

CHAPTER 1: SOLID STATE

3 MARKS QUESTION

Q.1. Calcium metal crystallises in a fcc lattice with edge length of 0.556nm calculate the density of the metal if it contains , (i) 0.5% frenkel defect (ii) 0.2% schottky defect.

A.1 (i) $d = 1.5458 \text{ g cm}^{-3}$ (ii) 1.5427 g cm^{-3}

Q.2. How is ferromagnetism different from paramagnetism & antiferromagnetism & explain what type substances show antiferromagnetism.

A.2 Attracted strongly by magnetic field , paramagnetic substances are weakly attracted, antiferromagnetic substances not attracted

Q.3. What is electrical conductivity due to in (i) metals (ii) ionic solids (iii) semiconductors

A.3:

a. due to flow of electrons

b. flow of ions in solution or melt and defects in solid

c. due to presence of impurities and defects

Q.4. What is the difference between schottky defect & frenkel defect .

A.4: Schottky defect- vacancy defect, density lowers frenkel defect- interstitial defect density is not affected.

Q.5. Derive an expression for the calculation of density of the cubic crystal of an element whose edge is "a" pm & atomic mass is M

A.5. $\text{density} = \frac{Z \cdot M}{a^3 \cdot N_A}$

Q.6. How would account for the following

a. Frenkel defects are not found in alkali metal halides.

b. schottky defects lower the density of related solids.

c. impurity doped silicon is a semiconductor .

A.6 (i) similar size of cations and anions (ii) equal no of cations and anions are missing results into decrease in mass (iii) due to presence of free electrons or creation of positive hole.

Q.7. Define the following terms in relation to crystalline solids

a. Unit cell

b. coordination number

c. P- type semiconductor

A.7 (i) it is the smallest portion of the crystal lattice which when repeated in all directions gives the entire lattice. (ii) Number of nearest neighbour (iii) gr-14 doped with gr-13 creates positive hole.

Q.8. What type of defect can arise when solid is heated? Which physical property is affected by it & in what way?

A.8. Vacancy defect, density decreases because some atoms , ions leave the crystal completely

Q.9. An element has bcc structure with cell edge of 288pm .The density of the element is 7.2 gm/cm³. How many atoms are present in 208 gm of the element?

A.9. $M = 51.8 \text{ gmol}^{-1}$ no of atoms = 24.16×10^{23}

Q.10. (I) Solid A is very hard , electrical insulator in solid as well as molten state & melt at extremely high temprature what type of solid is it ?

(II) A compound forms hcp structure. What is the total no of voids in 0.5 mol of it? How many of these are tetrahedral voids ?

A.10. i) covalent network solid , silicon carbide ii) no of o.v =0.5 mol no of t.v =1.0 mol total voids =1.5Mol

Solid State

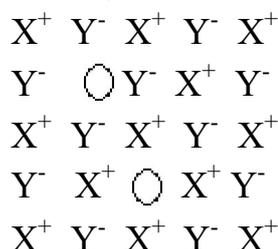
3 Marks questions

Q.1:- Iron has body centred cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.874 gm/cm³. Use this information calculate Avogadro's number.
(At mass 56 of Iron)

Q.2:- Iron (II) oxide has a cubic structure and each side of unit cell is 5 Å. If density of the oxide is 4 gm/cm³, Calculate the number of Fe⁺² and O⁻ ion present in the each unit cell.(At mass of Fe=56, O=16, N_A=6.022 x 10²³)

Q.3:- An element occurs in bcc structure. It has a cell edge length of 250 pm. Calculate the molar mass if its density is 8.0 gm/cm³. Also calculate the radius of an atom of element.

Q.4:- Examine the given defective crystal -



Answer the following questions -

- Is the above defect stoichiometric or non-stoichiometric.
- What is this defect called ? Give one example .
- How does this defect affect the density of the crystal .

Q.5:- Answer these -

- What type of stoichiometric defect shown by KCl .
- What type of semi conductor is formed when silicon doped with As.
- What type substances would make better magnets ferromagnetic or ferrimagnetic.

Q.6:- (a) What type of semi conductor is obtained when silicon is doped with boron?

(b) What type of magnetism is shown in the following alignment of magnetic moments.

(c) What type of point defects are produced when AgCl is doped with CdCl₂ ?

Q.7:- An element has a body centred cubic (bcc) structure with a cell edge of 288 pm.

The density of the element is 7.2 gm/cm³. How many atoms are present in 208 gm. of the element.

Q.8:- A sample of ferrous oxide has actual formula Fe_{0.93}O_{1.00}. In this sample what fraction and percentage of metal ions are Fe⁺² ions ? What type of nonstoichiometric defect is present in this sample.

Q.9:-Copper crystalizes with face-centred cubic unit cell. If the radius of copper atom is 127.8 pm. Calculate density of copper metal.

Q.10:-Differentiate Schottky and Frenkel defect.

OR

Differentiate n-type and p-type semi conductor.

