2023-24 II PUC ANNUAL EXAMINATION
CHEMISTRY

PART – A

I. Select the correct option from the given choices: (15 × 1 = 15)

1. If the process of dissolution of a solid in liquid is an endothermic, its solubility:
   a) decreases with increase in temperature
   b) remains same at all temperature
   c) increase with increase in temperature
   d) increase with decrease in temperature

   Ans : c) increase with increase in temperature

2. When the concentration of electrolytic solution approaches zero, the resulting molar conductivity is known as:
   a) specific conductance
   b) resistivity
   b) conductivity
   d) limiting molar conductivity

   Ans : d) limiting molar conductivity

3. During discharging of lead storage battery the correct half-cell reaction is;
   a) At anode, Pb is converted into PbO_2
   b) At anode, Pb is converted into $PbSO_4$
   c) At anode, PbO_2 is converted into $PbSO_4$
   d) At cathode, Pb is converted into $PbSO_4$

   Ans : b) At anode, Pb is converted into $PbSO_4$

4. The catalyst in a chemical reaction provides an alternate pathway or reaction mechanism by decreasing ;
   a) Activation energy
   b) Kinetic energy
   c) Normal energy of reacting species
   d) Potential energy

   Ans : a) Activation energy

5. Which of the following pair of metal oxides are amphoteric?
   a) V_2O_5, Cr_2O_3
   b) Mn_2O_7, CrO_3
   c) V_2O_5, V_2O_4
   d) CrO, V_2O_5

   Ans : a) V_2O_5, Cr_2O_3

6. The correct IUPAC name of $[Pt(NH_3)_2Cl_2]$ is ;
   a) Diamminedichloridoplatinum (II)
   b) Dichloridodiammineplatinum (0)
   c) Dichloridodiammineplatinate (II)
   d) Diamminedichloridoplatinate (0)

   Ans : a) Diamminedichloridoplatinum (II)

7. The stereoisomers related to each other as non-superimposable mirror images are called ;
   a) Enantiomers   b) Diastereomers   c) Anomers   d) Racemic mixture

   Ans: a) Enantiomers

8. Anisole on treatment with CH_3Cl in the presence of anhydrous $AlCl_3$ gives ;
   a) Toluene   b) o – Chloroanisole
   c) ortho and para-methylanisoles   d) p – chloroanisole

   Ans : c) ortho and para-methylanisoles

9. The enzyme which can catalyse the conversion of glucose to ethanol is ;
   a) Invertase   b) Maltase   c) Zymase   d) Sucrase

   Ans : c) Zymase

10. Nucleophilic attack on carbonyl carbon atom changes its hybridization from ;
    a) sp to sp^2 b) sp^2 to sp^3 c) sp^3 to sp^2 d) sp to sp^3

    Ans : b) sp^2 to sp^3

11. Decarboxylating reagent is a mixture of
    a) Alc. KOH + H_2O_2 b) NaOH + CO_2
    c) NaOH + CaO   d) Conc. HCl + $ZnCl_2$

    Ans : c) NaOH + CaO

12. To prepare p-Nitroaniline as a major product from aniline, the amino group is protected by ;
    a) Acetylation   b) Alkylation   c) Saponification   d) Sulphonation

    Ans : a) Acetylation

13. The reagent used to separate the mixture of methylamine and dimethylamine are ;
    a) $CHCl_3$ and HCl   b) $C_6H_5SO_2Cl$ and KOH
    c) $C_6H_5SO_2Cl$ and HCl   d) $CHCl_3$ and KOH

    Ans : b) $C_6H_5SO_2Cl$ and KOH

14. The carbohydrate which is also known as animal starch and stored in animal body is ;
    a) Starch   b) Sucrose   c) Glycogen   d) Cellulose

    Ans : c) Glycogen

15. Which vitamin deficiency causes the disease cheilosis?
    a) Vitamin B_1 b) Vitamin B_2 c) Vitamin B_6 d) Vitamin B_{12}

