dimethyl amine is more basic than methylamine.
   ii) Trimethyl amine is less basic then dimethyl amine and methyl amine in aqueous medium.

   c) 3° amines cannot be acylated. Why ? (1)

43. a) Write the Haworth's structure of Maltose. (2)

   b) What are essential and non essential amino acids? Give examples. (2)

   c) Name the optically inactive a-amino acid. (1)

PART – E (PROBLEMS)

VII **Answerany three of the following. Each question carries three marks.**

$$3 \times 3 = 09$$

44. 18 g of glucose, $C_6H_{12}O_6$, is dissolved in 1 kg of water in a saucepan. At what temperature will water boil at 1.013 bar? Kb for water is 0.52 K kg mol^{-1}.

45. 45g of ethylene glycol ($C_2H_6O_2$) is mixed with 600 g of water. Calculate (a) the freezing point depression and (b) the freezing point of the solution.

46. The electrical resistance of a column of 0.05molL^{-1} NaOH solution of diameter 1 cm and length 50cm is $5.55 \times 10^3 \Omega$. Calculate its resistivity, conductivity and molar conductivity.

47. 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?

48. Time required to decompose SO_2Cl_2 to half of its initial amount is 60 minutes. If the decomposition is a first order reaction. Calculate the rate constant of the reaction.

49. The first order rate constant for the decomposition of ethyl iodide by the reaction $C_2H_5 I(g) \rightarrow C_2H_4 (g) + HI(g)$ at 600 K is $1.60 \times 10^{-5} s^{-1}$. Its energy of activation is 209 kJ/mol. Calculate the rate constant of the reaction at 700 K.

* * *

ANSWERS TO MODEL QUESTION PAPER-4

PART-A

I . 1. c   2. c   3. a   4. c   5. a

  6. b   7. c   8. a   9. a   10. a

  11. c   12. d   13. c   14. d   15. d

II 16. solid solution   17. exponentially   18. V_2O_5.

  19. sp^2 20. primary

PART-B

IV 21. i) Sugar and NaCl are polar and Benzene is non-polar and intermolecular interactions between them is not same.

    ii) At lower temperature more O_2 dissolves in water Or Solubility of gases increases with decrease in temperature.

22. ● Concentration of the reactants   ● Nature of reactants

    ● Temperature   ● Pressure

    ● Catalyst

23. The metal-carbon bond in metal carbonyls has both σ and π character.

The metal-carbon σ (sigma) bond is formed due to the donation of lone pair of electrons by the carbon atom of CO to vacant orbitals of metal atom.

The M-C, π bond is formed by the donation of a pair of electrons from the filled d-orbital of metal into vacant antibonding orbital of carbon monoxide, known as Back-Bonding.
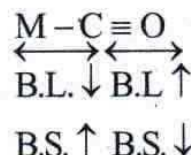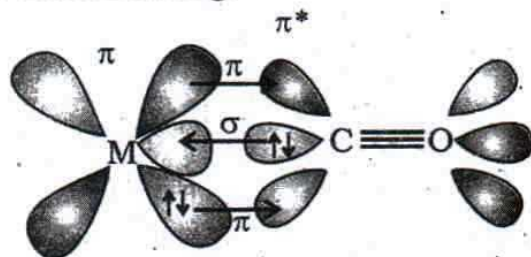

The bond length beween metal and carbon decreased, whereas carbon and oxygen increases in metal carbonyls, thus Bond strength between metal and carbon increases and carbon and oxygen decreases. It is known as synergic effect in metal carbonyls.
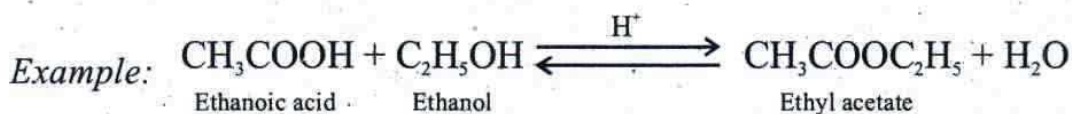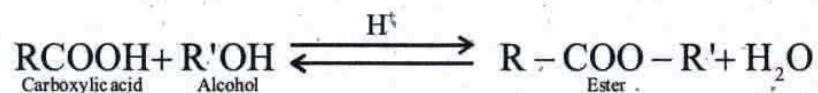
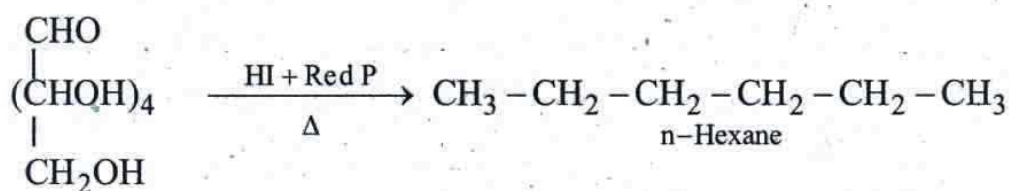**24.** When haloarenes are treated with sodium metal in dry ether gives diaryls is called Fittig's reaction.

Biphenyl (Diphenyl)

Example:

Chlorobenzene   Chlorobenzene   Diphenyl / Biphenyl
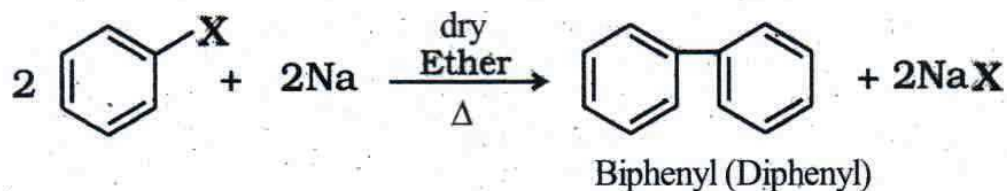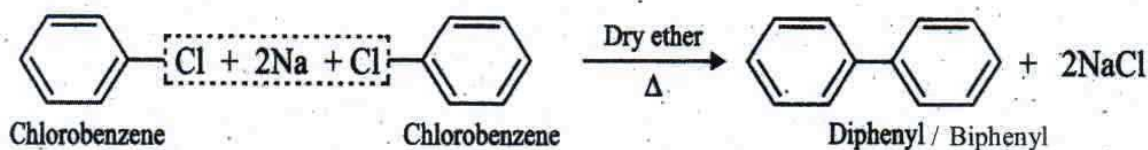
25. Carboxylic acids react with alcohols in the presence of Con. H_2SO_4 to form an ester is called esterification. i.e.,

$$\underset{\text{Carboxylic acid}}{RCOOH} + \underset{\text{Alcohol}}{R'OH} \underset{}{\overset{H^+}{\rightleftharpoons}} \underset{\text{Ester}}{R-COO-R'} + H_2O$$

Example: $\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \overset{H^+}{\rightleftharpoons} \underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H_2O$

26. Glucose on heating with HI and Red Phosphorous gives n-hexane. This shows that Glucose contains all the six carbon atoms in the straight chain. i.e.

$$\begin{array}{c} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{array} \xrightarrow[\Delta]{HI + Red\,P} \underset{\text{n-Hexane}}{CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3}$$

PART-C

IV 27. The transition elements and their compounds behaves as catalysts due to -

   i) Variable oxidation states.

   ii) Large surface area for a adsorption of reactant molecules

   iii) The presence of incompletely filled or partially filled d-orbitals.

   iv) Formation of intermediate compounds.

Examples: 1) Vandium pentoxide is used as catalyst in contact process (manufacture of H_2SO_4).

2) Iron oxide is used as a catalyst in the Haber's process (manufacture of NH_3)

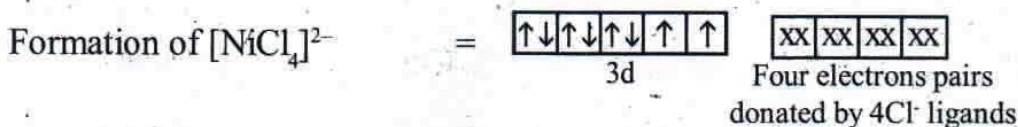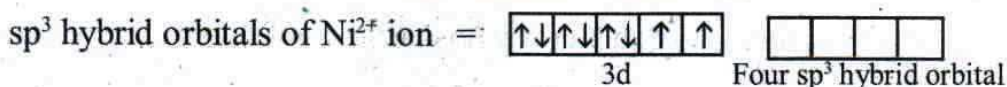3) Nickel is used as a catalyst in the hydrogenation of oils

$$\left(Oils \xrightarrow[+H_2]{Ni} Fat \right)$$
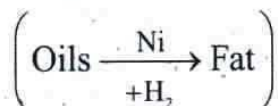
28. i) Cu (1) or Cu^+ ion has absence of unpaired electrons in the d-orbital. Hence it is diamagnetic. ($3d^{10} 4s^0$).   Cu (II)/Cu^{2+} ion is paramagnetic due to the presence of unpaired electrons in the d-orbital i.e. $3d^9 4s^0$. Hence it is paramagnetic.

ii) Because in metallic radius due to increase in effective nuclear charge.

29. i) The gradual decrease in Atomic and ionic size eventhough increase in Atomic number from Lanthandum to Lutetium is called Lanthanoid contraction.

ii) Due to the imperfect shielding of one electron by another in the same set of orbitals. (Poor screening of 4f electrons)

30. i) Cr^{2+} is reducing as its configuration changes from d^4 to d^3, the latter having a half-filled t_{2g} level. One the other hand, the change from Mn^{3+} to Mn^{2+} results in the half-filled (d^5) configuration which has extra stability.

ii) Much larger third ionisation energy of Mn (where the required change is d^5 to d^4) is mainly responsible for this. This also explains why the +3 state of Mn is of little importance.

31. The oxidation state of Ni in $[NiCl_4]^{2-}$ is +2 and electronic configuration of Ni atom = $[Ar]^{18} 3d^8 4s^0$

Ni^{2+} ion = $[Ar]^{18}$
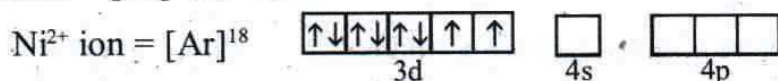
Cl⁻ is a weak ligand, hence does not pairing takes place.

one 4s and three 4p vacant orbitals undergo sp3 hybridisation forms 4sp3 hybrid orbitals gives Tetrahedral shape.

sp^3 hybrid orbitals of Ni^{2+} ion = [↑↓|↑↓|↑↓|↑|↑] [| | |]

                                      3d   Four sp^3 hybrid orbital

Formation of [NiCl$_4$]$^{2-}$ = [↑↓|↑↓|↑↓|↑|↑] [xx|xx|xx|xx]

                                        3d   Four electrons pairs
                                                          donated by 4Cl ligands

Hybridisation = sp^3 [Outer orbital complex]

Geometrical shape = tetrahedral

Magnetic property = paramagnetic (due to presence of unpaired electrons.)

                              = High spin or spin free complex.

32. The splitting of degenerated five d-orbitals due to entry of ligands in to triple generated (t$_{2g}$) and double generated (e$_g$) orbitals into two energy levels is called crystal field splitting and the energy difference between t$_{2g}$ and e$_g$ is called crystal field splitting energy in octahedral complex [Δ_0].

● p represents the energy required for electron pairing in a single orbital.

● Upto d^3 ion, electrons enters according to Hund's rule. But after d^4 ion, two possible ways.

    a) If $\Delta_0 > p$: the fourth electron occupy t$_{2g}$ orbital with configuration $t_{2g}^4 e_g^0$.

        Ligands which produce this effect are known as strong field ligands and form low spin complex.

    b) If $\Delta_0 < p$: the fourth electron enters e$_g$ orbital forms $t_{2g}^3 e_g^1$. Ligands which shows this effect are weak field ligands forms high spin complex.

V 33. a) At constant temperature the solubility of a gas in a liquid is directly proportional to the partial pressure of the gas present over the liquid or solution. **OR**

      The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution.

      i.e. P_{gas} = $K_H \cdot \chi_{gas}$

          K_H = Henry's law constant.

          χ = Mole fraction of a gas.

  b) 0.5 or 1/2

34. a) The Resistance of a conductor whose length is 1m and area of cross section is 1m^2.

i.e. $\rho = R\dfrac{a}{\ell} = \Omega\dfrac{Cm^2}{Cm} = \Omega\, Cm = \Omega\, m$ (SI unit)

[*Note:* $1\Omega\, m = 1\Omega \times 1m = \Omega \times 100\, cm = 100\,\Omega\, cm$]

b) The amount of substance that liberated or deposited at any electrode during electrolysis is directly proportional to the quantity of electricity passed through the electrolytic soluiton.
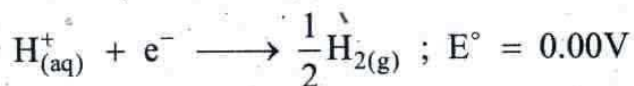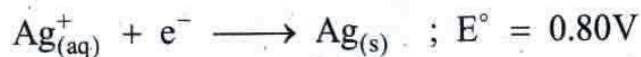
i.e. $W \propto Q$ But $Q = It$

$W \propto It$

OR $W = \dot{Z}It$

Where I = current in ampere ;   t = time in seconds

Z = Electrochemical equivalent

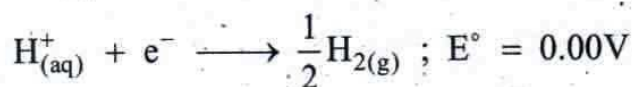**35.** i) **At cathode:** The following reduction reactions compete to take place at the cathode.

$Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$; $E^\circ = 0.80V$

$H^+_{(aq)} + e^- \longrightarrow \dfrac{1}{2}H_{2(g)}$; $E^\circ = 0.00V$

The reaction with a higher value of E$^\circ$ takes place at the cathode. Therefore, deposition of silver   will take place at the cathode.,

At anode: The Ag anode is attacked by NO_3^- ions. Therefore, the silver electrode at the anode dissolves in the solution to form Ag^+.

ii) **At cathode:** The following reduction reactions compete to take place at the cathode.
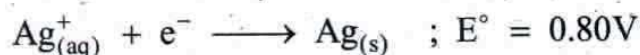
$Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$; $E^\circ = 0.80V$

$H^+_{(aq)} + e^- \longrightarrow \dfrac{1}{2}H_{2(g)}$; $E^\circ = 0.00V$

The reaction with a higher value of E$^\circ$ takes place at the cathode. Therefore, deposition of silver will take place at the cathode.
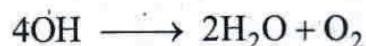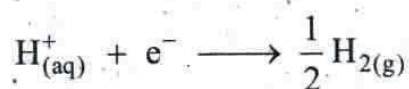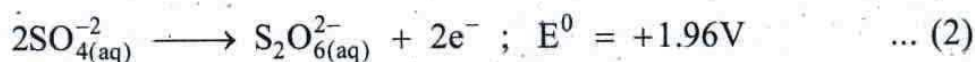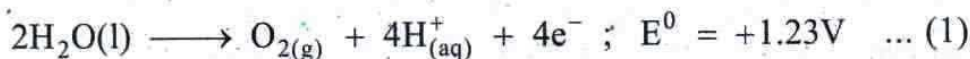
At anode: Since Pt electrodes are inert, the anode is not attacked by NO_3^- ions. Therefore, OH^- or NO_3^- ions can be oxidized at the anode. But OH – ions having a lower discharge potential and get preference and decompose to liberate O_2.

$$OH^- \longrightarrow OH + e^-$$

$$4OH \longrightarrow 2H_2O + O_2$$

iii)   **At the cathode,** the following reduction reaction occurs to produce H_2 gas.

$$H_{(aq)}^+ + e^- \longrightarrow \frac{1}{2}H_{2(g)}$$

At the anode, the following processes are possible.

$$2H_2O(l) \longrightarrow O_{2(g)} + 4H_{(aq)}^+ + 4e^- \; ; \; E^0 = +1.23V \quad \text{... (1)}$$

$$2SO_{4(aq)}^{-2} \longrightarrow S_2O_{6(aq)}^{2-} + 2e^- \; ; \; E^0 = +1.96V \quad \text{... (2)}$$

For dilute sulphuric acid, reaction (i) is preferred to produce O_2 gas. But for concentrated sulphuric acid, reaction (ii) occurs.