UNIT 1 SOLID STATE
SHORT ANSWER QUESTIONS (3MARKS)

Q1. What is the difference between Schottky and Frankel defect?

Ans1.

Serial no.	<i>Schottky defect</i>	<i>Frankel defect</i>
1.	It decreases the density of the crystal.	It does not decrease the density of the crystal.
2.	It occurs in compounds with high Co-ordination number.	It occurs in compounds with low number.
3.	It occurs in compounds in which cations and anions are of similar size. Examples: NaCl, KCl, KBr, CsCl.	It occurs in compounds in which cations and anions differ in their size to a large extent. Examples: ZnS, AgCl, AgBr, AgI.

Q.-2 A metal crystallises into two cubic phases, fcc and bcc, whose unit lengths are 3.5 and 3.0Å^o respectively. Calculate the ratio of the densities of fcc and bcc.

A-2 $d \propto \frac{Z}{a^3}$

for fcc, Z = 4 for bcc, Z = 2 then

$$\frac{dfcc}{dbcc} = \frac{Zfcc}{a^3fcc} \times \frac{a^3bcc}{Zbcc} = \frac{4}{2} \left(\frac{3}{3.5} \right)^3 = 1.26$$

Q.3 In corundum, oxide ions are arranged in hcp arrangement and the aluminium ions occupy 2/3 of the octahedral voids. What is the formula of corundum.

A-3 Number of oxide Ions = 8 x 1/8 = 1 per unit cell

Number of Al ions = 2/3

formula Al_{2/3} O or Al₂ O₃

OR

Rank of hcp = 6 = No. of octahedral voids.

$$\text{No. of Al ions} = 6 \times \frac{2}{3} = 4$$

Formula Al_4O_6 or Al_2O_3 .

Q4. Explain why?

(i) Conductivity of metals decreases with increase in temperature.

(ii) Conductivity of semiconductors increases with increase in temperature.

A-4. (i) The conductivity of metals is due to the migration of free mobile electrons under the influence of applied potential difference. This migration of electrons is hindered to some extent by the lattice vibrations. At low temperature, lattice vibrations are quite insignificant, and as such metals are excellent electric conductors at low temperature. But with the rise of temperature lattice vibrations increases due to thermal energy and as such migration of electrons is hindered. Therefore, electrical conductivity of metals decreases with rise in temperature.

(ii) Electrons and holes produced by the ionisation or defects contribute to the electronic conduction of semiconductors. Unlike metals, the conductivity of semiconductors increases with increase in temperature. This can be explained as follows. In semiconductors electrons are bound rather tightly to local centres at room temperature. When temperature is raised these electrons are freed and are now able to move through the crystal. The higher the temperature, the greater the number of electrons freed. Due to greater number of free electrons the conductivity increases even though lattice vibrations offer more resistance at the higher temperature.

Q-5 Given that for Fe, $a=286 \text{ pm}$; $d=7.86\text{g/cm}^3$. Find the type of the cubic lattice to which the crystal of iron belongs to. Also calculate the radius of Fe atom.

A-5. $d = Z \times M / a^3 N_0$

$$Z = d / a^3 N_0 M$$

$$= \frac{(7.86 \text{ g cm}^{-3}) \times (286 \times 10^{-10} \text{ cm})^3 \times (6.02 \times 10^{23})}{55.85 \text{ g mol}^{-1}}$$

$$= 2$$

Since the no. of the atoms in the unit cell is 2, it is therefore body-centered cubic structure.

For the body centered cubic structure, the radius of the atom

$$r = \frac{\sqrt{3}}{4} a = \frac{\sqrt{3}}{4} \times 286 \text{ pm} = 123.80 \text{ pm}$$

Q-6. Chromium metal crystallizes with a body-centered cubic lattice. the length of the unit cell edge is found to be 287 pm. calculate the atomic radius. What would be the density of chromium in g/cm^3 ?

A-6. For the body centered cubic structure, the radius of the atom

$$r = \frac{\sqrt{3}}{4} a = \frac{\sqrt{3}}{4} \times 287 \text{ pm} = 124.27 \text{ pm}$$

THUS, THE ATOMIC RADIUS OF CHROMIUM=124.27 pm

Mass of an atom of chromium = atomic mass of Cr/Avogadro's no.
 $= 51.99 \text{ g} / 6.02 \times 10^{23}$.

No. of atoms in one unit cell = 2

Volume of the unit cell = $(287 \text{ pm})^3 = (287 \times 10^{-10} \text{ cm})^3$

Density of Cr = mass of unit cell/ volume of the unit cell
 $= 2 \times 51.99 / (287 \times 10^{-10} \text{ cm})^3 \times 6.02 \times 10^{23} = 7.32 \text{ g/cm}^3$

Q. 7. In the mineral spinel; having the formula MgAl_2O_4 . The oxide ions are arranged in CCP, Mg^{2+} ions occupy the tetrahedral voids. While Al^{3+} ions occupy the octahedral voids.