    Ans : b) Vitamin B_2

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

[ionic charge, Grignard reagent, $C_6H_5N_2^+Cl^-$, Collision frequency, Molality, Molarity]

16. The number of moles of solute present in one kilogram of the solvent is called _____.

   Ans : Molality

17. The number of collisions per second per unit volume of the reaction mixture is known as _____.

   Ans : Collision frequency

18. Transition metals form large number of complex compounds due to high _____ .

   Ans : ionic charge

19. The common name of alkyl magnesium halide is _____ .

   Ans : Grignard reagent

20. The formula of benzenediazonium chloride is _____ .

   Ans : $C_6H_5N_2^+Cl^-$

PART – B

III. Answer any three of the following. Each question carries 2 marks: **(3 × 2 = 6)**

21. **What type of deviation from Raoult's law is observed, when equal volume of ethanol and acetone are mixed together? Mention the reason for it.** **(2)**
   Ans :
   Positive deviation from Raoult's law.

   Because: Force of attraction between ethanol and acetone molecules is less than that of ethanol – ethanol & acetone – acetone molecules.

22. **Mention any two differences between order and molecularity of a reaction.** **(2)**
   Ans :

Molecularity	Order
It can be calculated by adding the molecules of the slowest step in the reaction mechanism	It can be determined experimentally only and cannot be calculated
It cannot be zero or fraction.	It can be zero as well as fraction.

23. **a) What is spectrochemical series?** **(1)**
   Ans :
   Arrangements of ligands in a series in the order of increasing field strength.

   b) **Between [Co(en)₃]³⁺ and [Co(NH₃)₆]³⁺ complex ions which is more stable?** **(1)**
   Ans :
   [Co(en)₃]³⁺

24. **Write the IUPAC name of product obtained when ethylbromide reacts with sodium iodide in dry acetone. Name the reaction.** (2)
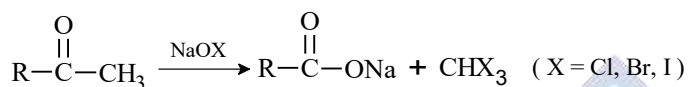
Ans :

Iodoethane, Finkelstein reaction.

25. **Explain Haloform reaction with chemical equation.** (2)

Ans :

Aldehydes and ketones having at least one methyl group linked to the carbonyl carbon atom (methyl ketones) are oxidised by sodium hypohalite to sodium salts of corresponding carboxylic acids having one carbon atom less than that of carbonyl compound. The methyl group is converted to haloform.

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

26. **Name two hormones which regulate the glucose level in the blood.** (2)
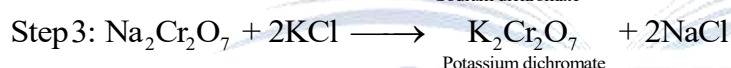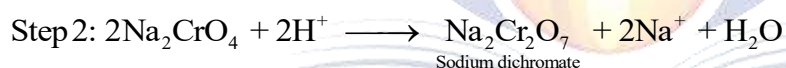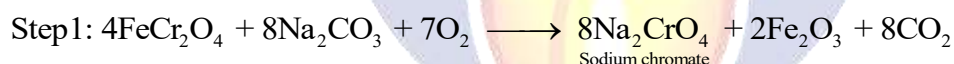
Ans :

Insulin

Glucagon

PART – C

IV . Answer any three of the following. Each question carries 3 marks : $(3 \times 3 = 9)$

27. **Write the balanced chemical equations in the manufacture of potassium dichromate from chromite ore.** (3)

Ans :

$$\text{Step1: } 4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \longrightarrow \underset{\text{Sodium chromate}}{8Na_2CrO_4} + 2Fe_2O_3 + 8CO_2$$

$$\text{Step 2: } 2Na_2CrO_4 + 2H^+ \longrightarrow \underset{\text{Sodium dichromate}}{Na_2Cr_2O_7} + 2Na^+ + H_2O$$

$$\text{Step 3: } Na_2Cr_2O_7 + 2KCl \longrightarrow \underset{\text{Potassium dichromate}}{K_2Cr_2O_7} + 2NaCl$$