36.   a)
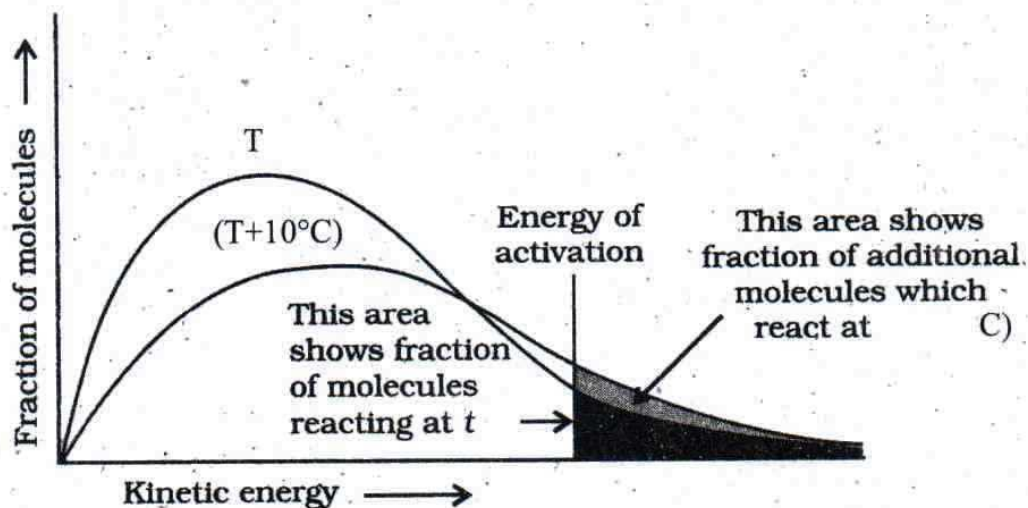
Increasing the temperature of the substance increases the fraction of molecules, which collide with energies greater than E_a. It is clear from the diagram that in the curve at (T + 10°C), the area showing the fraction of molecules having energy equal to greater than activation energy gets doubled leading to doubling the rate of reaction.

b) $K = Ae^{-Ea/RT}$

where   A $=$ frequency factor OR Arrhenius factor.

          K $=$ rate constant ;

          R $=$ Universal gas constant

          T $=$ Kelvin temperature

PART-D

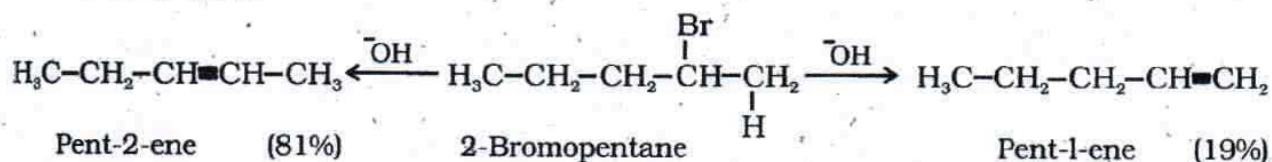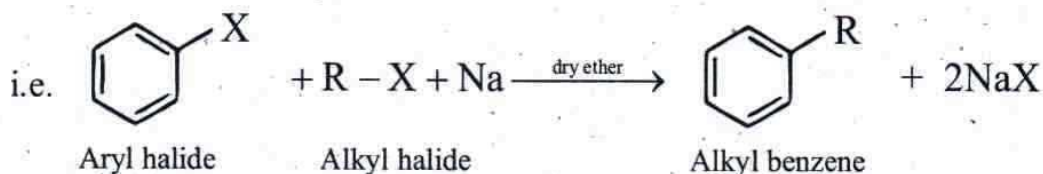**VI 37.** a)   It states that " In Dehydrohalogenation elimination of H-atom of alkyl halide takes place from that β - carbon atoms having less number of H-atoms is called Saytzeff elimination".

For *example:*

$$H_3C-CH_2-CH\bullet CH-CH_3 \xleftarrow{\bar{O}H} H_3C-CH_2-CH_2-\overset{\overset{Br}{|}}{\underset{\underset{H}{|}}{C}H}-CH_2 \xrightarrow{\bar{O}H} H_3C-CH_2-CH_2-CH\bullet CH_2$$

Pent-2-ene   (81%)   2-Bromopentane   Pent-1-ene   (19%)

b)   A reaction between alkyl halide and aryl halide with sodium metal in presence of dry ether to form alkyl benzene is called Wurtz-Fittig's reaction.

i.e.   [Aryl halide with X] $+ R - X + Na \xrightarrow{\text{dry ether}}$ [Alkyl benzene with R] $+ 2NaX$

     Aryl halide   Alkyl halide   Alkyl benzene

[R = alkyl group may be CH_3 or C_2H_5,   X $=$ Br, I, Cl.]

Example :

i)   [Chlorobenzene with Cl] $+ CH_3 - Cl + 2Na \xrightarrow{\text{dry ether}}$ [Toluene with CH_3] $+ 2NaCl$

     Chlorobenzene   Chloromethane   Toluene

ii)   [Chlorobenzene with Cl] $+ C_2H_5Cl + 2Na \xrightarrow{\text{dry ether}}$ [Ethyl benzene with C_2H_5] $+ 2NaCl$

     Chlorobenzene   Chloroethane   Ethyl benzene
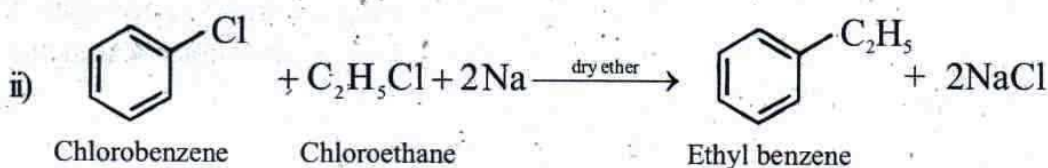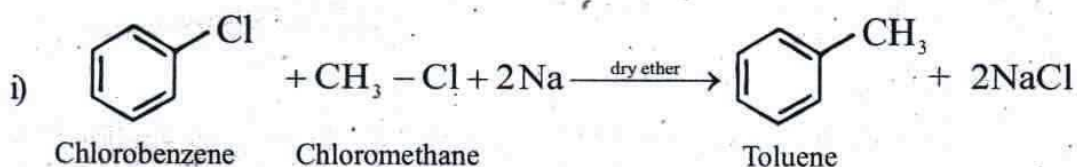
c) i) It is widely used as a refrigerant in refrigerators and air conditioners.

ii) It is used as a propellant in aerosols and foams (i.e hair sprays, deodarants, shaving creams, cleansers, insecticides etc).

Environmental effect: In the stratosphere disrupts the natural ozone balance.

38. a) When the vapours of alcohol are passed over heated copper or silver catalyst at 573 K.

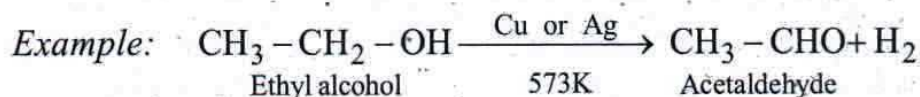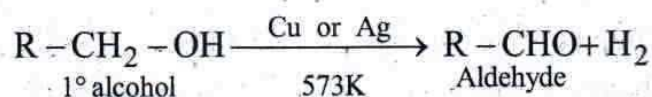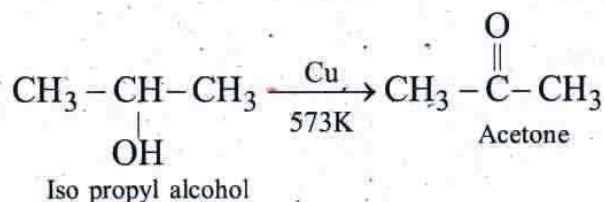i) Primary alcohols undergo dehydrogenation when passed over heated copper or silver catalyst at 573K to give aldehydes.

$$R-CH_2-OH \xrightarrow[573K]{Cu \ or \ Ag} R-CHO+H_2$$
$$\text{1° alcohol} \qquad\qquad \text{Aldehyde}$$

Example: $CH_3-CH_2-OH \xrightarrow[573K]{Cu \ or \ Ag} CH_3-CHO+H_2$
$$\text{Ethyl alcohol} \qquad\qquad \text{Acetaldehyde}$$

ii) Secondary alcohols when heated with Cu at 573 K forms ketones.

$$CH_3-CH-CH_3 \xrightarrow[573K]{Cu} CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$$
$$\qquad\quad | \qquad\qquad\qquad\qquad \text{Acetone}$$
$$\qquad\quad OH$$
$$\text{Iso propyl alcohol}$$

iii) 3° alcohols do not undergo dehydrogenation due to the absence of free hydrogens attached to it.

b) Sugar in molasses or sugar cane is converted to glucose and fructose in the presence of invertase.

$$C_{12}H_{22}O_{11}+H_2O \xrightarrow{Invertase} C_6H_{12}O_6+C_6H_{12}O_6$$
$$\qquad\qquad\qquad\qquad\qquad\qquad \text{Glucose} \qquad \text{Fructose}$$
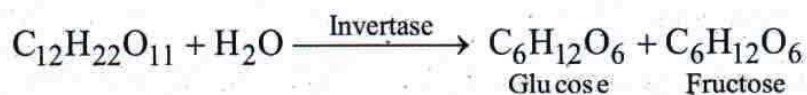
Glucose and fructose undergo fermentation in the presence of zymase.

$$C_6H_{12}O_6 \xrightarrow{Zymase} 2C_2H_5-OH+2CO_2$$

39. a) i) $CH_3 - CH_2 - CH_2 - CH_2 - OH$
               Bu tan–l–ol

ii) $CH_3 - CH - CH_3$
                    |
                    OH
               Propan-2-ol

iii) $CH_3 - \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_6}{|}}{C}} - OH$

2–Methylpropan–2–ol

b) i)   This is due to strong electron withdrawing nature of the $-NO_2$ group.

ii)   Because the phenoxide ion is stabilised by resonance but alkoxide ion is not stabilised by resonance. Therefore phenols are stronger acids than alcohols.

40. a) On passing carbonmonoxide and HCl gas through a solution of benzene in the presence of a catalyst anhydrous $AlCl_3$ and traces of CuCl, benzaldehyde is formed known as Gatterman-Koch reaction.

i.e

b)

c) $CH_3CH_2OH > CH_3CHO > CH_3OCH_3 > CH_3CH_2CH_3$

41. a) Ans: Acetamide : Acetic acid heated with ammonia gives ammonium salt which is decomposed to acetamide by heating.

$$CH_3COOH + NH_3 \longrightarrow CH_3COO^-NH_4^+ \xrightarrow{\text{Heat}} CH_3CONH_2 + H_2O$$
$\quad$ Acetic acid $\qquad\qquad\qquad$ Amm. acetate $\qquad\qquad$ Acetamide

Benzamide: Benzoic acid heated with ammonia gives benzamide.

b) Aldehydes without α-hydrogen atom undergo cannizzaro reaction.

42. a) It is used to prepare both aliphatic and aromatic primary amines. In this method an acid amide treated with an alcoholic potassium hydroxide and bromine to form primary amine.

$$\underset{\text{Amide}}{R - \overset{\overset{\displaystyle O}{\|}}{C} - NH_2} + Br_2 + 4\,KOH \longrightarrow \underset{1°\text{ amine}}{R - NH_2} + K_2CO_3 + 2\,K\,Br + 2H_2O$$
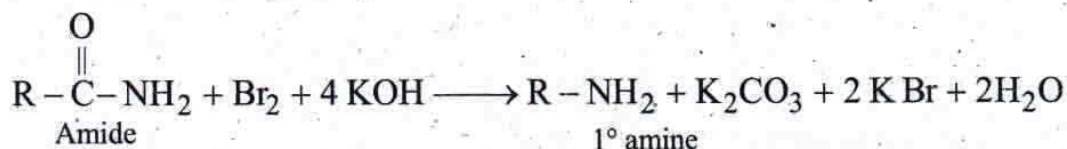
b) i) As the number of electron donating group increases, basicity increases. Hence dimethyl amine is more baisc than methyl amine.

ii) Trimethyl amine is less baisc than dimethyl amine and methyl amine in aqueous medium because of stearic hindrance and absence of hydrogen bonding.

c) 3° amines cannot be acylated because of absence of hydrogen on Nitrogen atom.

43. a) Maltose - $C_{12}H_{22}O_{11} + H_2O \longrightarrow \underset{\alpha-D-Glucose}{C_6H_{12}O_6} + \underset{\alpha-D-Glucose}{C_6H_{12}O_6}$
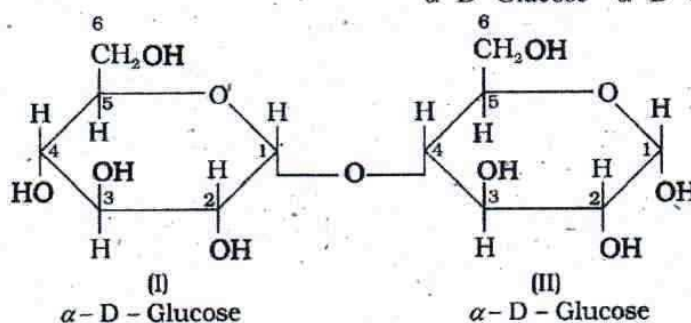

Glycosidic linkage is represented by $\alpha - (1,4)$.

b) The amino acids which cannot be synthesized in the body supplied through diet are called Essential amino acids.

Examples: Valine, Leucine, Isoleucine, Phenyl alanine, Methionine, Tryptophan, Threonine, Lysine, Arginine and Histidine.

Amino acids which are synthesized in the body are called Non-essential Amino acids.

For examples: Glycine, Alanine, Tyrosine, Aspargine, Aspartic acid, Glutamic acid, seriene cysteine etc.

c) Glycine,

$$H - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle NH_2}{|}}{C}} - COOH$$
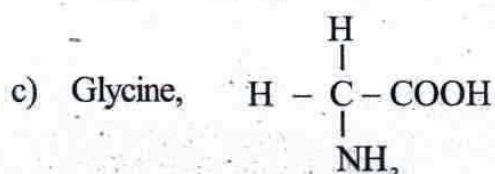
PART-E

VII44. Moles of glucose = 18 g/180gmol^{-1} = 01.