(i) What percentage of tetrahedral voids is occupied by Mg^{2+} ions ?

(ii) What percentage of octahedral voids is occupied by Al^{3+} ions ?

Ans. According to the formula, MgAl_2O_4 . If there are 4 oxide ions, there will be 1 Mg^{2+} ions and 2 Al^{3+} . But if the 4 O^{2-} ions are ccp in arrangement, there will be 4 octahedral and 8 tetrahedral voids.

$$(i) \quad \text{Percentage of tetrahedral voids occupied by Mg}^{2+} = (1 / 8) \times 100$$

$$= 12.5\%$$

$$(ii) \quad \text{Percentage of octahedral voids occupied by Al}^{3+} = (2 / 4) \times 100$$

$$= 50\%$$

Q. 8. Analysis shows that nickel oxide has the formula NiO_{0.98}O_{1.00}. What fractions of nickel exist as Ni²⁺ and Ni³⁺ ions ?

Ans. NiO_{0.98}O_{1.00}

Let Ni²⁺ be x and Ni³⁺ be 0.98 – x

Total charge on compd. is equal to zero.

$$[2 (\text{Ni}^{2+}) + 3 (\text{Ni}^{3+}) - 2 (\text{O}^{2-})] = 0$$

$$2x + 3(0.98 - x) - 2 = 0$$

$$x = 0.94$$

$$\text{Therefore Ni}^{2+} \% = \frac{0.94}{0.98} \times 100 = 96\%$$

$$\text{Ni}^{3+} = 4\%$$

Q. 9. How many unit cells are present in a cube shaped ideal crystal of NaCl of mass 1 gm ?

Ans. Mass of 1 unit cell = volume × density

$$= a^3 \times d$$

$$= \frac{a^3 \times M \times Z}{N^0 a^3}$$

$$= \frac{58.5 \times 4}{6.023 \times 10^{23}}$$

No. of unit cells in 1 gm = 1/M

$$= 6.023 \times 10^{23} / 58.5 \times 4$$

$$= 2.57 \times 10^{21}$$

Solutions

3 Marks Questions

1. A solution contains 25% H₂O, 25% C₂H₅OH and 50% CH₃COOH by mass. Calculate mole fraction of each component.

Ans: $n(\text{water}) = 1.388$, $n(\text{alc}) = 0.543$, $n(\text{acid}) = 0.833$

Mole fractions: Water = 0.502; Alcohol = 0.196; Acid = 0.301

2. Calculate the partial pressures of benzene and toluene in the solution having –

(a) Equal moles of benzene and toluene (b) 1 mole of benzene mixed with 4 moles of toluene

(c) Equal mass of benzene and toluene ; vapor pressures of pure benzene and pure toluene are 160 mm and 60 mm respectively.

Ans: (a) mole Fraction of each = 0.5, VP of benzene = $160 \times 0.5 = 80$ mm;
VP of toluene = $60 \times 0.5 = 30$ mm

(a) mole Fraction of benzene and toluene are 0.2 and 0.8

VP of benzene = $160 \times 0.2 = 32$ mm; VP of toluene = $60 \times 0.8 = 48$ mm

(b) mass of both taken = 100 g, mole Fraction of benzene and toluene are 0.520 and 0.480, VP of benzene = $160 \times 0.52 = 83.2$ mm; VP of toluene = $60 \times 0.48 = 28.8$ mm

3. Calculate vapour pressure of solution containing 0.6% of urea (NH₂CONH₂) at 25°C. the vapour pressure of pure water is 24 mm Hg and density of solution is 1g/mL.

$$\frac{P_A^* - P_A}{P_A^*} = \frac{W_B / M_B}{W_A / M_A}$$
$$\frac{24 - P_A}{P_A} = \frac{0.6 / 60}{99.4 / 18}$$

Ans: $P_A = 23.9568 \text{ mm Hg}$

4. A motor radiator of 8 L capacity has 2 L of CH₃OH (density of CH₃OH = 0.8 g/mL) and rest water. Calculate the lowest temperature up to which water in radiator will not freeze. (K_f for water = 1.86 K/m)

Ans:

$$\begin{aligned} \text{Mass of water} &= 8 - 2 = 6 \text{ kg (or 6L)} \\ \text{Mass of CH}_3\text{OH} &= 2 \times 0.8 = 1.6 \text{ kg} = 1600 \text{ g} \\ \Delta T_f &= \frac{K_f \times W_B}{M_B \times W_A} = \frac{1.86 \times 1600}{32 \times 6} = 15.5^\circ\text{C} \\ T_f &= T_f^\circ - \Delta T_f = 0^\circ - 15.5^\circ\text{C} = \boxed{-15.5^\circ\text{C}} \end{aligned}$$

5. Assuming complete ionization, calculate the freezing point of solution containing 6.0 g of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ in 0.1 Kg of water. (K_f for water = 1.86 K/m)