28. **a) give a reason for each of the following :**

i) The spin only magnetic moment of Sc^{3+} is zero. (1)

Ans :

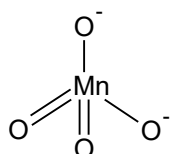due to the absence of unpaired electrons

ii) Alloys are readily formed by transition metals. (1)

Ans :

Because of similar radii and other characteristics of transition metals.

b) Write the structure of manganate ion $\left(MnO_4^{2-} \right)$. (1)

Ans :

29. **What is Lanthanoid Contraction? Mention two consequences of it.** (3)

Ans :

Lanthanoid contraction:

Regular decrease (contraction) in the atomic and ionic radii of lanthanoids with increasing atomic number is known as lanthanoid contraction.
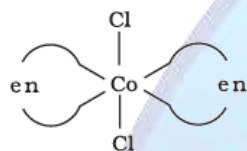
Consequences:

1. The radii of 3rd row transition series elements are almost similar to that of 2nd row transition series elements.

2. The separation of lanthanoids in pure state becomes difficult.

30. **a) Draw the geometrical isomers of $\left[CoCl_2 \left(en \right)_2 \right]$.** (2)

Ans :
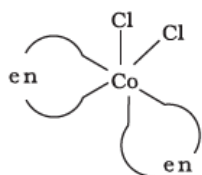
Cis isomer   trans isomer

b) Give an example for ambidentate ligand. (1)

Ans :

SCN$^-$

31. **On the basis of Valence Bond Theory [VBT], explain geometry, hybridisation and magnetic property of $\left[Co \left(NH_3 \right)_6 \right]^{3+}$ ion. [Atomic number of cobalt is 27)** (3)
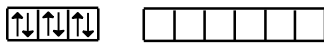
Ans :

$[Co(NH_3)_6]^{3+}$

Central metal ion : Co^{3+}

Electronic configuration of Co^{3+}: $[Ar]\ 3d^6$

Orbitals of Co^{3+} ion

3d   4s   4p

d^2sp^3 hybridised Orbitals of Co^{3+} ion

3d d^2sp^3 hybrid

$[Co(NH_3)_6]^{3+}$

inner orbital complex or low spin complex

3d   six pairs of electrons from six NH$_3$ molecules

Magnetic property : Diamagnetic
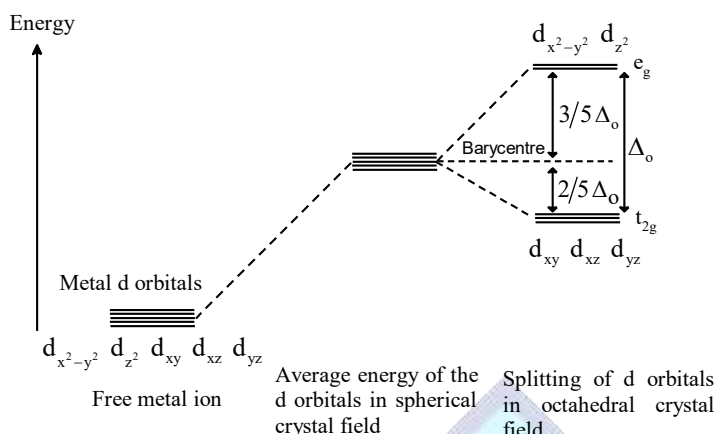
Hybridisation : d^2sp^3

Geometry : Octahedral

Nature of complex : Inner orbital complex or low spin complex or spin paired complex

32. **a) Draw the energy level diagram for the splitting of d- orbitals in an octahedral crystal field.** **(2)**

Ans :

b) If $\Delta_0 < P$, on the basis of crystal field theory [CFT]. Write the electronic configuration of

d^4 - ion in octahedral complexes. **(1)**

Ans :