Number of kilograms of solvent = 1 kg

Thus molality of glucose solution = 0.1 mol kg^{-1}

For water, change in boiling point

$$\Delta T_b = K_b \times m$$

$$= 0.52K \, kg \, mol^{-1} \times 0.1 \, mol \, Kg^{-1}$$

$$= 0.052 \, K$$

Since water boils at 373.15K at 0.013 bar pressure, therefore, the boiling point of solution will be,

$$373.15 + 0.052 = 373.202 \, K$$

45. Depression in freezing point is related to the molality, therefore, the molality of the solution with respect to ethylene glycol

$$= \frac{moles \ of \ ethylene \ glycol}{mass \ of \ water \ in \ kilograms}$$

Moles of ethylene glycol $= \dfrac{45 \, g}{62 \, g \, mol^{-1}} = 0.73 \, mol$

Mass of water in kg $= \dfrac{600}{1000 \, g \, kg^{-1}} = 0.6 \, kg$

Hence molality of ethylene glycol $= \dfrac{0.73 \, mol}{0.60 \, kg} = 1.2 \, mol \, kg^{-1}$

Therefore freezing point depression,

$$\Delta T_f = 1.86 \, K \, kg \, mol^{-1} \times 1.2 \, mol \, kg^{-1} = 2.2 \, K$$

Freezing point of the aqueous solution = 273.15K – 2.2K = 270.95 K.

46. R = 5.55 c 10^3 Ω;

$$\left[A = \pi r^2 = 3.143 \times \left(\frac{1}{2} cm\right)^2 = 0.785 \, cm^2 = 0.785 \times 10^{-4} m^2\right.$$

$$\left.(cm)^2 = \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} \, m^2 = 10^{-4} m^2\right]$$

1) $R = \rho \dfrac{\ell}{a}$ ∴ $\rho = \dfrac{R \times a}{\ell} = \dfrac{5.55 \times 10^3 \times 0.785 \times 10^{-4}}{0.5\,m} = 87.135 \times 10^{-2}\,\Omega\,m$

2) $k = \dfrac{\ell}{\rho} = \dfrac{1}{87.135 \times 10^{-2}\,\Omega m} = \dfrac{100\,\Omega^{-1}m^{-1}}{87.135} = 1.148\,sm^{-1}$

3) $\wedge_m = \dfrac{k}{C} = \dfrac{1.148\,sm^{-1}}{50\,mol.m^{-3}} = 229.6 \times 10^{-4}\,sm^2\,mol^{-1}$

47. $t = 600s$ charge = current $\times$ time $= 1.5A \times 600\,s = 900\,C$.

Adding to the reaction: $Cu^{2+}(aq) + 2e^- = Cu(s)$

We require 2F or 2×96487 C to deposit 1 mol or 63 g of Cu.

For 900 C, the mass of Cu deposited $= \dfrac{(63g\,mol^{-1} \times 900C)}{(2 \times 96487\,C\,mol^{-1})}$

$= 0.2938\,g$

48. $k = \dfrac{2.303}{t} \log \dfrac{[R]_0}{[R]}$

$k = \dfrac{2.303}{60} \times \log \dfrac{[R]_0}{[R]_0/2} = \dfrac{2.303}{60\,min} \times \log 2$

$= \dfrac{2.303}{60\,min} \times 0.3010 = 0.01155\,min^{-1}$

49. We know that, $\log k_2 - \log k_1 = \dfrac{E_a}{2.303\,R}\left[\dfrac{1}{T_1} - \dfrac{1}{T_2}\right]$

$\log k_2 = \log k_1 + \dfrac{E_a}{2.303\,R}\left[\dfrac{1}{T_1} - \dfrac{1}{T_2}\right]$

$\log_{10} k_2 = \log(1.60 \times 10^{-5}) + \dfrac{209000\,J\,mol\,L^{-1}}{2.303 \times 8.314\,J\,mol\,L^{-1}\,K^{-1}}\left[\dfrac{1}{600K} - \dfrac{1}{700K}\right]$

$\log k_2 = -4.796 + 2.599 = -2.197$

$k_2 = 6.36 \times 10^{-3}\,s^{-1}$

* * *

MODEL QUESTION PAPER-5
II PUC - CHEMISTRY(34)

Time: 3 Hrs. 15 Mints. (Total No. of questions: 49)   **Max. Marks : 70**

Instructions:

1. *Question paper has FIVE parts. All parts are compulsory.*
2. *a) Part-A carries 20 marks. Each question carries 1 mark. b) Part-B carries 06 marks. Each question carries 2 marks. c) Part-C carries 15 marks. Each question carries 3 marks. d) Part-D carries 20 marks. Each question carries 5 marks. e) Part-E carries 09 marks. Each question carries 3 marks.*
3. *In Part-A questions, first attempted answer will be considered for awarding marks.*
4. *Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.*
5. *Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.*
6. *Use log tables and simple calculator if necessary (Use of scientific calculators is not allowed.)*

PART-A

I   Select the correct option from the given choices: **1 × 15 = 15**

1. If the temperature increases, molarity of solution

   a) Increases   b) Decreases   .   c) No change   d) Slightly increases

2. Colourless gas evolves when HCl reacts with zinc metal is

   a) NH_3 b) N_2 c) H_2 d) Cl_2

3. With respect to strong electrolyte which of the following statement is not correct,

   a) Dissociates completely

   b) HCl is an exmple for strong electrolyte

   c) The temperature does not affect   d) NH_4OH is an example

4. If Rate $= k[A]^{1/2} [B]^{3/2}$ order of reaction is,

   a) 4   b) 2   c) $\dfrac{1}{2}$ d) 0

5. Magnetic behaviour shown by aqueous colourless solution of metal ion of 3d series is

   a) paramagnetic   c) ferromagnetic
   c) dia magnetic   d) Antiferro magnetic

6. Primary valences are satisfied by

   a) positive ions   b) negative ions

   c) neutral molecules   d) Both (a) and (c)

7. Optical isomerism is exhibited by

   a) Primary butyl chloride

   b) Secondary butyl chloride

   c) Tertiary butyl chloride

   d) Isobutyl chloride

8. Which of the following is most acidic?

   a) Phenol   b) Ethyl alcohol   c) Picric acid   d) p-Nitrophenol

9. In Lucas test of alcohols, the appearance of cloudiness is due to the formation of

   a) Aldehydes   b) Ketones   c) Acid chlorides   d) Alkyl chlorides

10. Organic compounds formed by the oxidation of secondary alcohols is,

    a) ketones

    b) carboxylic acids

    c) amines

    d) none of the above

11. The reagent used in Clemmensen's reduction is

    a) conc. H_2SO_4

    b) Zn–Hg/conc. HCl

    c) aq. KOH

    d) alc. KOH

12. Chemical name of Hinsberg's reagent is

    a) Benzene sulpuryl chloride

    b) Benzyl chloride

    c) Benzene sulphonyl chloride

    d) Chlorobenzene

13. Among the following compound; NH_3, CH_3NH_2, $C_6H_5NH_2$ and $C_2H_5NH_2$ and the least basic compound is

    a) NH_3 b) CH_3NH_2 c) $C_2H_5NH_2$ d) $C_6H_5NH_2$

14. Glucose when reduced with HI and red phosphorous gives

    a) n-heptane   b) n-hexane   c) n-pentane   d) n-octane

15. The hormone which increases the blood sugar leve is

    a) Glucocorticoids   b) Glucagon   c) Progesterone   d) Thyroxine

II Fill in the blanks by choosing the appropriate word from those given in the brackets: **5 × 1 = 5**

[initial concentration, $CHCl_3$, nitrogen, $K_2Cr_2O_7$, dissolved salts, $TiCl_4 + Al(C_2H_5)_3$]

16. Freezing point of sea water is less than 0°C due to _____.

17. For a zero order reaction, half-life period is inversely proportional to the _____.

18. Ziegler-natta catalyst is _____ .

19. Polyhalogen compounds is _____ .

20. The gas liberated when methanamine is treated with nitrous acid is _____ .

PART-B

III Answer any three of the following. Each question carries two marks.

$3 \times 2 = 06$

21. Justify: i) Raw mangoes shrivel when pickled in salt water.

    ii) Wilted flowers revive when placed in fresh water.

22. Distinguish between order and molecularity.

23. What are metal carbonyls? Give an example.

24. Explain the reaction of alcohol with dry HCl and anhydrous $ZnCl_2$. Write the general equation. What is the name of the process?

25. How do you convert benzene to aromatic ketone by Friedle-crafts acylation? Give reaction.

26. What are fibrous proteins? Give an example.

PART - C

IV Answer any three of the following. Each question carries three marks.

$3 \times 3 = 09$

27. Write the characteristics of Transition elements.

28. Explain the variable oxidation state of transition elements.

29. Write general characters of Lanthanoids.

30. a) What is facial or fac-isomer and Meridianal or Mer isomer?

    b) What is denticity?

31. a) A solution of $[Ni(H_2O)_6]^{2+}$ is green but a solution of $[Ni(CN)_4]^{2-}$ is colourless. Explain.

    b) Write the molecular formula for potassium trioxalatoaluminate (III).

32. Mention any three applications of co-ordination compounds in the field of industry.

V Answer any two of the following. Each question carries three marks.

$2 \times 3 = 06$

33. a) i)   Define the term Molarity (M).   (1)

    ii) How does molarity changes with temperature ?   (1)

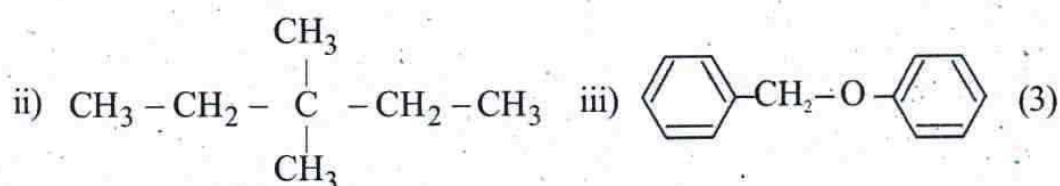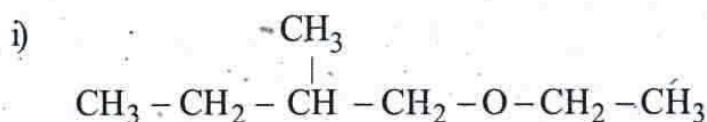   b) Give reason: Pressure has little effect on solubility of a solid in a liquid. (1)

34. Write the characteristic feature OR sailent features OR importance of SRP values of electro chemical series. (3)

35. Explain the 'corrosion is a electro chemical phenomenon'. (3)

36. Show that Half life period for a zero order reaction is directly proportional to the initial concentration of the reactants OR Derive half life period expression for a zero order reaction. (3)

PART - D

VI Answer any four of the following. Each question carries five marks.

$$4 \times 5 = 20$$

37. a) Mention any three differences between S_N1 and S_N2 reaction. (3)

    b) What are enantiomers? Give an example. (2)

38. a) How do you convert benzene to phenol. OR How do you convert benzene sulphonic acid to benzene. (3)

    b) Explain the oxidation of phenols. (2)

39. a) Give the major products that are formed by heating each of the following ethers with HI.

    i)
    $$CH_3 - CH_2 - \overset{\overset{\displaystyle -CH_3}{|}}{CH} - CH_2 - O - CH_2 - CH_3$$

    ii) $CH_3 - CH_2 - \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}} - CH_2 - CH_3$ iii) $\langle\!\!\bigcirc\!\!\rangle - CH_2 - O - \langle\!\!\bigcirc\!\!\rangle$ (3)

    b) Explain bromination of phenol with Br_2 in CS_2 OR CCl_4 (Non-polar solvent).

40. a) Explain the preparatin of aldehydes from nitriles. (2)

    b) The boiling points of aldehydes and ketones are higher than hydrocarbons and ether of comparable molecular masses. Give reason. (2)

    c) Aromatic aldehyde do not answer Fehling's solution test. Give reason. (1)

41. a) How do you prepare carboxylic acids from esters? Give reactions. (2)

    b) Explain the effect of substitutents on the acidity of carboxylic acids. (2)

    c) Aromatic carboxylic acids do not undergo Friedel craft's reaction. Why?(1)

42. a) An aromatic compound 'A' on treatment with aqueous Ammonia and heating forms compound 'B' which on heating with Br_2 and KOH forms a compound 'C' of molecular formula C_6H_7N. Write the structure and IUPAC names of compounds A, B and C.   (3)

    b) What are Coupling reactions? Give example.   (2)

43. a) Write the Haworth structure of
       i) $\alpha - D(-)$ Fructofuranose ; ii) $\beta - D(-)$ Fructofuranose.   (2)

    b) What is a Zwitter ion? Write the Zwitter ion structure for a α – amino acid.   (2)

    c) What is a peptide bond?   (1)

PART – E (PROBLEMS)

VII   **Answerany three of the following. Each question carries three marks.**

$$3 \times 3 = 09$$

44. The vapour pressure of pure liquids A and B are 450mmHg & 700mmHg respectively at 350K. Find out the composition of the liquid mixture if total vapour pressure is 600mm Hg. Also find the composition of the vapour phase.

45. Calculate the mole fraction of Benzene in solution containing 30% by mass in carbon tetrachloride.

46. Calculate $\wedge_m^0$ for $CaCl_2$ and $MgSO_4$ from the following data.

$$\wedge_{mca^{++}}^0 = 119.0 \, cm^2 \, mol^{-1} \, ; \, \wedge_{mMg^{2+}}^0 = 106.0 \, cm^2 \, mol \, ; \, \wedge_{mSO_4^-}^0 = 160.0 \, cm^2 / moL$$

47. How much charge is required for the following reductions:
    i) 1 mol of Al^{3+} to Al   ii) 1 mol of Cu^{2+} to Cu   iii) 1 mol of to MnO_4^- to Mn^{2+}

48. For the reaction $R \longrightarrow P$, the concentration of a reactant changes from 0.03 M to 0.02 M in 25 minutes. Calculate the average rate of reaction using units of time both in minutes and seconds.

49. The first order rate constant for the decomposition of ethyl iodide by the reaction $C_2H_5 I(g) \rightarrow C_2H_4 (g) + HI(g)$ at 600 K is $1.60 \times 10^{-5} \, s^{-1}$. Its energy of activation is 209 kJ/mol. Calculate the rate constant of the reaction at 700 K.

* * *

ANSWERS TO MODEL QUESTION PAPER-5

PART-A

I	1. b	2. c	3. d	4. b	5. c
	6. b	7. b	8. c	9. d	10. a
	11. b	12. c	13. d	14. b	15. b

II 16. <u>dissolved salts</u> 17. <u>initial concentration</u> 18. <u>$TiCl_4 + Al(C_2H_5)_3$</u>

19. <u>$CHCl_3$</u> 20. <u>Nitrogen</u>

PART-B

IV 21. i) Water molecules of mango enter into salt-water (brine solution) due to exosmosis.

ii) Due to endosmosis water molecules enter into flowers.

22.

Order	Molecularity
• It is the sum of powers of molar concentration of all the reactants in the experimentally determined rate equation.	• It is the number of atoms molecules or ions colliding simultaneously to cause a chemical reaction.
• It is experimentally determined quantity.	• It is a theoritical quantity
• It may be zero/fraction/whole number.	• It is always a whole number.
• It is applicable both elementary and complex reactions.	• Molecularity is applicable only for elementary reactions.

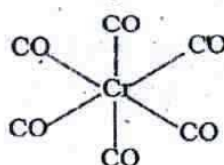23. Organometallic compounds containing carbonyl ligands are called Metal carbonyls.