Ans:

$$\begin{aligned} \Delta T_f &= \frac{i \times K_f \times W_B \times 1000}{M_B \times W_A} \\ \Delta T_f &= \frac{3 \times 1.86 \times 6 \times 1000}{322 \times 100} = 0.173^\circ\text{C} \\ T_f &= T_f^\circ - \Delta T_f = 0^\circ - 0.173 = \boxed{-0.173^\circ\text{C}} \end{aligned}$$

6. An aqueous solution of 3.12 g of BaCl_2 in 250 g of water boils at 100.083°C . Calculate degree of dissociation of BaCl_2 . (K_b for water = 0.52 K/m)

Ans:

$$\begin{aligned} \Delta T_b &= \frac{i \times K_b \times W_B \times 1000}{M_B \times W_A} \\ \Delta T_b &= \frac{3 \times 0.52 \times 3.12 \times 1000}{208 \times 250} = 0.173^\circ\text{C} \\ T_b &= T_b^\circ + \Delta T_b = 100^\circ + 0.173 = \boxed{100.173^\circ\text{C}} \end{aligned}$$

7. A decimolar solution of $\text{K}_4[\text{Fe}(\text{CN})_6]$ is 50% dissociated at 300 K. Calculate osmotic pressure. ($R = 0.082 \text{ L bar K}^{-1}\text{Mol}^{-1}$).

Ans:

$$\begin{aligned} \pi &= i \times C \times R \times T \\ &= 3 \times 0.1 \times 0.083 \times 300 \\ \pi &= \boxed{7.47 \text{ bar}} \end{aligned} \quad \left| \begin{aligned} i &= 1 - \alpha + m\alpha \\ &= 1 - 0.5 + (5 \times 0.5) \\ i &= 3 \end{aligned} \right.$$

8. The osmotic pressure of blood is 8.21 atm at 37°C . how much glucose is added in 1L solution for an intravenous injection?

$$w_B = \frac{\pi \times M_B \times V(\text{ml})}{R \times T \times 1000}$$

$$w_B = \frac{8.21 \times 180 \times 1000}{0.082 \times 310 \times 1000}$$

Ans:

$$w_B = 58.135 \text{ g}$$

9. A solution is made by mixing of equal volumes of two different solutions, one has 0.05 moles of glucose in 250 ml and other has 3.42 g of sucrose in 250 mL at 25°C. Calculate osmotic pressure of resultant solution.

Ans:

$$n_1 = \frac{0.05}{180} = 0.00028$$

$$n_2 = \frac{3.42}{342} = 0.01$$

$$\pi = \frac{(n_1 + n_2) RT \times 1000}{(V_1 + V_2)}$$

$$\pi = 0.508 \text{ bar}$$

10. Calculate the amount of ice that will be separated out on cooling a solution of 50 g of ethylene glycol in 200 g of water to -9.3°C.

Ans:

$$w_A = \frac{k_f \times w_B \times 1000}{M_B \times \Delta T_f}$$

$$= \frac{1.86 \times 50 \times 1000}{62 \times 9.3}$$

$$w_A = 161.29 \text{ g}$$

$$\text{Separated ice} = 200 - 161.29 = 38.71 \text{ g}$$

SOLUTIONS

Question bank

3 Marks Questions

1. a) State Henry's Law ?

b) What is the significance of K_H ?

c) What is the effect of temperature on the solubility of a gas in a liquid?

Ans a) Henry's Law –It states that at constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas above the surface of the liquid.

b) K_H is inversely proportional to the solubility of a gas. Higher the value of K_H of a gas lesser is its solubility in the liquid at the given temp.

c) solubility of a gas decreases with increase in temperature.

2) Benzene & toluene form ideal solution over the entire range of composition. The vapour pressures of pure benzene & toluene at 300 K are 50.71 mm Hg & 32.06 mm Hg respectively. Calculate the mole fraction of benzene in the vapour phase if 80 g of benzene is mixed with 100 g of toluene.

Ans. M benzene = 78

M toluene = 92

n benzene = $80/78$

= 1.026

n toluene = $100/92 = 1.087$

X benzene = $n \text{ benzene} / n \text{ benzene} + n \text{ toluene}$

= $1.026 / 1.026 + 1.087$

= 0.486

X toluene = $1 - 0.486$

= 0.514

P benzene = X benzene \times P° benzene

0.486×50.71

benzene/ = 24.65 mm

SOLUTIONS

Question bank

P toluene = X toluene x P° toluene

$$= 0.514 \times 32.06$$

$$= 16.48 \text{ mm}$$

X benzene in the vapour phase = P benzene + P toluene

$$= \frac{24.65}{24.65 + 16.48}$$

$$= 0.60$$

3. i) Why is an increase in temperature observed on mixing chloroform & acetone ?

ii) Why does sodium chloride solution freeze at a lower temperature than water?

iii) Determine the value of i for potassium phosphate.