$t_{2g}^3 \ e_g^1$

V. Answer any two of the following. Each question carries 3 marks. $(2 \times 3 = 6)$

33. **a) What is reverse osmosis? Mention one of its application.** **(2)**

Ans :

The direction of osmosis can be reversed if a pressure larger than the osmotic pressure is applied to the solution side. This phenomenon is called **reverse osmosis.**

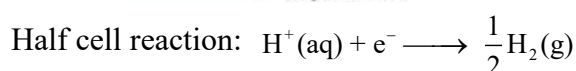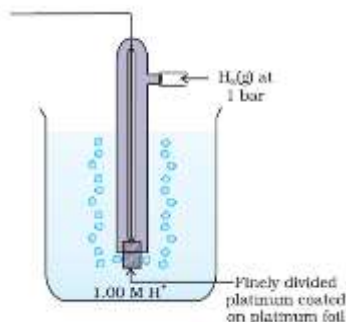Reverse osmosis is used in desalination of sea water.

b) State Henry's Law. **(1)**

Ans :

"The partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution"
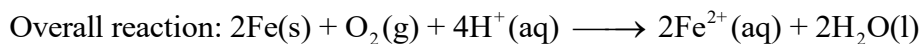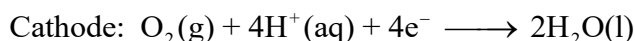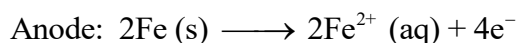
34. **Draw a neat labelled diagram of Standard Hydrogen Electrode (SHE). Write its half – cell reaction.** **(3)**

Ans :

Half cell reaction: $H^+(aq) + e^- \longrightarrow \frac{1}{2} H_2(g)$

35. **Write the anodic, cathodic and overall reactions of corrosion of iron occurs in the presence of water and air.** (3)

Ans :

Anode: $2Fe\,(s) \longrightarrow 2Fe^{2+}\,(aq) + 4e^-$

Cathode: $O_2\,(g) + 4H^+\,(aq) + 4e^- \longrightarrow 2H_2O(l)$

Overall reaction: $2Fe(s) + O_2\,(g) + 4H^+\,(aq) \longrightarrow 2Fe^{2+}\,(aq) + 2H_2O(l)$

36. **Derive integrated rate equation for rate constant of a zero order reaction.** (3)

Ans :

Zero order reaction means that the rate of the reaction is proportional to zero power of the concentration of reactants.

Consider the reaction, $R \longrightarrow P$

$\text{Rate} = -\dfrac{d[R]}{dt} = k[R]^0 \qquad [R]^0 = 1$

$\text{Rate} = -\dfrac{d[R]}{dt} = k$

$d[R] = -kdt$

Integrating both sides

$[R] = -kt + I ----(1)$

Where, I is the constant of integration.

At t = 0, the concentration of the reactant $R = [R]_0$, Where $[R]_0$ is the initial concentration of the reactant.

Equation (1) becomes

$[R]_0 = -k \times 0 + I$

$I = [R]_0$

Substituting value of I in equation (1)

$[R] = -kt + [R]_0 ----(2)$

$kt = [R]_0 - [R] ----(3)$

$k = \dfrac{[R]_0 - [R]}{t} ----(4)$

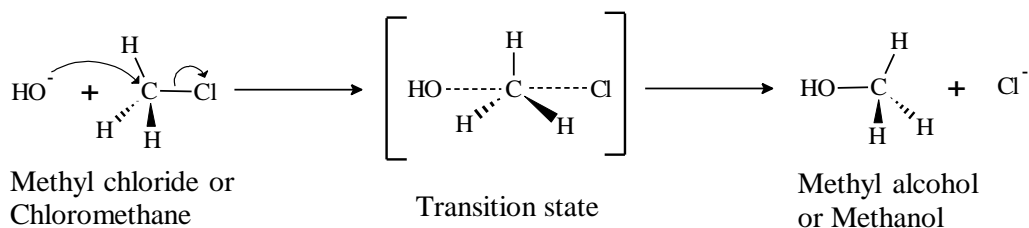Equation (4) is the rate constant expression for zero order reaction.