For eg: $[Ni(CO)_4]$, $[Fe(CO)_5]$, $[Cr(CO)_6]$, $[Mn_2(CO)_{10}]$
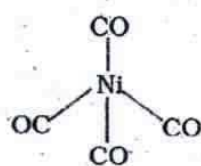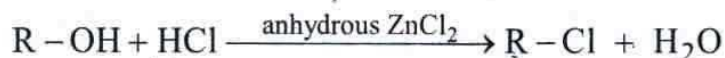

$Ni(CO)_4$
Tetrahedral
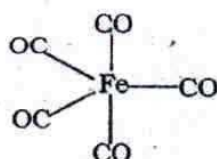
$Fe(CO)_5$
Trigonal bipyramidal

$Cr(CO)_6$ Octahedral
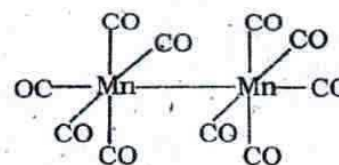
$[Mn_2(CO)_{10}]$

(Any one)

24. Alkyl chlorides are obtained by heating alcohol with anyhdrous $ZnCl_2$ and dry HCl.

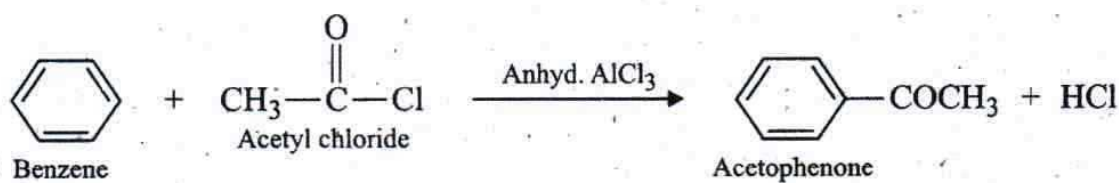$$R-OH + HCl \xrightarrow{\text{anhydrous } ZnCl_2} R-Cl + H_2O$$

Name of the proces is Groove's process.

25. Reaction of Benzene with Acid chloride in the presence of anhydrous $AlCl_3$ (Lewis acid) to give aromatic ketone is called Friedle-crafts reaction.

i.e.
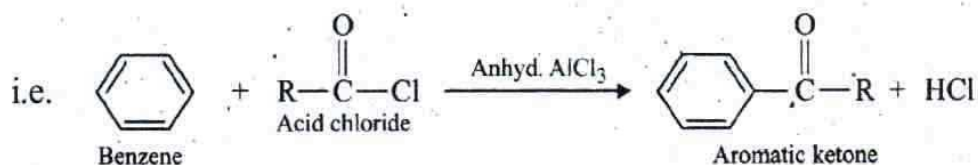
Example:

26. Proteins calssified 2 types based on molecular shape.

Fibrous proteins: Polypeptide chains parallel and held together by hydrogen and disulphide bonds. Fibre like structure and insolube in water.

Example: Keratin (present in hair, wool, silk)

　　　　　Myosin (present in muscles)

PART-C

IV 27. The characteristics of Transition elements are

1. It shows various electronic configuration due to stability in the case of $Cr(24) - [Ar]^{18} 3d^5 fs^1$ and $Cu_{(29)} - [Ar]^{18} 3d^{10} 4s^1$. [$d^5$ (Half filled d-orbital d^{10} completely filled d-orbital are always stable].

2. They show various oxidation states because of ↑ energy gap between $(n - 1)d$ and ns orbitals. *Example:* Mn^{+2} to Mn^{+7}.

3. They can form coloured compounds because the presence of unpaired electrons and undergo d-d transition. *Example:* $CuSO_4$ solution is blue in colour.

4. They can form complex compounds due to variable oxidation state, small size and high charge density and availability of vacant d-orbitals to accept electrons from ligards. *Example:* $K_4[Fe(CN)_6]$

5. They can show catalystic property due to variable oxidation state, Large surface area and small atomic size.

    Example: V_2O_5 as catalyst in contact process (H_2SO_4).

6. They can sjow magnetic property of paramagnetism due to the presence of unpaired electronsin the d-orbital.

    Example: $Cu^{+1} \rightarrow$ diamagnetic, $Cu^{+2} \rightarrow$ paramagnetic

7. They can form interstitial compounds where small atoms like H, C or N are trapped inside the crystal lattice of metals. *Example:* Tic, Fe_3H

(Any three)

28. d-block elements shows variable oxidation state because the energy difference betweeen $(n-1)d$ and ns orbital are very small, hence both $(n-1)d$ and ns electrons are involved in bond formation.

3d series elements shows variable oxidation states, this is because energy levels of 3d and 4s are nearly same.

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
		+2	+1	+2	+2	+2	+2	+1	+2
+3	+3	+3	+2	+3	+3	+3	+3	+2	
		+4	+4	+4	+4	+4	+4	+4	
			+5	+5	+5				
			+6	+6	+6				
				+7					

- The minimum oxidation state is shown by Cu and Cr i.e., +1
- The maximum oxidation state is shown by Mn in KMnO4 i.e., +7
- The common oxidation stte is +2, shown by all elements.
- Zn and Sc are not show variable oxidation state.
- In 4d series: Ruthenium (Ru) have oxidation state of +8.
- In 5d series: Osmium (OS) have maximum o.s. of +8.

29. General characters of Lanthanoids are:

- All the lanthanides are silvery white soft metals and tarnish rapidly in air.

- The hardness increases with increasing atomic number, samarium being steel hard.
- They have typical metallic structure and are good conductors of heat and electricity.
- Many trivalent lanthanide ions are coloured both in the solid state and in aqueous solutions.
- The lanthanide ions other than the f^0 type (La^{3+} and Ce^{4+}) and the f^{14} type (Ub^{2+} and Lu^{3+}) are all paramagnetic.

30. a) When three donor atoms of the same ligands occupies the adjacent positions at the corners of one of the octohedral faces is called Facial or fac-isomer. When the positions of the three atoms of the same ligands are arround the meridian of the octahedran is called Meridianal or Mer-isomer.

For eg: $[Co(NH_3)_3(NO_2)_3]$.

fac–   mer–
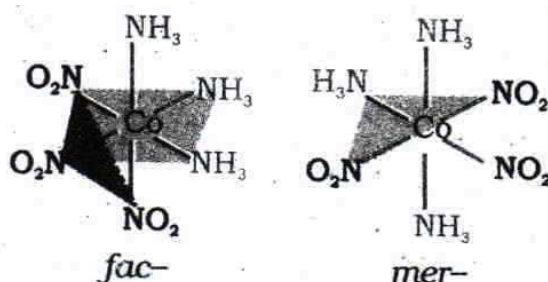
b) The number of ligating atoms present in a ligand is called denticity.

Greater the denticity, Greater is the stability of the complex.

For *example:* The denticity of $[EDTA]^{4-}$ is 6 ;

The denticity of oxalato is 2.

31. a) In $[Ni(H_2O)_6]^{2+}$ $H_2\overset{..}{O}$, is a weak field ligand. Therefore, there are unpaired electrons in Ni^{2+}. In this complex, the d electrons from the lower energy level can be excited to the higher energy level i.e., the possibility of $d-d$ transition is present. Hence, $Ni(H_2O)_6]^{2+}$ is coloured.

In $[Ni(CN)_4]^{2-}$, the electrons are all paired as CN- is a strong field ligand. Therefore, d-d transition is not possible in $[Ni(CN)_4]^{2-}$. Hence, it is colourless.

b) $K_3[Al(C_2O_4)_3]$

32. i) Many co-ordination compounds are used as catalysts.

For eg : $[(Ph_3P)_3RhCl]$ it is called wilkinson's catalyst used in hydrogenation of alkenes.

ii) Gold and silver complex ions are used in electroplating.

iii) To remove AgBr, hypo is used in black and white photography.

V 33. a) i) It is the number of moles of solute dissolved per litre of the solution (or $1 dm^3$)

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litre}} \quad \text{or}$$

$$\left[\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000 \ cm^3}{\text{Volume of solution}} \right]$$

Note: Unit of molarity is mol/lit, wherever, volume of solution measured in litres or mL, is always a temperature dependent.

ii) Molarity decreases with increase in temperature

OR $M \ \alpha \ \dfrac{1}{\text{Temperature}}$.

b) Pressure has no little effect on solubility because solids and liquids are highly incompressible.

34. i) The electrode kept above hydrogen atm,

- They have –ve SRP.
- They readily undergo oxidation.
- They readily release electron.
- They acts as good reducing agent.

Example: Lithium metal is good reducing agent.

ii) The electrode kept below hydrogen,

- They have +ve SRP.
- They readily undergo reduction.
- They readily accept electron.
- They acts as good oxidising agent.

Example: F_2 gas strongest oxidising agent.

iii) The metals kept above hydrogen are more reactive than hydrogen and they liberate hydrogen gas when added to acid like dil HCl OR H_2SO_4.

$$Zn + 2 HCl \longrightarrow ZnCl_2 + H_2 \uparrow$$
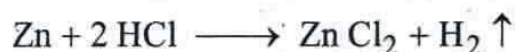
iv) The metals kept below hydrogen are less reactive than hydrogen and they do not liberate hydrogen gas when added to acid like dil HCl OR H_2SO_4.
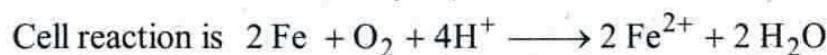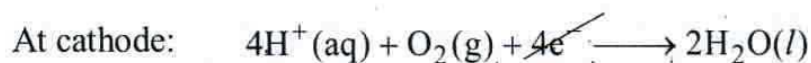
$$Cu + 2 HCl \longrightarrow NO \text{ reaction.}$$

v) The electrode kept above hydrogen behaves as anode when combined with SHE.

vi) The electrode kept below hydrogen behaves as cathode when combined with SHE.

vii) An electrochemical cell can be formed by combining any two electrode selected from ECs with large difference in SRP values. The cathode with higher SRP value acts as cathode. The electrode with lower SRP value acts as anode.

35. Corrosion or rusting is an electrochemical phenomeona. It involves anodic and cathodic reaction and it is a redox reaction.
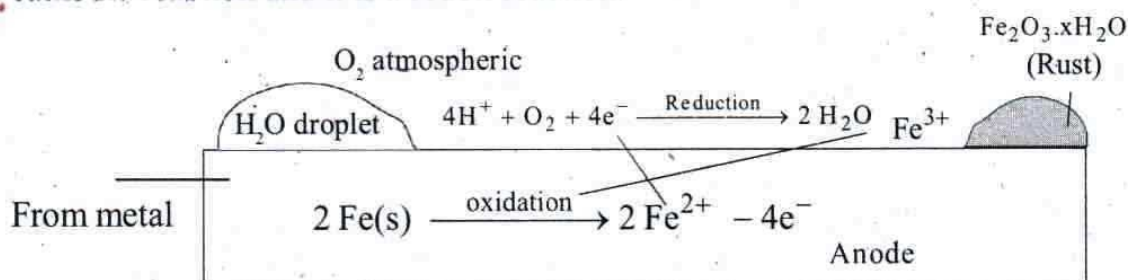
When iron object is exposed to atmospheric air, iron undergoes oxidation and acts as anode. Released electrons move from anodic spot to another spot on the metal and reduce oxygen in the presence of H^+ which acts as cathodic spot.

At anode: $2 Fe_{(s)} \longrightarrow 2 Fe^{2+} (aq) - 4e^-$

At cathode: $4H^+ (aq) + O_2 (g) + 4e^- \longrightarrow 2H_2O(l)$

Cell reaction is $2 Fe + O_2 + 4H^+ \longrightarrow 2 Fe^{2+} + 2 H_2O$

The ferrous ions are further oxidised by atmospheric oxygen to ferric (Fe^{3+}) ions which come out as rust in the form of hydrated ferric oxide ($Fe_2O_3 . xH_2O$) and with further production of hydrogen ions.

$$Fe_2O_3 + xH_2O \longrightarrow Fe_2O_3 . xH_2O$$
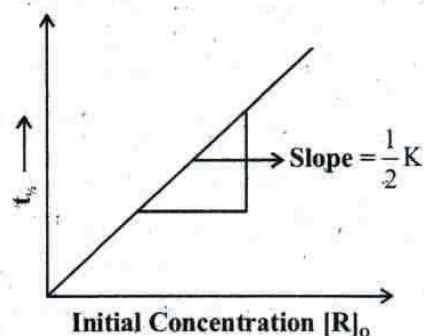$$\text{Rust}$$

36. Half life period ($^t\frac{1}{2}$) is the time in which concentration of a reactant is reduced to one half of its initial concentration.

The rate constant equation for a zero order reaction is, $k = \dfrac{[R_0] - [R]}{t}$

At $t = {}^t\frac{1}{2}$, $[R] = \dfrac{1}{2}[R]_0$

$$\therefore \quad k = \dfrac{[R]_0 - \dfrac{1}{2}[R]_0}{t_{\frac{1}{2}}} = \dfrac{2[R]_0 - [R]_0}{2t_{\frac{1}{2}}}$$

$$\therefore \quad k = \dfrac{[R]_0}{2t_{\frac{1}{2}}} \quad \textbf{OR} \quad t_{\frac{1}{2}} = \dfrac{[R]_0}{2k}$$

Slope $= \dfrac{1}{2}K$

Initial Concentration $[R]_0$

It is clear that half life period for a zero order reaction is directly proportional to the initial concentration of the reactants and inversely proportional to the rate constant

i.e. $t_{\frac{1}{2}} \, \alpha \, [R]_0$ and $t_{\frac{1}{2}} \, \alpha \, \dfrac{1}{k}$

Hence plot of half life period ($^t\frac{1}{2}$) versus initial concentration $[R]_0$ gives a straight line passing through the origin slope $= \dfrac{1}{2k}$.

PART-D

VI 37. a)

S_N1 mechanism	S_N2 mechanism
• It follows first order kinetics.	• It follows second order kinetics
• The decreasing order of reactivity of haloalkanes is $3^0 > 2^0 > 1^0$.	• The decreasing order of reactivity of alkyl halides $CH_3 > 1^0 > 2^0 > 3^0$.
• It is a two step reaction.	• It is a single step reaction.
• Rate of reaction depends on the concentration of alkyl halide.	• Rate of reaction depends on the concentration of alkyl halide and OH^α (Nucleophile).
• Takes place by partial racemization.	• Take place by complete inversion of configuration.
• Polar protic solvents (water, alcohols, acids) of high dielectric constants favours S_N1 reaction.	• Polar aprotic solvents (acetone, acetonitrile) of dielectric constant favour S_N2 reaction.
• It is a unimolecular reaction.	• It is a bimolecular reaction.
• Carbocations are intermediate.	• Carbocations are not intermediates. The reaction occurs through a transition state.

**b)** Optical isomers which are non-superimposable mirror images of each other are called Enantiomers.

Example:

Butan - 2-ol
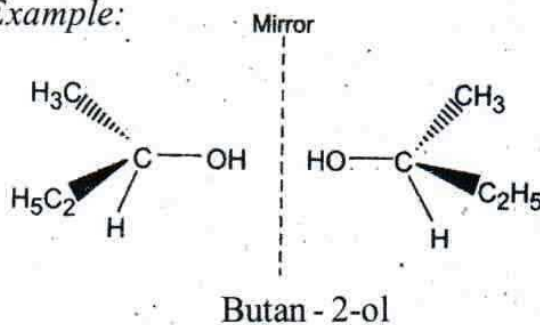
38. a) Sulphonation of benzene with oleum (70% H_2SO_4) gives benzene sulphonic acid fused with alkali NaOH to form sodium phenoxide. Acidification of sodium phenoxide gives phenol.