Ans i). The force of attraction between acetone and acetone and force of attraction between chloroform and chloroform is dipole – dipole interactions whereas the force of attraction between chloroform and acetone is hydrogen bond which is stronger than the other interactions in their pure state which is responsible for the release of energy.

ii) When a non volatile solute is added to a volatile solvent its vapour pressure decreases. As a result the solvent freezes at a lower temperature.

iii) i for K_2SO_4 = no. Of particles after dissociation / no. Of particles before dissociation

$$= 3/1$$

SOLUTIONS

Question bank

=3

- 4)a) State Raoult's Law for a solution containing volatile components.
b) Why is glycol & water mixture used in car radiators in cold countries ?
c) Use of pressure cooker reduce cooking time why?

Ans.a)It states that for a solution of volatile components the partial pressure of each component is directly proportional to its mole fraction.

b)It lowers the freezing point of water .

c)In a pressure cooker the boiling point of water is elevated and so the food cooks faster.

5)A sample of drinking water was found to be severely contaminated with chloroform CHCl_3 , which is supposed to be carcinogen. The level of contamination was 15ppm (by mass).

- i) Express the concentration in percent by mass.
ii) Determine the molality of chloroform in the water sample.

Ans.Let the mass of solution =10,00000g

Mass of solute =15g

i)percentage by mass = $15/10,00000 \times 100$

=.0015%

ii)moles of chloroform =mass of chloroform/molar mass

= $15/119.5$

=0.126

Molality of solution = $0.126/1000$

=.000126mol/Kg.

6.Differentiate between non ideal solutions showing positive deviation and non ideal solutions showing negative deviation from Raoult's law?

Non Ideal solution positive nonideal negative deviation

SOLUTIONS

Question bank

$$1) P_{\text{solution}} > P_a + P_b$$

$$2) \Delta H_{\text{mixing}} > 0$$

$$3) \Delta V_{\text{mixing}} > 0$$

$$1) P_{\text{solution}} < P_a + P_b$$

$$2) \Delta H_{\text{mixing}} < 0$$

$$3) \Delta V_{\text{mixing}} < 0$$

7 a) What are azeotropes ? Give its two types with an example of each?

b) What is anoxia?

Ans.a) Azeotropes are constant boiling mixtures which boil without any change in its composition. They are of 2 types – maximum boiling azeotropes and minimum boiling azeotropes.

Ex of max. Boiling azeotrope is nitric acid and water.

Ex. Of min. Boiling azeotrope is alcohol and water.

b) At high altitudes low blood oxygen causes climbers to become weak and make them unable to think clearly. This disease is called Anoxia

8. a) What are bends ? How can we minimise it ?

b) What is the effect of temperature on Molarity ? Explain reason ?

Ans.a) Scuba divers have large quantity of N_2 dissolved in their blood. When they come to surface that N_2 dissolved in blood comes out due to less solubility on the surface. This creates a very painful condition called Bends. It can be minimised by taking oxygen cylinders diluted with He.

b) molarity is the no. Of moles of solute present in 1 litre of a solution. On increasing temperature volume of the solution increases and so the molarity decreases.

9. Two elements A and B form compounds having molecular formula AB_2 and AB_4 . When dissolved in 20 g of benzene 1g of AB_2 lowers the freezing point by 2.3K while 1g of AB_4 lowers it by 1.3K. K_f for benzene = 5.1 K Kg/mole. Calculate atomic masses of A and B.

$$\text{Ans. } M_b = K_f \times 1000 \times W_b / \Delta T_f \times W_a$$

$$M_{AB_2} = 5.1 \times 1000 \times 1 / 2.3 \times 20 = 110.87$$

$$M_{AB_4} = 5.1 \times 1000 \times 1 / 1.3 \times 20 = 196.15$$

$$M_{AB_2} = A + 2B = 110.87 \quad (i)$$

$$M_{AB_4} = A + 4B = 196.15 \quad (ii)$$

Subtracting (i) from (ii)

$$2B = 85.28$$

$$B = 42.64$$

SOLUTIONS

Question bank

Substituting value Of B in (i) we get

$$A + 85.28 = 110.87$$

$$\text{Or } A = 25.59$$

10. Based on solute solvent interactions arrange the following in the increasing order of solubility in n-octane. Explain.

Cyclohexane, KCl, CH₃OH, CH₃CN

Ans. (i) cyclohexane and n-octane both are non polar hence they will mix completely in all proportions .

(ii) KCl is an ionic compound whereas n-octane is non polar solvent hence KCl will remain insoluble.

(iii) CH₃OH & CH₃CN both are polar but CH₃CN is less polar than CH₃OH. As n octane is a non polar solvent hence CH₃CN will dissolve more than CH₃OH.

Therefore the order of solubility in n-octane will be
KCl < CH₃OH < CH₃CN < Cyclohexane.