PART – D

VI . Answer any four of the following. Each question carries 5 marks: $(4 \times 5 = 20)$

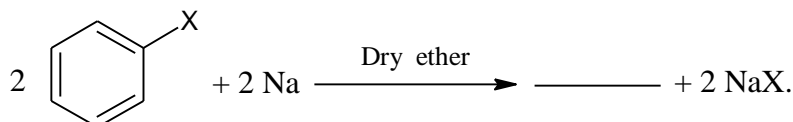37. **a) Write the mechanism for the conversion of methyl chloride to methyl alcohol . Mention the order.** (3)
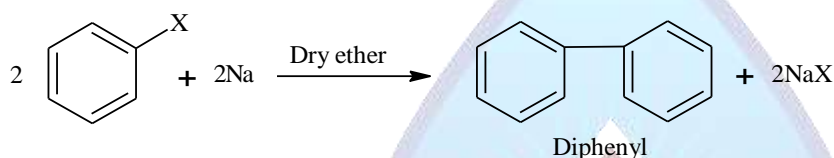
Ans :

It follows second order kinetics.

Methyl chloride or Chloromethane — Transition state — Methyl alcohol or Methanol

b) complete the following equation :

i)

$$2 \; \text{C}_6\text{H}_5\text{X} + 2\,\text{Na} \xrightarrow{\text{Dry ether}} \underline{\hspace{2cm}} + 2\,\text{NaX}.$$

(1)

Ans :

Diphenyl
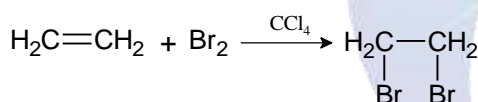
ii) $H_2C{=}CH_2 + Br_2 \xrightarrow{CCl_4}$
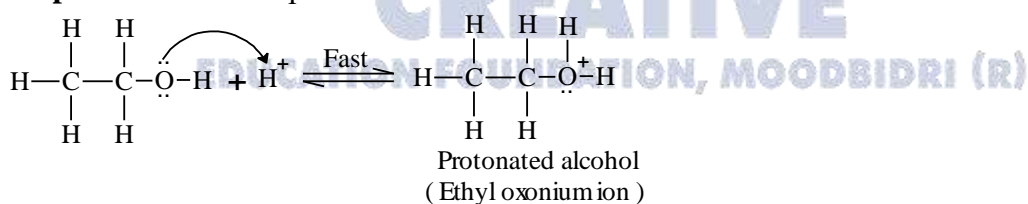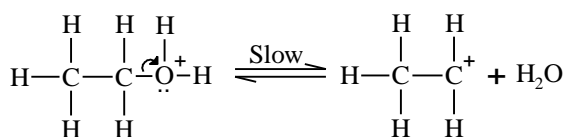
(1)

Ans :

38. **a) Write the steps involved in the mechanism of acid catalysed dehydration of ethanol to ethene.**

(3)

Ans :

Step 1: Formation of protonated alcohol.

Protonated alcohol
(Ethyl oxonium ion)

Step 2: Formation of carbocation: It is the slowest step and hence, the rate determining step of the reaction.

Step 3: Formation of ethene by elimination of a proton.