Benzene   Benzene sulphunic   Phenol
                              acid
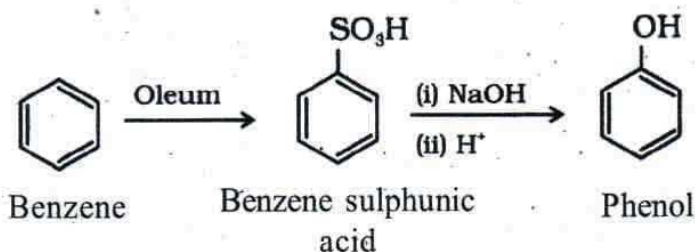
b) i) The oxidation of phenol by chromic acid, forms benzoquinone. Quinones are not aromatic compounds. They are α, β-unsaturated ketones.

Phenol   Benzoquinone
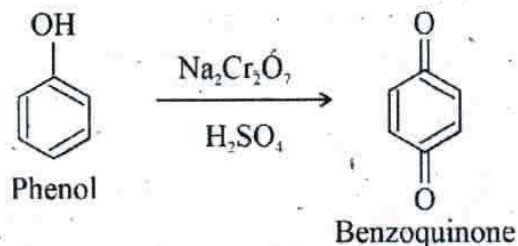
ii) Pehnols undergo slow oxidation in the presence of air to give benzenequinone, a pink coloured liquid. Hence kept in a dark coloured bottle.

Phenol   Benzoquinone
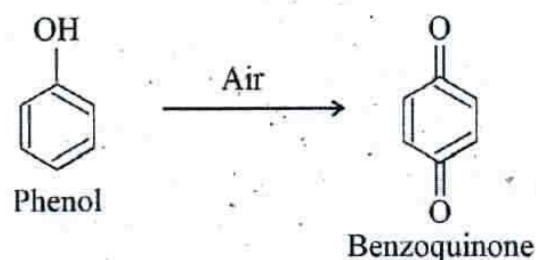
39. a) i) $CH_3 - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_2OH + CH_3CH_2I$

ii) $CH_3CH_2CH_2OH + CH_3CH_2 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - I$ **iii)**

b) Phenol reacts with Br_2 in CS_2 at low temperature form ortho-bromophenol and P-bromophenol.

Minor   Major

40. By stephen's reduction: Nitriles on reduction with stannous chloride and hydrochloric acid gives imine hydrochloride which on hydrolysis gives corresponding aldehyde.
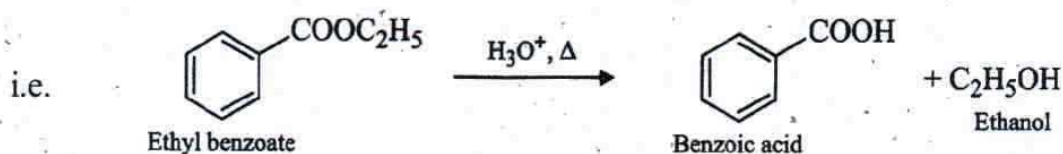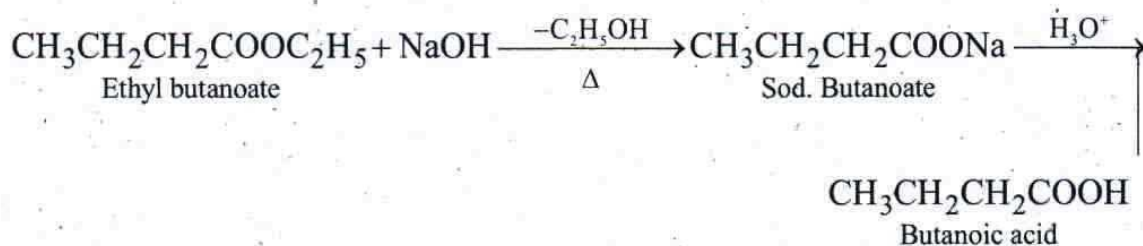
$$R-C \equiv N + 2[H] \xrightarrow[\text{Ether}]{SnCl_2 + Conc.\,HCl} R-CH = NH.\,HCl \xrightarrow{H_2O\ boil} R-\overset{\overset{\displaystyle O}{||}}{C}-H + NH_4Cl$$

Example:

$$CH_3-C \equiv N + 2[H] \xrightarrow[\text{290 K}]{SnCl_2 + Conc.\,HCl} CH_3CH = NH.\,HCl \xrightarrow{H_2O\ boil} CH_3-\overset{\overset{\displaystyle O}{||}}{C}-H + NH_4Cl$$

OR

By using DIBAL-H: Nitriles on reduction with di isobutyl aluminium hydride (DIBAL-H) gives imines which on hydrolysis gives aldehydes.

$$R-CN \xrightarrow[\text{2. } H_2O]{\text{1. DIBAL-H}} R-CHO$$

Example: $CH_3-CN \xrightarrow[\text{2. } H_2O]{\text{1. DIBAL-H}} CH_3-CHO$

Methyl cyanide   Acetaldehyde

b) The boiling points of aldehydes and ketones are higher than hydrocarbons and ethers of comparable molecular masses. It is due to weak molecular association in aldehydes and ketones arising out of the dipole-dipole interactions. Also, their boiling points are lower than those of alcohols of similar molecular masses due to absence of intermolecular hydrogen bonding.

c) Aromatic aldehyde like benzaldehyde do not contain α-hydrogen atom and undergo cannizaro reaction due to presence of alkali in Fehling's solution.

41. a) Acid Hydrolysis of esters with mineral acids gives carboxylic acids.

i.e.

Ethyl benzoate → Benzoic acid $+ C_2H_5OH$ Ethanol

$$\text{Ethyl benzoate} \xrightarrow{H_3O^+, \Delta} \text{Benzoic acid} + C_2H_5OH$$

Alkaline hydrolysis of esters followed by acidification gives carboxylic acids.

$$\underset{\text{Ethyl butanoate}}{CH_3CH_2CH_2COOC_2H_5} + NaOH \xrightarrow[\Delta]{-C_2H_5OH} \underset{\text{Sod. Butanoate}}{CH_3CH_2CH_2COONa} \xrightarrow{H_3O^+}$$

$$\underset{\text{Butanoic acid}}{CH_3CH_2CH_2COOH}$$

b) Electron withdrawing groups $-NO_2$, CN^- etc increase the acidity of carboxylic acids by resonance stabilization of carboxylate anion through delocalization of negative charge.
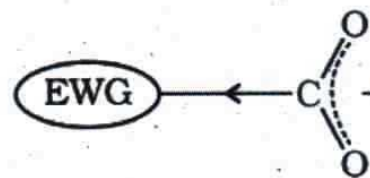
Electron donating groups like $-CH_3$, $-C_2H_5$ etc. decrease the acidic strength by destabilising the carboxylate ion.
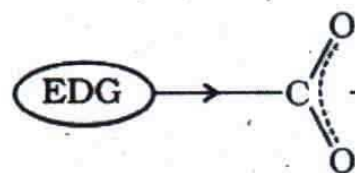
c) Because carboxylic acid group is deactivating and catalyst $AlCl_3$ (Lewis acid) bonded to the carboxylic acid and forms the complex salt.

42. a) B = Benzamide = $C_6H_5CONH_2$

A = Benzoic acid = C_6H_5COOH

C = $C_6H_5NH_2$ = Aniline

b) The reaction of Benzene diazonium chloride with phenols and Aromatiac amines in suitable condition to form azo compounds (Ar–N = N–Ar) is called Coupling reaction.

Example-1: Benzene diazonium chloride reacts with phenol in basic medium at 273-287K to form P-Hydroxyazobenzene a orange dye.

i.e.


p-Hydroxyazobenzene (orange dye)
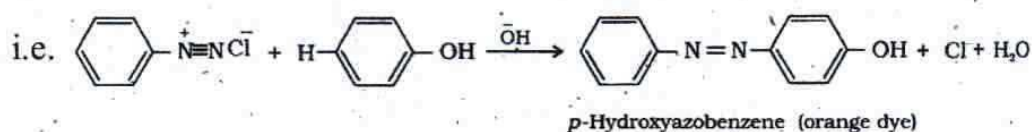
Example-2: Benzene diazonium chloride reacts with aromatic amines in acidic medium at 273-278K to form coupling compound P-Aminoazobenzene a yellow dye.


p-Aminoazobenzene
(yellow dye)

43. a)

$\alpha - D - (-) -$ Fructofuranose $\qquad$ $\beta - D - (-) -$ Fructofuranose
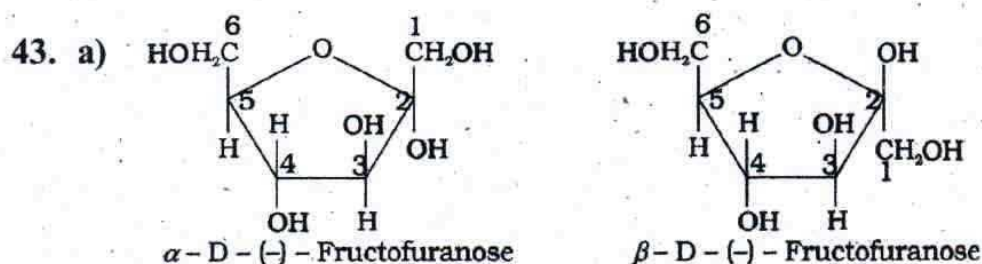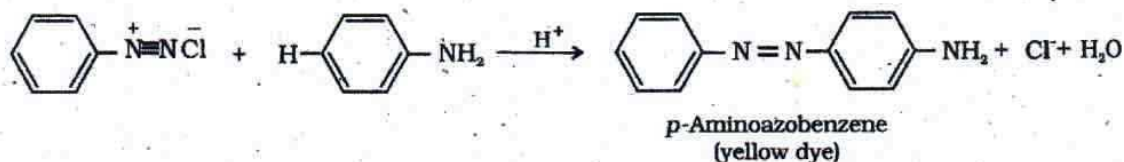
(These structures are written by the help of furan a five member heterocyclic ring of 4C & 1 oxygen atom)

b) The dipolar ion of Amino acid is called Zwitter ion (OR) In an aqueous solution carboxyl group of amino acid donate a proton to amino group of same amino acid to form a dipolar ion called Zwitter ion. It is neutral.

$$H_3N^+ - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle R}{|}}{C}} - COO^-$$
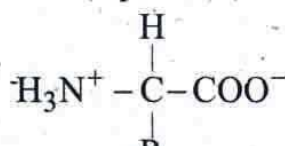
c) An amide formed between –COOH and –NH$_2$ group by the loss of water is called Peptide bond or Peptide linkage.

It is represented by,

$$-\overset{\overset{\displaystyle O}{\|}}{C} - \overset{\overset{\displaystyle H}{|}}{N} -$$
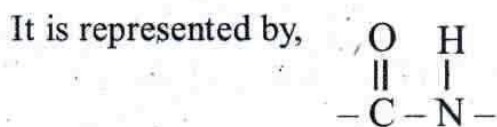
PART-E

VII44. Here $P_A^o = 450$ mm Hg; $\quad P_B^o = 700$ mm Hg; $\quad P_{total} = 600$ mm Hg

Applying Raoult's law

$$P_A = P_A^o \times \chi_A \quad \text{and} \quad P_B = \chi_B . P_B^o$$

$$\therefore \quad P_{total} = P_A + P_B = \chi_A P_A^o + (1 - \chi_A) P_B^o$$

$$P_{total} = P_B^o + \left(P_A^o - P_B^o\right) \chi_A$$

$\therefore$ $600 = 700 + (450 - 700)\chi_A$

$600 = 700 + 250\chi_A$ or $250\chi_A = 100$

$\therefore$ $\chi_A = \dfrac{100}{250} = 0.40$

Hence $\chi_A = 1 - \chi_A = 1 - 0.40 = 0.60$

Mole fraction of A in the vapour phase $= \dfrac{P_A}{P_A + P_B} = \dfrac{180}{180 + 420} = 0.30$

$\therefore$ Mole fraction of B $= 1 - A = 1 - 0.30 = 0.70$

$[P_A = \chi_A . P_A^o = 0.40 \times 450\ mm = 180,$

$P_B = \chi_B . P_B^o = 0.60 \times 700 = 420\ mm]$

45.   30% of Benzene in carbon tetrachloride $\Rightarrow$

Mass of Benzene = 30g   Molar mass of Benzene = 78 g mol^{-1}

Mass of CCl_4 = 70g   Molar mass of CCl_4 = 154 g mol^{-1}

Mass of solution = 100g

No of moles of Benzene $= \dfrac{Mass}{Molar\ Mass} = \dfrac{30}{78} = 0.385$

No of moles of CCl_4 $= \dfrac{Mass}{Molar\ Mass} = \dfrac{70}{154} = 0.455$

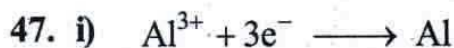Mole fraction of Benzene $= \dfrac{No.\ of\ moles\ of\ Benzene}{Total\ No.\ of\ moles\ in\ the\ solution}$

$= \dfrac{0.385}{0.455 + 0.385} = \dfrac{0.385}{0.840} = 0.458$

Mole fraction of CCl_4 $= 1 - 0.458 = 0.542$
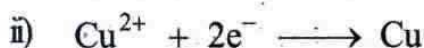
46.   We know from Kohlrausch law that

$\wedge_{m(Cacl_3)}^0 = \lambda_{Ca^{2+}}^0 + 2\lambda_{Cl}^0$

$= 119.0\,S\,cm^2\,mol^{-1} + 2(76,3)\,S\,cm^3\,mol^{-1}$

$= (119.0 + 152.6)\,S\,cm^2\,mol^{-1}$

$= 271.6\,S\,cm^2\,mol^{-1}$

$$\Lambda^0_{m(MgSO_4)} = \lambda^0_{Mg^{2+}} + 2\lambda^0_{SO_4^{2-}}$$

$$= 106.0 \ S \ cm^2 \ mol^{-1} + 160.0 \ S \ cm^3 \ mol^{-1}$$

$$= 266 \ S \ cm^2 \ mol^{-1}$$

47. **i)** $Al^{3+} + 3e^- \longrightarrow Al$

Therefore, Required charge $= 3 \ F$

$= 3 \times 96487 \ C = 289461 \ C$

ii) $Cu^{2+} + 2e^- \longrightarrow Cu$

Therefore, Required charge $= 2 \ F$

$= 2 \times 96487 \ C = 192974 \ C$

iii) $MnO_4^- \longrightarrow Mn^{2+}$

i.e., $Mn^{7+} + 5e^- \longrightarrow Mn^{2+}$
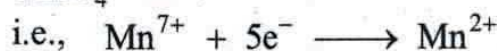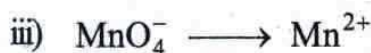
Therefore, Required charge $= 5 \ F$

$= 5 \times 96487 \ C = 482435 \ C$

48. Average rate of reaction

$$= -\frac{\Delta[R]}{\Delta t} = \frac{[R]_2 - [R]_1}{t_2 - t_1} = -\left[\frac{0.02 - 0.03}{25}\right] mol \ L^{-1} \ min^{-1}$$

$$= -\left[\frac{-0.01}{25}\right] M \ min^{-1} = 4 \times 10^{-4} \ mol \ L^{-1} \ min^{-1}$$

$$= \frac{4 \times 10^{-4}}{60} M \ s^{-1} = 6.667 \times 10^{-6} \ mol \ L^{-1} \ s^{-1}$$

49. For a first order reaction,

$$\log \frac{[R]_1}{[R]_2} = \frac{k(t_2 - t_1)}{2.303}$$

$$= \frac{2.303}{(t_2 - t_1)} \log \frac{[R]_1}{[R]_2}$$

$$= \frac{2.303}{(60 \ min - 0 \ min)} \log \frac{1.24 \times 10^{-2} \ mol \ L^{-1}}{0.20 \times 10^{-2} \ mol \ L^{-1}}$$

$$= \frac{2.303}{60} \log 6.2 \ min^{-1}$$

$$k = 0.0304 \ min^{-1}$$

* * *

MODEL QUESTION PAPER-6
II PUC - CHEMISTRY(34)

Time: 3 Hrs. 15 Mints. (Total No. of questions: 49)   **Max. Marks : 70**

Instructions:

1. Question paper has FIVE parts. All parts are compulsory.
2. a) Part-A carries 20 marks. Each question carries 1 mark. b) Part-B carries 06 marks. Each question carries 2 marks. c) Part-C carries 15 marks. Each question carries 3 marks. d) Part-D carries 20 marks. Each question carries 5 marks. e) Part-E carries 09 marks. Each question carries 3 marks.
3. In Part-A questions, first attempted answer will be considered for awarding marks.
4. Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.
5. Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.
6. Use log tables and simple calculator if necessary (Use of scientific calculators is not allowed.)