CHAPTER 3. SOLUTION

Short answer type questions (3 marks)

Q.21 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 exert a partial pressure of 0.987 bar. Given that Henry's law constant for N_2 at 293 K is 76.48.

$$\text{Ans. } x(\text{Nitrogen}) = \frac{p(\text{nitrogen})}{K_H} = \frac{0.987 \text{ bar}}{76,480 \text{ bar}} = 1.29 \times 10^{-5}$$

As 1 litre of water contains 55.5 mol of it, therefore if n represents Number of moles of N_2 in solution,

$$x(\text{Nitrogen}) = \frac{n \text{ mol}}{n \text{ mol} + 55.5 \text{ mol}} \approx \frac{n}{55.5} = 1.29 \times 10^{-5}$$

(n in denominator is neglected as it is $\ll 55.5$)

$$\text{Thus } n = 1.29 \times 10^{-5} \times 55.5 \text{ mol} = 7.16 \times 10^{-4} \text{ mol}$$

$$= \frac{7.16 \times 10^{-4} \text{ mol} \times 1000 \text{ mol}}{1 \text{ mol}} = 0.716 \text{ m mol}$$

1 mol

Q.22 The partial pressure of ethane over a saturated solution containing 6.56×10^{-2} g of ethane is 1 bar. if the solution contains 5.0×10^{-2} g of ethane, then what will be the partial pressure of the gas?

Ans. Applying Henry's law

$$m = K_H \times p, \quad 6.56 \times 10^{-2} \text{ g} = K_H \times 1 \text{ bar}$$

$$K_H = 6.56 \times 10^{-2} \text{ g bar}^{-1}$$

Put the value of K_H in the second case

$$5 \times 10^{-2} \text{ g} = 6.56 \times 10^{-2} \text{ g bar}^{-1} \times p$$

$$p = \frac{5 \times 10^{-2} \text{ g}}{6.56 \times 10^{-2} \text{ g bar}^{-1}} = 0.765 \text{ bar}$$

Q.23 Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.?

Ans. Let the total mass of the solution = 100 g

$$\text{Then the mass of benzene} = 30 \% \text{ of } 100 = 30 \text{ g.}$$

$$\text{Mass of carbon tetrachloride} = \text{total mass} - \text{mass of benzene}$$

$$= (100 - 30) \text{ g} = 70 \text{ g}$$

Molar mass of benzene (C_6H_6) = $6 \times 12 + 6 \times 1 = 78 \text{ g mol}^{-1}$

Use the formula

Number of moles of $C_6H_6 = 30 / 78 = 0.3846 \text{ mol}$

Molar mass of carbon tetrachloride (CCl_4) = $1 \times 12 + 4 \times 35.5 = 154 \text{ g mol}^{-1}$

Use same formula again we get

Number of moles of $CCl_4 = 70 / 154 = 0.4545 \text{ mol}$

Use the formula of mole fraction

$$\text{Mole fraction of } C_6H_6 = \frac{\text{Number of Mole of } C_6H_6}{\text{Number of Mole of } C_6H_6 + \text{Number of Mole of } CCl_4}$$

$$\text{Mole fraction of benzene} = \frac{0.3846}{(0.3846 + 0.4545)} = 0.458$$

Q.24 H_2S , a toxic gas with rotten egg like smell, is used for the qualitative analysis. If the solubility of H_2S in water at STP is 0.195 m, calculate Henry's law constant.?

Ans. Given that , Molality = 0.195 m,

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in liter}}$$

Let take mass of solvent (water) = 1 kg

Use above formula we get

Moles of solute = 0.195 mol

Molar mass of water (H_2O) = $2 \times 1 + 16 = 18$

Mass of water (mass of solvent 1 kg) = 1000 g

$$\text{Number of Moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

Number of moles of water = $1000 \text{ g} / 18 = 55.56 \text{ mol}$

Number of moles of component

$$\text{Mole fraction of Component} = \frac{\text{Number of moles of component}}{\text{Total Number of Moles}}$$

$$\text{Mole fraction of H}_2\text{S} = 0.195 / (0.195 + 55.56) = 0.0035$$

At STP, pressure (p) = 0.987 bar always

According to Henry's law:

$$p = K_H \times X$$

$$K_H = p / X = 0.987 / 0.0035 = 282 \text{ bar.}$$

Q.25 The vapour pressure of pure liquids A and B are 450 and 700 mm Hg respectively, at 350 K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase.?