Ethene
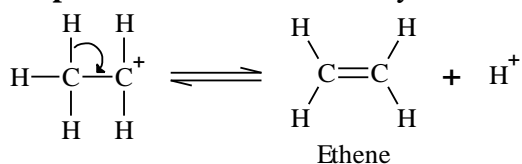
b) What is Lucas reagent? Which class of alcohols does not produce turbidity with it at room temperature? **(2)**
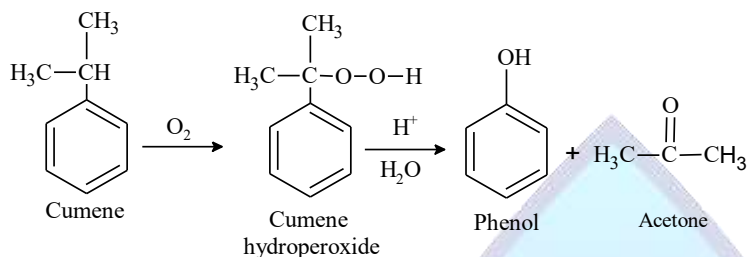
Ans :

Lucas reagent: Mixture of Conc.HCl and anhydrous $ZnCl_2$.

Primary alcohols does not produce turbidity with it at room temperature

39. **a) Write the chemical equations in the manufacture of phenol by cumene process.** **(2)**
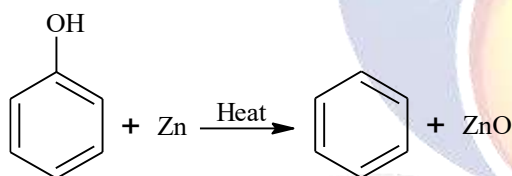
Ans :

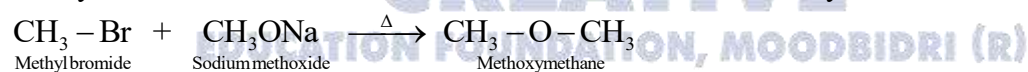**b) Complete the equation.** **(1)**

Ans :

c) Explain Williamson's reaction for the preparation of methoxymethane. **(2)**

Ans :

Methyl bromide reacts with Sodium methoxide to form Methoxymethane.

$$\underset{\text{Methyl bromide}}{CH_3-Br} + \underset{\text{Sodium methoxide}}{CH_3ONa} \xrightarrow{\Delta} \underset{\text{Methoxymethane}}{CH_3-O-CH_3}$$
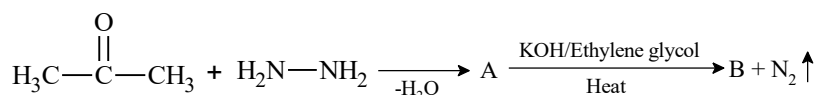
40. **a) How does methanal reacts with hydroxylamine? Explain with equation.** **(2)**

Ans :

Methanal reacts with hydroxylamine to form oxime.

$$HCHO + NH_2OH \longrightarrow \underset{\text{Oxime}}{H_2C=N-OH} + H_2O$$
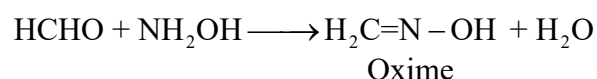
b) Identify A and B in the following reaction. **(2)**

Ans:

$$A = \underset{H_3C}{\overset{H_3C}{>}}C=N-NH_2 \qquad B = CH_3CH_2CH_3$$

Hydrazone   Propane
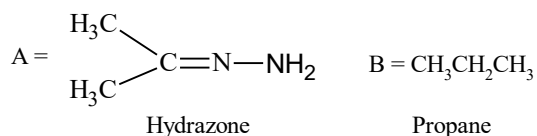
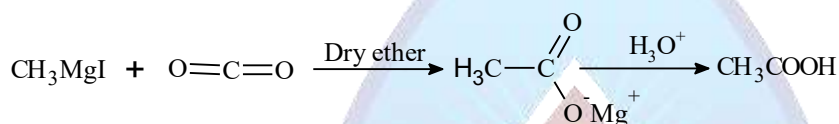**c) Write any one reagent used to distinguish between aldehyde and ketone.** (1)

Ans :

Tollens' reagent

41. **a) When methyl magnesium iodine reacts with dry ice forms an intermediate, which on acidification gives compound 'A'**

   i)   Write the equation for the above chemical reaction. (2)