PART-A

I   Select the correct option from the given choices: $1 \times 15 = 15$

1. Which of the following is not a colligative property.

    a) Optical activity   b) Osmotic pressure

    c) Depression in freezing point   d) Elevation in boiling point

2. The process of zinc-plating on iron-sheet is knows as

    a) Annealing   b) Roasting   c) Galvanisation   d) Smelting

3. Specific conductivity of a soluiton,

    a) increases with dilution   b) decreases with dilution

    c) remains unchanged with dilution   d) depends on mass of electrolyte

4. In the Arrhenius equation, the factor $e^{\frac{-E_a}{RT}}$ corresponds to

    a) collision frequency   b) proper orientation

    c) the fraction of molecules with kinetic energy $> E_a$

    d) Threshold energy

5. Which of the following is colourless

    a) Cu^+ b) Zn^{2+} c) Cr^{3+} d) Both 'a' and 'b'

6. The ligand SCN^- is an example for

    a) Monodentate   b) Didentate   c) Ambidentate   d) Tridentate

7. The IUPAC name of tertiary butyl chloride is
   a) 2-Chloro-2-methylpropane
   b) 3-Chlorobutane
   c) 4-Chlorobutane
   d) 1,2-Chloro-3-methylpropane

8. Anisole on treatment with CH_3Cl in presence of anhydrous $AlCl_3$ gives
   a) Toluene
   b) o-Chloroanisole
   c) o-and p-methylanisoles
   d) p-Chloroanisole

9. In Kolbe's reaction the reacting substances are
   a) Phenol and $CHCl_3$
   b) Sodium phenate and CO_2
   c) Phenol and CCl_4
   d) Sodium phenate and CCl_4

10. Iodoform test is not given by
    a) HCHO
    b) CH_3CHO
    c) CH_3-CH_2-OH
    d) CH_3COCH_3

11. Stephen's reaction is reduction of
    a) alkyl cyanide with $LiAlH_4$
    b) alkyl cyanide with $SnCl_2$ and HCl
    c) alkyl isocyanide with Na and alcohol
    d) acyl halide in the presence of $Pd/BaSO_4$

12. The gas evolved when methylamine reacts with nitrous acid is _____ .
    a) NH_3
    b) N_2
    c) H_2
    d) C_2H_6

13. The bad smelling substance formed by the action of alcoholic caustic potash on chloroform and aniline is
    a) Nitrobenzene
    b) Phenyl isocyanide
    c) Phenyl cyanide
    d) Phenyl isocyanate

14. Carbohydrates are stored in human body as the polysaccharide
    a) starch
    b) glycogen
    c) cellulose
    d) amylose

15. Which of the following gives positive Fehling's solution test?
    a) Sucrose
    b) Galactose
    c) Fats
    d) Protein

II Fill in the blanks by choosing the appropriate word from those given in the brackets: $5 \times 1 = 5$

[one, +3, hypertonic solution, zero, diastereomers, benzene sulphonyl chloride]

16. A solution which has more osmotic pressure than other solution is called _____ .

17. The rate is independent of concentration of reactant in _____ order reaction.

18. The common oxidation state of Lanthanoide is _____ .

19. Super imposable mirror images to each other are called _____ .

20. _____ is the chemical name of Hinsberg's reagent.

PART-B

III Answer any three of the following. Each question carries two marks.

$$3 \times 2 = 06$$

21. Mention any two applications of Henry's law.

22. Write Nernst equation for the system $M^{n+}_{(aq)} + ne- \rightarrow M_{(s)}$.

23. What is solvate or Hydrate isomerism? Give example.

24. Aryl halides are less reactive towards nueleophilic substitution compared to alkyl halides. Give reasons.

25. Would you expect benzaldehyde to be more reactive or less reactive in nucleophilic addition reactions than propanal? Explain your answer.

26. Explain the classification of vitamins.

PART - C

IV Answer any three of the following. Each question carries three marks.

$$3 \times 3 = 09$$

27. Transition metals form large number of complex compounds. Give reason. .

28. i) Write the structure of chromate and dichromate ion.

    ii) What is the action of heat on $KMnO_4$?

29. Write general characters of Lanthanoids.

30. Name the type of complexes. Give examples.

31. Give the main points of Crystal Field theory.

32. Give any two uses of co-ordination compounds in medical field.

V Answer any two of the following. Each question carries three marks.

$$2 \times 3 = 06$$

33. Mention the factors affecting solubility of a gas in a liquid.

34. Explain the working function of lead-storage battery and uses.

35. Explain the effect of catalyst on the rate of reaction.

36. i) What is activation energy (Ea)? (1)

ii) By taking formation of HI, explain Arrhenius theory of activated complex by using potential energy level diagram. (2)
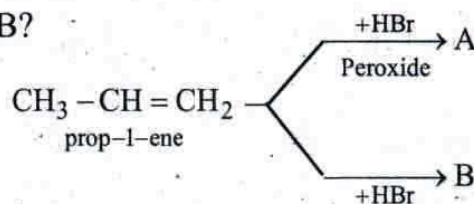
PART - D

VI Answer any four of the following. Each question carries five marks.

$$4 \times 5 = 20$$

37. a) Explain the preparation of Aryl Chlorides used in bromides by electrophilic substitution of toluene. (2)

b) What are A and B? (2)

$$CH_3 - CH = CH_2 \underset{prop-1-ene}{} \begin{cases} \xrightarrow[Peroxide]{+HBr} A \\ \xrightarrow[+HBr]{} B \end{cases}$$

c) What is Chairality?

38. a) How to convert Benzyl chloride to benzyl alcohol. (2)

b) What happens when phenol treated with Zn-dust? (2)

c) What is wood spirit? (1)

39. a) Write the structures of the major products expected from the following reactions:
   i) Mononitration of 3-methylphenol
   ii) Dinitration of 3-methylphenol
   iii) Mononitration of phenyl methanoate (3)

b) How do you prepare phenol from Haloarenes OR How do you convert chlorobenzene to phenol. (2)

40. a) Explain clemmenson reduction with an example. (2)

b) What is decarboxylation? Give an example. (2)

c) Carboxylic acids have higher boiling points. (1)

41. a) Write chemical reactions to affect the followingn transformations: (3)
   i) Butan-1-ol to butanoic acid.
   ii) Cyclohexene to hexane-1, 6-dioic acid
   iii) Butanal to butanoic acid

b) What is the reaction of PCl_5, PCl_3 and $SoCl_2$ with carboxylic acids? Give example. (2)

42. a) How do you convert benzene diazonium chloride into nitro benzene?   (2)

    b) Explain Sandmeyers reaction with an example.   (2)

    c) Diazonium salts of Aromatic amines are more stable than those of Aliphatic amines.   (1)

43. a) What are reducing sugars? Give an example.   (2)

    b) Explain types of secondary structure.   (2)

    c) Water soluble vitamins cannot be stored in our body. Give reason.   (1)

PART – E (PROBLEMS)

VII   Answerany three of the following. Each question carries three marks.

$$3 \times 3 = 09$$

44. Calculate the mole fraction of Benzene in solution containing 30% by mass in carbon tetrachloride.

45. Calculate the Osmotic pressure in pascals exerted by a solution prepared by dissolving 1.0g of polymer of molar mass 185,000 in 450ml of water at 37^0 C.

46. The conductivity of 0.001028 mol L^{-1} acetic acid is 4.95×10^{-5} S cm^{-1}. Calculate its dissociation constant if $\wedge_m^0$ for acetic acid is 390.5 S cm^2 mol^{-1}.

47. $\wedge_m^0$ for NaCl, HCl and NaAc are 126.4, 425.9 and 91.0 S cm^2 mol^{-1} respectively. Calculate $\wedge_m^0$ for HAc.

48. The following data were obtained during the first order thermal decomposition of N2O5(g) at constant volume: $2N_2O_5(g) \rightarrow 2 N_2O_2(g) + O_2(g)$

Sl.No.	Time/s	Total Pressure/(atm)
1.	0	0.5
2.	100	0.512

Calculate the rate constant.

49. The rate constant of a reaction is 1.2×10^{-3}s^{-1} at 30ºC and 2.1×10^{-3} s^{-1} at 40ºC. Calculate the energy of activation of a reaction.

* * *

ANSWERS TO MODEL QUESTION PAPER-6

PART-A

I 1. a   2. c   3. b   4. c   5. d

   6. c   7. a   8. c   9. b   10. a

   11. b   12. b   13. b   14. d   15. d

II 16. hypertonic solution   17. zero   18. +3

    19. diastereomers   20. Benzene sulphonyl chloride

PART-B

IV 21. i) To increase solubility of CO_2 in soft drinks and soda water, the bottles are sealed under high pressure.

ii) In deep sea diving (Scuba divers). To avoid bends as well as toxic effects of high concentration of nitrogen in the blood, the tank used by scuba diver's are filled with air diluted with helium. (11.7% Helium, 56.2% Nitrogen and 32.1% Oxygen.)

iii) For climbers or people living at high altitudes where concentration of oxygen is low in blood and tissues causing a disease called anoxia. Symptom is unable to think clearly.

22. $$E_{cell} = E_{cell}^0 - \frac{RT}{nF} \log \frac{[M]}{[M^{n+}]}$$

or $$E_{M^{n+}/M} = E_{M^{n+}/M}^0 - \frac{RT}{nF} \log \frac{1}{[M^{n+}]}$$

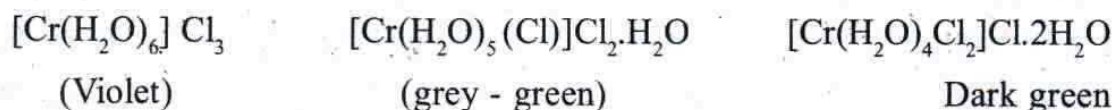or $$E_{M^{n+}/M} = E_{cell}^0 - \frac{2.303\ RT}{nF} \log_{10} \frac{1}{[M^{n+}]}$$

where,   E = Electrode potential ;   E° = Standard electrode Potential

         R = Gas constant ;   T = Kelvin temperature .

         F = Faraday constant ;   n = number of electrons in the reaction

23. Complexes having same chemical formula but differ in the number of solvent (water) molecules present as ligands and as free solvent molecules outside the

co-ordination sphere are called Solvate isomers and the phenomenon is called as Solvate Isomerism.

For *Example:*

$[Cr(H_2O)_6]\,Cl_3$ $[Cr(H_2O)_5\,(Cl)]Cl_2.H_2O$ $[Cr(H_2O)_4Cl_2]Cl.2H_2O$

(Violet)   (grey - green)   Dark green

24. i)   The C-X bond acquires partial double bond character due to resonance.

ii)   Carbon in haloarene is sp^2 hybridised. It has more 's' character and hence more electronegative. It can hold the electron pair of C-X bond more tightly.

iii) Instability of phenyl cation.

iv) Electron rich benzene ring repels electron rich nucleophile.

25. The carbon atom of the carbonyl group of benzaldehyde is less electrophilic than carbon atom of the carbonyl group present in propanal. The polarity of the carbonyl group is reduced in benzaldehyde due to resonance as shown below and hence it is less reactive than propanal.
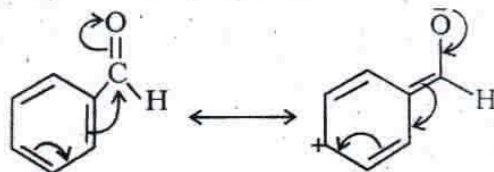
26. Vitamins are classified into two types depending on their solubility in water.

a) Fat soluble vitamins: Vitamins A, D, E and K are soluble in fat and oils but insoluble in water. They are stored in liver and adipose tissues (fat storing tissues).

Example: Vitamins A, D, E and K.

b) Water soluble vitamins: Vitamin B and C are soluble in water. They must be supplied regularly in diet because they are readily excreted in urine and cannot be stored in our body (except vitamin B_{12}).

Example: B group vitamins and vitamin C. Vitamin B has sub-groups $B_1, B_2, B_6, B_{12}.$
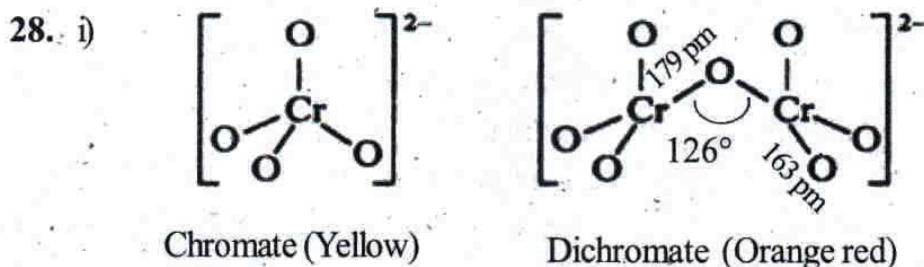
PART-C

IV 27. This is due to

i)   Smaller size of the metal ions.

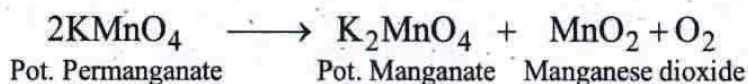ii) Their high ionic charges OR Large charge/size ratio OR Polarising power

iii) Availability of d-orbitals for bond formation.

   Eg: $[Cu(NH_3)_4]^{2+}$, $[Fe(CN)_6]^{3-}$, $[Fe(CN)_6]^{4-}$, $[PtCl_4]^{2-}$

iv) Formation of Π - bond and back-bonding in metal carbonyls.

28. i)

Chromate (Yellow)   Dichromate (Orange red)

ii) On heating $KMnO_4$ at 513K decomposed to O_2. (Disproportionation)

$$2KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$$

   Pot. Permanganate   Pot. Manganate   Manganese dioxide

29. General characters of Lanthanoids are:

- All the lanthanides are silvery white soft metals and tarnish rapidly in air.
- The hardness increases with increasing atomic number, samarium being steel hard.
- They have typical metallic structure and are good conductors of heat and electricity.
- Many trivalent lanthanide ions are coloured both in the solid state and in aqueous solutions.
- The lanthanide ions other than the f^0 type (La^{3+} and Ce^{4+}) and the f^{14} type (Ub^{2+} and Lu^{3+}) are all paramagnetic.