Ans. Given that

Vapour pressure of pure liquid A, $P_A^0 = 450$ mm of Hg

Vapour pressure of pure liquid B, $P_B^0 = 700$ mm of Hg

Total vapour pressure, $p_{\text{total}} = 600$ mm of Hg

Use the formula of Raoult's law

$$600 = (450 - 700) X_A + 700$$

$$250 X_A = 100$$

$$X_A = 100 / 250 = 0.4$$

Use formula

$$X_B = 1 - X_A$$

Plug the values we get

$$X_B = 1 - 0.4 = 0.6$$

use formula

$$P_A = P_A^0 \times X_A = 450 \times 0.4 = 180 \text{ mm of Hg}$$

$$P_B = P_B^0 \times X_B = 700 \times 0.6 = 420 \text{ mm of Hg}$$

Now, in the vapour phase:

Mole fraction of liquid A

$$= 180 / (180 + 420) = 0.30$$

Mole fraction of liquid B, $Y_B = 1 - Y_A = 1 - 0.30 = 0.70$

Q26. Boiling point of water at 750 mm Hg is 99.63°C. How much sucrose is to be added to 500 g of water such that it boils at 100°C. Molal elevation constant for water is 0.52 K kg mol⁻¹?

Ans. Normal boiling point of water = 100° C

Elevation of boiling point, $\Delta T_b = 100 - 99.63 = 0.37$

Mass of water $w_1 = 500$ g

Molar mass of sucrose (C₁₂H₂₂O₁₁), $M_2 = 12 \times 12 + 22 \times 1 + 11 \times 16 = 342$ g mol⁻¹

Molal elevation constant, $K_b = 0.52$ K kg mol⁻¹

Use the formula

$$M_2 = \frac{1000 K_b w_2}{w_1 \Delta T_b}$$

Cross multiply and solve for the value of w_2

$$w_2 = \frac{M_2 \times w_1 \times \Delta T_b}{1000 \times K_b}$$
$$= \frac{342 \text{ g mol}^{-1} \times 500 \text{ g} \times 0.37 \text{ K}}{1000 \text{ g kg}^{-1} \times 0.52 \text{ K kg mol}^{-1}}$$

$w_2 = 121.67$ g

mass of added sucrose = 121.67 g

Q27. Calculate the mass of ascorbic acid (Vitamin C, C₆H₈O₆) to be dissolved in 75 g of acetic acid to lower its melting point by 1.5°C. $K_f = 3.9$ K kg mol⁻¹?

Ans Given that

Mass of acetic acid, $w_1 = 75$ g

Molar mass of ascorbic acid (C₆H₈O₆), $M_2 = 6 \times 12 + 8 \times 1 + 6 \times 16 = 176$ g mol⁻¹

Lowering of melting point, $\Delta T_f = 1.5$ K

Use formula again we get

$$M_2 = \frac{1000 K_f w_2}{w_1 \Delta T_f}$$

$$w_2 = \frac{M_2 \times w_1 \times \Delta T_f}{1000 \times K_f}$$

$$= \frac{(176 \text{ g mol}^{-1})(75 \text{ g})(1.5 \text{ K})}{(1000 \text{ g kg}^{-1})(3.9 \text{ K kg mol}^{-1})}$$

$$W_2 = 5.08 \text{ g}$$

Required mass of ascorbic acid = 5.08 g

Q28. At 300 K, 36 g of glucose present in a litre of its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of the solution is 1.52 bars at the same temperature, what would be its concentration?

Ans .Mass of glucose, $w = 36 \text{ g}$

Osmotic pressure, $\pi = 4.98 \text{ bar}$

Temperature, $T = 300 \text{ K}$

Volume of solution, $V = 1 \text{ L}$

Formula of osmotic pressure

$$\pi = CRT$$

$$= \frac{n}{V} RT$$

Plug the value and solve for R we get

$$R = \pi V / (nT) = 4.98 \times 180 / (36 \times 300)$$

$$R = 4.98 / 60 \text{ Latm K}^{-1} \text{mol}^{-1}$$

Plug the value in second case we get

$$\pi = CRT$$

$$C = \pi / (RT)$$

Put the values we get

$$C = \frac{1.52}{\frac{4.98}{60} \times 300}$$

$$C = 0.061 \text{ Mol.}$$

Since the volume of the solution is 1L, the concentration of the solution would be 0.061 M

Q29. Mass of solvent = 250g = 0.25 Kg Q33. 19.5 g of CH₂FCOOH is dissolved in 500 g of water. The depression in the freezing point of water observed is 1.00 C. Calculate the Van't Hoff factor and dissociation constant of fluoroacetic acid.

Ans . Given values in problem

Use the formula of molar mass, to get observed mass we get

After calculation we get observed mass

$$M_2 = 72.54 \text{ g mol}^{-1}$$

$$\text{Real molar mass of CH}_2\text{FCOOH} = 14 + 2 + 17 + 12 + 16 + 16 + 1 = 78 \text{ g mol}^{-1}$$

$$\text{Oles of CH}_2\text{FCOOH} = 19.5/78 = 0.25$$

$$\text{Molality} = \frac{0.25 \times 1000}{500} = 0.50 \text{ m}$$

$$500$$

$$\text{Depression in Freezing point} = K_f \times m = 1.86 \times 0.50 = 0.93\text{K}$$

Hence, van't Hoff factor, I = Observed FP depression/ calculated FP depression

$$= 1.0/0.93 = 1.0753$$

Let α is the degree of dissociation of CH₂FCOOH

Q.30 The air is a mixture of a number of gases. The major components are oxygen and nitrogen with approximate proportion of 20% is to 79% by volume at 298 K. The water is in equilibrium with air at a pressure of 10 atm. At 298 K if the Henry's law constants for oxygen and nitrogen are 3.30×10^7 mm and 6.51×10^7 mm respectively, calculate the composition of these gases in water.?