   Ans:

$$CH_3MgI + O=C=O \xrightarrow{Dry\ ether} H_3C-\underset{O^-Mg^+}{\overset{O}{\underset{|}{C}}}\xrightarrow{H_3O^+} CH_3COOH$$

   ii)   Write the IUPAC name of compound 'A". (1)

   Ans:

   Ethanoic acid

   b) Between acetic acid and monochloroacetic acid, which is more acidic? Give reason. (2)
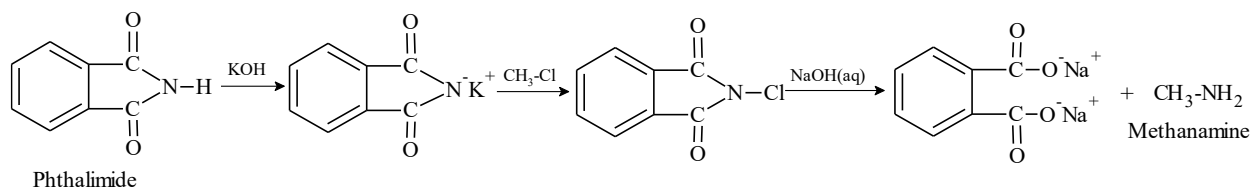
   Ans:

   Monochloroacetic acid is more acidic

   Reason: Chlorine in monochloroacetic acid increase the acidity by stabilising the conjugate base.

42. **a) Write the chemical equations involved in the Gabriel phthalimide synthesis of methanamine.** (3)

   Ans:

Phthalimide ... KOH ... + CH₃-Cl ... NaOH(aq) ... + CH₃-NH₂ Methanamine

   b) Explain the coupling reaction of benzene diazonium chloride with phenol using chemical equation. (2)

   Ans:
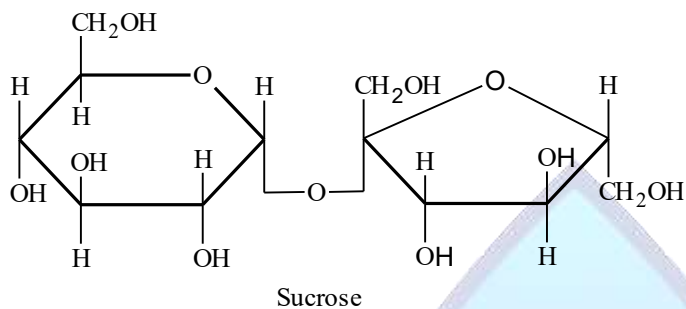
   Benzene diazonium chloride reacts with phenol to give azo dyes. These reactions are called coupling reactions.

$$\underset{\text{Benzenediazonium chloride}}{} N_2^+Cl^- + H-OH \xrightarrow{\text{OH}^-} N=N OH + Cl^- + H_2O$$

Benzenediazonium chloride   p-Hydroxyazobenzene
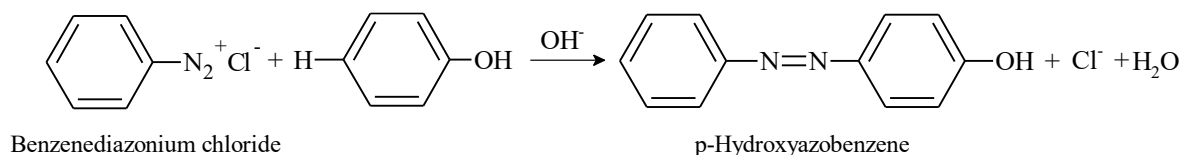
43. a) Write the Haworth structure of sucrose? **(2)**

Ans:

Sucrose

b) i) What are essential amino acids? **(1)**

Ans:

Amino acids which cannot be synthesised in the body and must be obtained through diet, are known as **essential amino acids.**

ii) Give an example for fibrous proteins. **(1)**

Ans:

Keratin, myosin.

c) Name the nitrogenous base present in DNA but not in RNA. **(1)**

Ans:

Thymine

PART – E

VII. Answer any three of the following. Each question carries 3 marks: $(3 \times 3 = 9)$

44. Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.