30. i) Cationic complexes - The complex ion carries net +ve charge.

   Example: $[Co(NH_3)_6]^{3+}$

ii) Anionic complexes - The complex ion carries net -ve charge.

   Example: $[CoF_6]^{3-}$, $[Fe(CN)_6]^{3-}$

iii) Neutral complexes - The complex ion carries no charge.

   Example: $[Ni(CO)_4]$, $[Fe(CO)_5]$

31. CFT was developed by HansBethe and John Van Vleck. CFT is an electrostatic model describes the splitting of d-orbitals by the ligand field.

According to CFT,

- The metal-ligand bond is ionic due to the electrostatic interactions between them.

- Ligands are treated as point of negative charges in case of anions and dipoles in case of neutral molecules.

- Due to electrostatic interactions between ligand and metal atom, the degeneracy is lifted resulted in splitting of d-orbitals.

    In $[Ni(CN)_4]^{2-}$, the electrons are all paired as CN- is a strong field ligand. Therefore, d-d transition is not possible in $[Ni(CN)_4]^{2-}$. Hence, it is colourless.
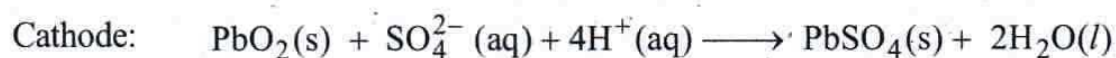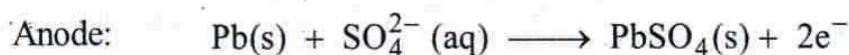
32. i) $EDTA^+$ is used to remove lead during lead poisoning.

ii)   Cisplatin is used for the treatment of Cancer tumours.

iii) In Chelate therapy to remove toxic metals from animals and plants (Cu & Fe) *Eg:* D-Penicillamine and Desferrioxime.

**V 33.** 1)   Nature of the gas and the solvent

2)   Effect of temperature

3)   Effect of pressure.

34. It is a secondary cell. It consists of lead as anode and a grid of lead packed with lead dioxide (PbO_2) as cathode. A 38% solution of sulphuric acid (H_2SO_4) as electrolyte.

The cell reactions when battery is in use are :

Anode: $Pb(s) + SO_4^{2-} (aq) \longrightarrow PbSO_4(s) + 2e^-$

Cathode: $PbO_2(s) + SO_4^{2-} (aq) + 4H^+(aq) \longrightarrow PbSO_4(s) + 2H_2O(l)$

Cell reaction: $Pb(s) + PbO_2(s) + 2H_2SO_4 (aq) \longrightarrow 2\,PbSO_4(s) + 2H_2O(l)$

On changing the battery the reaction is reversed. Chemical reaction occurs during recharging is,

$2PbSO_4(s) + 2H_2O(l) \longrightarrow Pb(s) + PbO_2(s) + 2H_2SO_4(aq)$
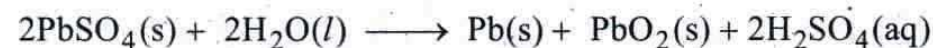
**The uses of lead-storage batteries are:**

i)   It is used in automobiles. ii) It is used in invertors.

iii) It is used in trains.   iv) It used in emergency power supplies (UPS)

35. A catalyst increases the rate of a reaction by lowering energy of activation (E_a). A catalyst provides an alternate reaction path or mechanism for the reaction to occur. A catalyst combines with the reactants to form an intermediate compound. It is then decomposed to product and the catalyst is regenerated.
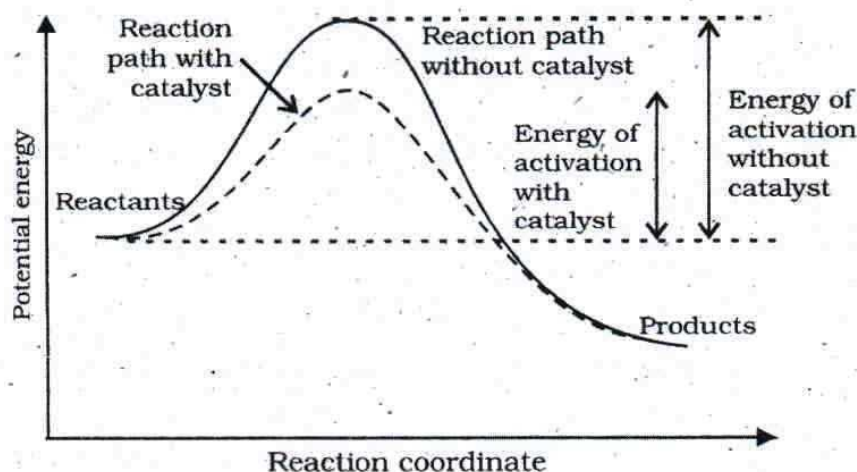
36. i) The minimum excess energy required by an average energy reactant molecule to attain threshhold energy is called activation energy.

Activation Energy = Threshold Energy – Average Energy of reactant molecules.

ii) According to Arrhenius, the reaction can take place only when a molecule of hydrogen and molecule of iodine collide to form an unstable intermediate (fig). It exists for a very short time and then breaks up to form two molecules of hydrogen iodide.
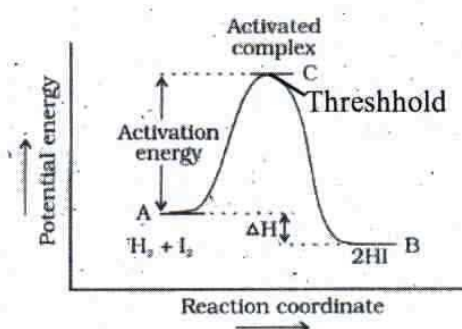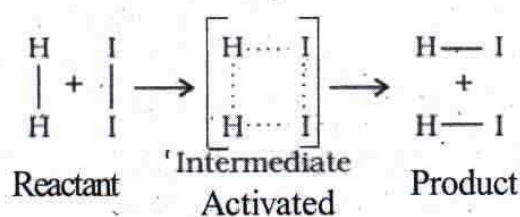
PART-D

VI 37. a) Aryl chlorides and bromides can be easily prepared by electrophilic substitution of arenes with chlorine and bromine respectively in the presence of Lewis acid catalysts like iron or iron (III) chloride.

Toluene   o-Halotoluence   p-Halotoluene
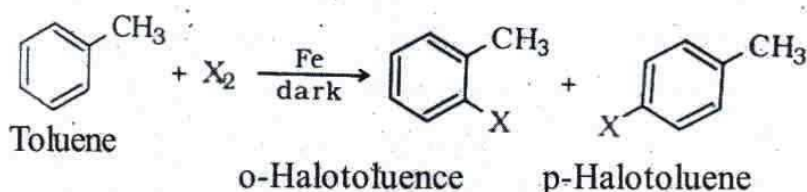
The ortho and para isomers can be easily separated due to large difference in their melting points. Reactions with iodine are reversible in nature and require the presence of an oxidising agent (HNO_3, HIO_4) to oxidise the HI formed during iodination. Fluoro compounds are not prepared by this method due to high reactivity of fluorine.
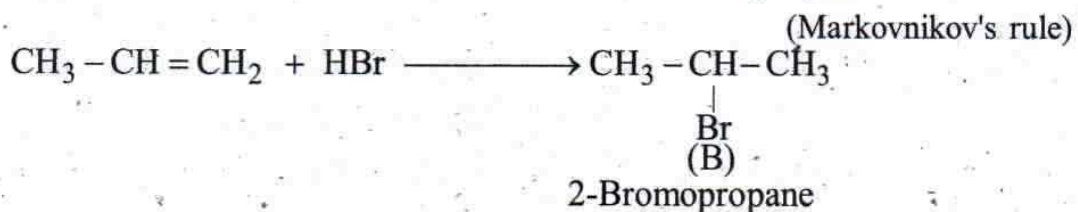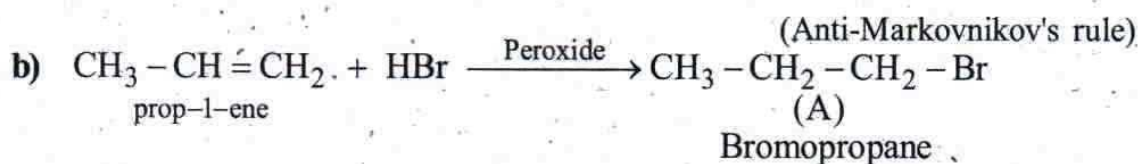
X = Cl or Br

b) $CH_3 - CH = CH_2 + HBr \xrightarrow{\text{Peroxide}} CH_3 - CH_2 - CH_2 - Br$

       prop–1–ene   (Anti-Markovnikov's rule)

                                           (A)

                                    Bromopropane

                                        (Markovnikov's rule)

   $CH_3 - CH = CH_2 + HBr \longrightarrow CH_3 - CH - CH_3$

                                              |

                                             Br

                                             (B)

                               2-Bromopropane

c)   Objects which are non-super imposable on their mirror images are called Chiral molecules and the property is called Chairality.

38. a)

     Benzyl chloride   Benzyl alcohol
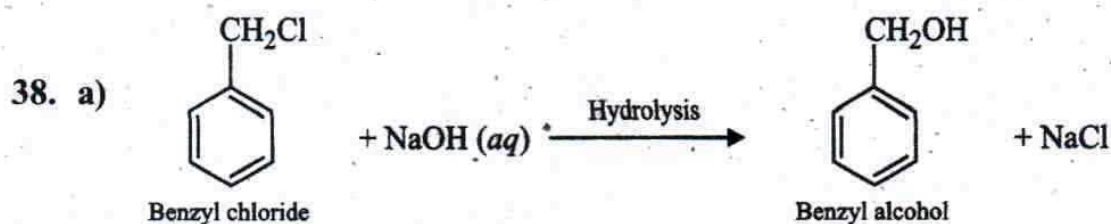
b)   Phenol on heating with zinc dust give benzene.

     Phenol   Benzene

c)   Methanol is called as spirit.

39. The combined influence of –OH and –CH$_3$ groups determine the position of the incoming group.

(a) and (b) (c)

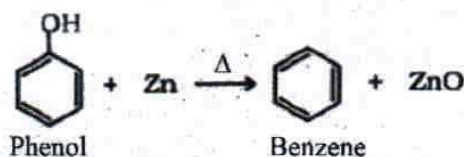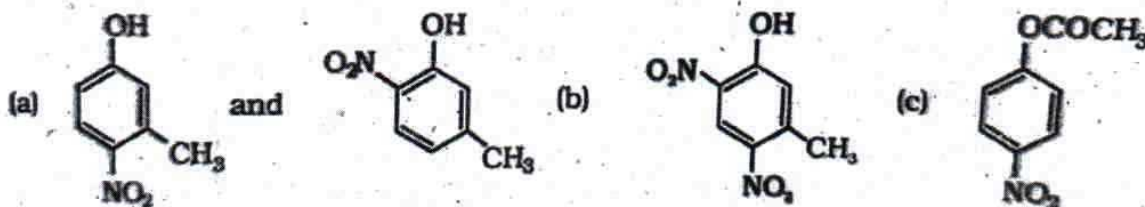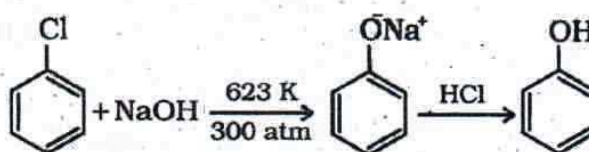**b)** Fusing chlorobenzene with NaOH at 623K and 300atm pressure to form sodium phenoxide which on acidification with dil.HCl gives phenol.

This method is called Dow's process.

40. a) The reduction of aldehydes and ketones into corresponding hydrocarbon on treatment with Zn amalgam and concentrated hydrochloric acid is called clemmenson reduction. During this reaction, the carbonyl group of aldehyde or ketone is reduced to –CH$_2$-group.

$$R-\overset{\overset{O}{\|}}{C}-R^1+4[H] \xrightarrow[\text{Conc. HCl}]{\text{Zn–Hg}} R-CH_2-R^1+H_2O$$

Example: $$CH_3-\overset{\overset{O}{\|}}{C}-H+4[H] \xrightarrow[\text{Conc. HCl}]{\text{Zn–Hg}} \underset{\text{Ethane}}{CH_3-CH_3}+H_2O$$

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3+4[H] \xrightarrow[\text{Conc. HCl}]{\text{Zn–Hg}} \underset{\text{Pr opane}}{CH_3-CH_2-CH_3}+H_2O$$
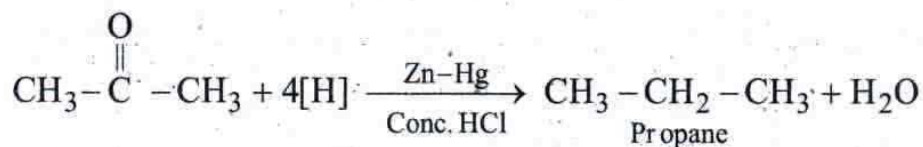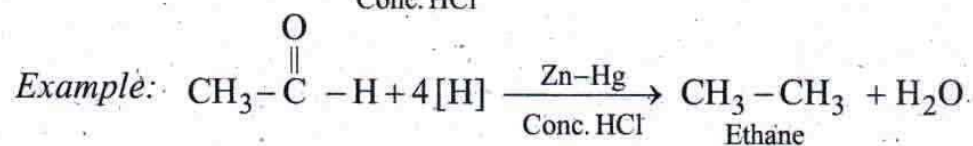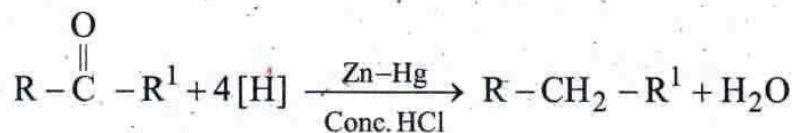
b) Carboxylic acids or sodium salts of carboxylic acids heated with sodalime (NaOH + CaO) to remove CO$_2$ and to form Hydrocarbon is called Decarboxylation.

i.e. $$R-COO-Na+NaOH \xrightarrow[\Delta]{CaO} \underset{\text{Hydro Carbon}}{R-H}+Na_2CO_3$$

Example: $CH_3COONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 \uparrow + Na_2CO_3$
Sod. acetate   Methane

$C_6H_5COONa + NaOH \xrightarrow[\Delta]{CaO} C_6H_6 + Na_2CO_3$
Sod. Benzoate   Benzene

c) Carboxylic acids have higher boiling points due to intermolecular hydrogen bonding.

41. a) i) $CH_3CH_2CH_2CH_2OH \xrightarrow[\text{Jones reagent}]{CrO_3\text{-}H_2SO_4} CH_3CH_2CH_2CCOH$
Butan-1-ol   Butanoic acid

ii)

Cyclohexene   Hexane-1, 6-dioic acid (Adipic acid)

iii) $CH_3CH_2CH_2CHO \xrightarrow[\text{(Tollens' reagent)}]{\text{Ammoniacal } AgNO_3} CH_3CH_2CH_2COOH$
Butanal   Butanoic acid

b) i) $R-COOH + PCl_5 \longrightarrow RCOCl + POCl_3 + HCl$

Example: $C_2H_5COOH + PCl_5 \longrightarrow C_2H_5COCl + POCl_3 + HCl$

ii) $3ROOH + PCl_3 \longrightarrow 3RCOCl + H_3PO_3$

iii) $R-COOH + SOCl_2 \longrightarrow RCOCl + SO_2 + HCl$

42. a)

b) The Cl^-, Br^- and CN^- nucleophiles can easily be introduced in the benzene ring in the presence of Cu(I) ion. This reaction is called Sandmeyer reaction.

$$C_6H_5 \overset{+}{N_2} Cl \underset{BDC}{}$$

$$\xrightarrow{Cu_2Cl_2/HCl} \underset{\text{Chlorobenzene}}{C_6H_5Cl} + N_2 \uparrow$$

$$\xrightarrow{Cu_2Br_2/HBr} \underset{\text{Bromobenzene}}{C_6H_5Br} + N_2 \uparrow$$

$$\xrightarrow{CuCN/KCN} \underset{\text{Cyanobenzene}}{C_6H_5 CN} + N_2 \uparrow$$

c) This is due to dispersal of the positive charge on the benzene ring.

43. a) Carbohydrates which reduces Felhing's solution and Tollen's reagent are called reducing sugars.

Examples: Glucose, Fructose, Lactose, Maltose

They contain free aldehydic or Ketonic group.

b) There are 2 types of secondary structure.

i) α -Helix structure   iii) β - pleated structure

α **-Helix structue:** The chain of α -amino acids coil into right handed helix (screw) due to hydrogen bonding.

β **-Pleated structure:** The peptide chains are streched out to the maximum extent and are laid side by side and are held together by inter molecular hydrogen bonds.

c) Because they are excreted in Urine. Therefore they are supplied regularly in the diet.

PART-E

VII44. 30% of Benzene in carbon tetrachloride $\Rightarrow$

Mass of Benzene = 30g   Molar mass of Benzene = 78 g mol⁻¹

Mass of CCl_4 = 70g   Molar mass of CCl_4 = 154 g mol⁻¹

Mass of solution = 100g

No of moles of Benzene $= \dfrac{\text{Mass}}{\text{Molar Mass}} = \dfrac{30}{78} = 0.385$

No of moles of CCl_4 $= \dfrac{\text{Mass}}{\text{Molar Mass}} = \dfrac{70}{154} = 0.455$

Mole fraction of Benzene $= \dfrac{\text{No. of moles of Benzene}}{\text{Total No. of moles in the solution}}$

$$= \frac{0.385}{0.455+0.385} = \frac{0.385}{0.840} = 0.458$$

Mole fraction of CCl_4 $= 1 - 0.458 = 0.542$

45. $n = \dfrac{1.0 g}{185,000 \, g \, mol^{-1}} = \dfrac{1}{185,000} mol$

$V = 450 \, mL = 0.450 \, L$

$T = 35^0 C = 37^0 C + 273 \, K = 310 \, K$

$R = 8.314 \times 10^3 \, Pa \, L \, K^{-1} \, mol^{-1}$

w.k.t $\pi = CRT$ **OR** $\pi = \dfrac{n}{V} RT$

$= \dfrac{1}{185000} mol \times \dfrac{1}{0.450 L} \times 8.314 \times 10^3 Pa.L.K^{-1}.mol^{-1} = 30.96 \, pa$

46. $A_m = \dfrac{k}{c} = \dfrac{4.95 \times 10^{-5} \, S \, cm^{-1}}{0.001028 \, mol^{-1}} \times \dfrac{1000 \, cm^3}{L} = 48.15 \, S \, cm^3 \, mol^{-1}$

$\alpha = \dfrac{\wedge_m}{\wedge_m^0} = \dfrac{48.15 \, S \, cm^2 \, mol^{-1}}{390.5 \, cm^2 \, mol^{-1}} = 0.1233$

$k = \dfrac{c\alpha^2}{(1-\alpha)} = \dfrac{0.001028 \, mol \, L^{-1} \times (0.1233)^2}{1 - 0.1233}$
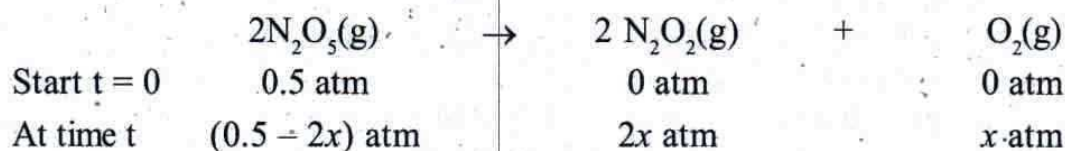
$= 1.78 \times 10^{-6} \, mol \, L^{-1}$

47. $\wedge_{m(HAc)}^0 = \lambda_{H^+}^0 + \lambda_{Ac}^0 = \lambda_{H^+}^0 + \lambda_{Cl^-}^0 + \lambda_{Na^+}^0 + \lambda_{AC^-}^0 - \lambda_{Na^+}^0 - \lambda_{Cl^-}^0$

$= \wedge_{m(HCl)}^0 + \wedge_{m(NaAc)}^0 - \wedge_{m(NaCl)}^0$

$= (425.9 + 91.0 - 126.4) \, S \, cm^2 \, mol^{-1}$

$= 390.5 \, S \, cm^2 \, mol^{-1}$

48. Let the pressure of $N_2O_5(g)$ decrease by $2x$ atm. As two moles of N_2O_5 decompose to give two moles of $N_2O_4(g)$ and one mole of $O_2(g)$, the pressure of $N_2O_4(g)$ increases by $2x$ atm and that of $O_2(g)$ increases by x atm.

$$2N_2O_5(g) \rightarrow 2\,N_2O_2(g) + O_2(g)$$

	$2N_2O_5(g)$	$2\,N_2O_2(g)$	$O_2(g)$
Start $t = 0$	0.5 atm	0 atm	0 atm
At time t	$(0.5 - 2x)$ atm	$2x$ atm	x·atm

$$p_t = p_{N_2O_5} + p_{N_2O_5} + p_{O_2}$$
$$= (0.5 - 2x) + 2x + x = 0.5 + x$$
$$x = p_t - 0.5$$
$$p_{N_2O_5} = 0.52x$$
$$= 0.52\,(p_t - 0.5) = 1.5 - 2p_t$$

$$p_{N_2O_5} = 1.5 - 2 \times 0.512 = 0.476 \text{ atm}$$

According to First order integrated equation,

$$k = \frac{2.303}{t} \log \frac{p_1}{p_A} = \frac{2.303}{100s} \log \frac{0.5 \text{ atm}}{0.476 \text{ atm}}$$

$$= \frac{2.303}{100\,s} \times 0.0216$$

$$= 4.98 \times 10^{-4} \text{ s}^{-1}$$

49. $T_1 = 30 + 273 = 303$ K; $T_2 = 40 + 273 = 313$ K; $Ea = ?$

$$\log \frac{k_2}{k_1} = \frac{Ea}{2.303R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$$

$$\log \frac{2.1 \times 10^{-3}}{1.2 \times 10^{-3}} = \frac{Ea}{2.303 \times 8.314} \left(\frac{313 - 303}{313 \times 303} \right)$$

$$\log \left(\frac{2.1}{1.2} \right) = \frac{Ea}{19.147} \left(\frac{10}{94839} \right)$$

$$\log 1.75 = \frac{Ea}{19.147} \times 0.0001051$$

$$\therefore Ea = \frac{\log 1.75 \times 19.147}{0.0001051} = 44276.4 \text{ J/mol} \quad \textbf{OR} \quad 44.2764 \text{ KJ/mol}$$

* * *

FREQUENTLY ASKED QUESTIONS

- Define the term Molarity (M).
- Define the term 'Molality' (m).
- State Henry's law. Write its Mathematical expression.
- State Raoult's law of liquid solutions.
- Mention any two differences between Ideal and non-Ideal solutions.
- What are azeotropic mixturs? Give example.
- What are isotonic solutions? Give an example.
- What are hypertonic solutions? Give an example.
- What are hypotonic solutions?
- What is reverse osmosis? Mention its use.
- What is the value of Van't Hoff factor (i) for the following:
    - (i) KCl solution   (ii) Ethanoic acid in Benzene
    - (iii) Aqueous $BaCl_2$ (iv) Benzoic acid in Benzene
- Explain the construction and working of a Standard Hydrogen Electrode.
- Write Nernst equation for a general electrochemical reaction, $aA + bB \xrightarrow{ne^-} cC + dD$.
- Mention the factors which affect conductivity of a solution.
- Define specific conductance OR Conductivity mention it's unit.
- State Kohlrausch law of independent migration of ions.
- Mention any two applications of Kohlrausch law.
- State Faraday's First law of electrolysis.
- State Faradays second law of electrolysis.
- Explain hydrogen-oxygen fuel cell (H_2–O_2 fuel cell).
- Distinguish between order and molecularity.
- Derive Integrated rate equation for rate constant of Zero order reaction.
- Derive integrated rate equation for the first order reaction.
- Show that Half life period for a zero order reaction is directly proportional to the initial concentration of the reactants OR Derive half life period expression for a zero order reaction.
- Derive an expression for half life period of a first order reaction. OR Show that half life period of a first order reaction is independent of initial concentration.
- What is a Pseudo first order reaction? Give example.
- Write Arrhenius Equation.
- Draw the energy distribution curve showing temperature dependence of rate of reaction and explain.
- What are the criteria/condition for the effective collisions between reactant molecules.
- Calculate the magnetic moment of the following ions in (aqueous) solution. Ti^{3+}, Ti^{2+}, V^{2+}, Cr^{2+}, Cr^{3+}, Fe^{3+}, Co^{3+}, Sc^{3+}, Cu^{2+}, Zn^{2+}
- Transition metals form large number of complex compounds. Give reason.
- Explain the catalystic properties of transition metals.
- How is potassium dichromate prepared from chromite ore?
- How is potassium permanganate prepared from MnO_2. Give equation.
- What is the cause for lanthanide contraction?

- Give any two consequences of lanthanoid contraction.
- Study of actinide elements is difficult. Give two reasons.
- Give (state) any three postulates of Werner theory of Co-ordination compounds.
- What are Homoleptic complexes? Give example.
- What are Heteroleptic complexes? Give example.
- What is denticity?
- What is Ionisation isomerism? Give example.
- What is linkage isomerism? Give example.
- What is solvate or Hydrate isomerism? Give example.
- Write the geometrical (cis and trans) isomers for $[Pt(NH_3)_2Cl_2]$ (diaminedichloridoplatinum(II)]
- Using VBT, explain the hybridisation, geometry and magnetic property of $[Co(NH_3)_6]^{3+}$ (hexaaminecobalt(III)ion)
- Using VBT, explain the hybridisation, geometrical shape and magnetic property of $[CoF_6]^{3-}$ (hexafluoridocobaltate(III)ion)
- On the basis of VBT, explain the hybridisation, geometrical shape and magnetic property of $[Ni(CN)_4]^{2-}$, tetracyanidonickelate(II) ion.
- Using VBT, explain the hybridisation, geometrical shape and magnetic property of $[NiCl_4]^{2-}$ or tetrachloridonickel(II) ion.
- Write the energy level diagram for d-orbital splitting in octahedral complex.
- Write energy level diagram for d-orbitals splitting in tetrahedral crystal field.
- Finkelstein reaction. ❖ Swarts reaction.
- What is Swart's reaction? Give example.
- Explain S_N2 mechanism or explain the mechanism involved in the conversion of chloromethane (methyl chloride) into methanol (methyl alcohol).
- Explain the mechanism of S_N1 reaction or explain the mechanism involved in the conversion of tertiary butyl bromide into tertiary alcohol.
- What is a Racemic mixture? ❖ What is racemization?
- What are enantiomers? ❖ State Saytzeff's rule (Zaitsev)& Give an example.
- Explain Friedel-crafts Alkylation reaction.
- Explain Wurtz-Fittigs reaction? Give example.
- Explain Fittig's reaction with example.
- Give the manufacture of phenol from Cumene. (Isopropyl benzene)
- How do you convert benzene to phenol. OR How do you convert benzene sulphonic acid to benzene.
- Phenols are stronger acids than alcohols. Give reason.
- What is Lucas reagent? How does it is used to distinguish primary alcohols and tertiary alcohols?
- Explain the mechanism of dehydration of ethanol to ethene.
- Explain Kolbe's reaction or How do you convert phenol to salicylic acid by Kolbe's reaction.
- What is Reimer-Tiemann's reaction? Explain.
- Explain Williamson's synthesis of ethers? Give an example.
- What is Etard's reaction? Explain.

- ❖ Explain Gatterman-Koch reaction. Give example. OR How would you convert Benzene to Benzaldehyde. Give equation.
- ❖ Explain mechanism of addition of HCN to aldehyde or ketone.
- ❖ What is cannizzaro's reaction? Give an example.
- ❖ The P^{ka} values of formic acid, acetic acid, benzoic acid are 3.75, 4.76 and 4.19 respectively. Arrange them in the increasing order of acidic strength.
- ❖ Explain Hell-Volhard-Zelinsky reaction (Halogenation) with equation.
- ❖ What is decarboxylation? Give an example.
- ❖ Explain esterification reaction. Give an example.
- ❖ Explain Hoffmann bromamide degradation method to prepare primary amines.
- ❖ Explain the preparation of   (i) Methanamine. (ii) Aniline by Hofmann Bromamide reaction. Give chemical equation for the reaction.
- ❖ Aromatic amines are weaker bases than ammonia. Give reason.
  OR Aniline is weaker base than ammonia. Give reason.
- ❖ The p^{Kb} values of Ammonia, Methanamine and benzanamine (Aniline) are 4.75, 3.38 and 9.38 respectively. Arrange them in the increasing order of their basic strength.
- ❖ Explain carbyl amine reaction with an example.
- ❖ Explain Sandmeyers reaction with an example.
- ❖ Explain the preparation of Benzene diazonium Chloride.
- ❖ What are non-reducing sugars? Give example.
- ❖ How does glucose reacts with hydrogen iodine ? OR How do you show that glucose contains 6 carbon atoms in a straight chain?
- ❖ How does glucose reacts with hydroxyl amine. OR How do you confirm presence of carboxyl group ($>C=0$) group in Glucose.
- ❖ How does glucose reacts with bromine water? OR Write the reaction to show that carboxyl group in glucose is an aldehydic group OR How do you show that glucose contains aldehydic group?
- ❖ How does glucose reacts with acetic anhydride? OR How do you show that glucose contains 5–OH groups.
- ❖ Write the Haworth's structure of Maltose.
- ❖ Write the Haworth's structure of Lactose.
- ❖ What are essential and non essential amino acids? Give examples.
- ❖ What is a Zwitter ion? Write the Zwitter ion structure for a α – amino acid.
- ❖ Write a note on proteins based on molecular shape.
- ❖ Mention the sources and deficiency diseases caused by different types of vitamins.
- ❖ Explain denaturation of proteins.
- ❖ Name the pyramidine base present in DNA only but not in RNA.
- ❖ Name the pyramidine base present in RNA but not in DNA.
- ❖ What are Hormones? Give examples.
- ❖ Give the functions of the following Hormones.
  i) Insuline   ii) Glucagon   iii) Thyroxine   iv) Epinephrine
  v) Estrogens and androgens   vi) Mineral corticoids
  vii) Oxytocin   viii) Glucocorticoids ix) Testosterone   x) Estradiol
  xi) Progesteronone