[Given Molar mass of Benzene = 78 g/mol, Molar mass of carbon tetrachloride = 154 g/mol]

Ans:

$$X_{C_6H_6} = \frac{n_{C_6H_6}}{n_{C_6H_6} + n_{CCl_4}}$$

30 g benzene   70 g CCl_4

$M_{C_6H_6} = 78$ g/mol $M_{CCl_4} = 154$ g/mol

$$n_{C_6H_6} = \frac{30}{78} \qquad n_{CCl_4} = \frac{70}{154}$$
$$= 0.384 \qquad\qquad = 0.454$$

$$X_{C_6H_6} = \frac{0.384}{0.384 + 0.454}$$

$$= \frac{0.384}{0.838} = 0.458$$

45. 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. The freezing point depression constant of benzene is 5.12 K kg mol^{-1}. Find the molar mass of the solute.
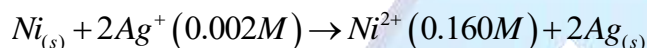
Ans:

$W_2 = 1.00$ g $W_1 = 50$ g

$\Delta T_f = 0.40$ K $K_f = 5.12$ K kg mol^{-1}

$$M_2 = \frac{K_f \times W_2 \times 1000 \, g \, kg^{-1}}{\Delta T_f \times W_1}$$

$$= \frac{5.12 \, K \, kg \, mol^{-1} \times 1.00 \, g \times 1000 \, g \, kg^{-1}}{0.40 \, K \times 50 \, g}$$

$$= \frac{5120}{20} = 256 \, g \, mol^{-1}$$

46. 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 $E^0_{cell} = 1.05V$ **at 298 K.**

Ans:
Given,

$E^\circ_{cell} = 1.05$ V

$$E_{cell} = E^\circ_{cell} - \frac{0.059}{2} \log \frac{[Ni^{2+}]}{[Ag^+]^2}$$

$$= 1.05 - \frac{0.059}{2} \log \frac{(0.160)}{(0.002)^2}$$

$$= 1.05 - \frac{0.059}{2} \log \left(\frac{(16 \times 10^{-2})}{(2 \times 10^{-3})^2} \right)$$
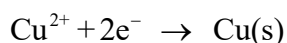
$$= 1.05 - 0.0710$$

$$= 0.979 \text{ V}$$

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?
[Molar mass of copper = 63 g/mol. 1F = 96487C]
Ans:

$Q = I \times t$

$I = 1.5 \times 10 \times 60 = 900$ C

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

$2 \times 96487 C \rightarrow 63 g$

$900 \text{ C} \rightarrow ?$

$$= \frac{900 \times 63}{2 \times 96487} = 0.2938 \text{ g}$$

48. A first order reaction has a rate constant $1.15 \times 10^{-3} \, s^{-1}$. **How long will 5 g of this reactant take to reduce to 3 g?**

Ans:

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

$$t = \frac{2.303}{1.15 \times 10^{-3}} \log \frac{5}{3}$$

$$= 2.002 \times 10^3 \times 0.2218$$

$$= 0.444 \times 10^3$$

$$= 444 \text{ s}$$

49. The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. calculate the E_a of the reaction assuming that it does not change with temperature.

Ans:

$$\log \frac{k_2}{k_1} = \frac{Ea}{2.303 \, R} \left[\frac{T_2 - T_1}{T_1 T_2} \right]$$

$$\log 4 = \frac{Ea}{2.303 \times 8.314} \left[\frac{313 - 293}{293 \times 313} \right]$$

$$0.6020 = \frac{Ea}{19.147} \left[\frac{20}{91709} \right]$$

$$Ea = \frac{0.6020 \times 19.147 \times 91709}{20} = 52854 \text{ J/mol}$$

$$= 52.854 \text{ kJ/mol}$$

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