Ans Given that

$$K_H \text{ for O}_2 = 3.30 \times 10^7 \text{ mm Hg}$$

$$K_H \text{ for N}_2 = 6.51 \times 10^7 \text{ mm Hg}$$

$$\text{Percentage of oxygen (O}_2) = 20 \%$$

$$\text{Percentage of nitrogen (N}_2) = 79\%$$

$$\text{Total pressure} = 10 \text{ atm,}$$

$$1 \text{ atm} = 760 \text{ mm Hg so we get}$$

$$\text{Total pressure} = 10 \times 760 = 7600 \text{ mm Hg}$$

$$\text{The partial pressure of oxygen} = 1520 \text{ mm Hg}$$

$$\text{The partial pressure of nitrogen} = 6004 \text{ mmHg}$$

Use the formula of Henry law (K_H is given in problem)

$$P_A = K_H \times X_A$$

Molar fraction of oxygen $X_{O_2} = P_{O_2} / K_H$

$$X_{O_2} = 1520 / (3.30 \times 10^7) = 4.61 \times 10^{-5}$$

Similarly for nitrogen

$$X_{N_2} = 6004 / (6.51 \times 10^7) = 9.22 \times 10^{-5}$$

$$\text{Mole fractions of oxygen} = 4.61 \times 10^{-5}$$

$$\text{Mole fraction of nitrogen} = 9.22 \times 10^{-5}$$

Q.31 Determine the amount of CaCl_2 ($i = 2.47$) dissolved in 2.5 litre of water such that its osmotic pressure is 0.75 atm at 27°C .

Ans. Given that

Osmotic pressure $\pi = 0.75$ atm

Volume $V = 2.5$ liter

van't Hoff factor $i = 2.47$

$$T = 27 + 273 = 300 \text{ K}$$

Let w is the amount of CaCl_2 required

Gas constant $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$

Molar mass of CaCl_2 $M = 1 \times 40 + 2 \times 35.5 = 111 \text{ g mol}^{-1}$

Use the formula of osmotic pressure

$$\begin{aligned} \pi &= i \frac{n}{V} RT \\ \Rightarrow \pi &= i \frac{w}{MV} RT \\ \Rightarrow w &= \frac{\pi MV}{iRT} \end{aligned}$$

Put the values in this formula we get

$$\Rightarrow w = \frac{0.75 \times 111 \times 2.5}{2.47 \times 0.0821 \times 300}$$

$$W = 3.43 \text{ g}$$

Required amount of $\text{CaCl}_2 = 3.42 \text{ g}$.

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PGT CHEM.

K. V. 1

AFS PATHANKOT

ELECTROCHEMISTRY

3-MARKS QUESTIONS

(Q.1) Define and give one example of each of the following-

- (i) Primary Cells (ii) Secondary Cells (iii) Fuel Cell
(3 Marks)

(Ans) (i) **Primary cells** are those which produce electrical energy from chemical energy. They cannot be recharged. *e.g.* Dry cell.

(ii) **Secondary cells** are used for storing electricity. They can be recharged. *e.g.* Lead storage battery.

(iii) **Fuel cells** are used to convert energy from combustion of fuels into electrical energy. They are called fuel cells. *e.g.* H₂-O₂ fuel cell.

(Q.2) Write the reactions taking place at cathode, at anode and cell reaction in lead storage cell.

(3 Marks)

(Ans) At Anode $\text{Pb (s)} + \text{SO}_4^{2-} \rightarrow \text{PbSO}_4(\text{s}) + 2\text{e}^-$

At Cathode $\text{PbO}_2(\text{s}) + \text{SO}_4^{2-} + 2\text{e}^- + 4\text{H}^+ \rightarrow \text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$

Cell reaction $\text{Pb (s)} + \text{PbO}_2(\text{s}) + 2\text{H}_2\text{SO}_4 \rightarrow 2\text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l})$

(Q.3) What is Nernst equation? Write its expression for single electrode & cell. (3 Marks)

(Ans) Nernst equation is relationship between temperature, concentration of electrolyte at electrode and electrode potential.

For reaction : $\text{M}^{n+} + \text{ne}^- \longrightarrow \text{M}_{(\text{s})}$

$$E_{\text{M}^{n+}/\text{M}_{(\text{s})}} = E_{\text{M}^{n+}/\text{M}_{(\text{s})}}^{\circ} - \frac{2.303RT}{nF} \log \left[\frac{\text{M}_{(\text{s})}}{\text{M}^{n+}} \right]$$

Where,

$E_{\text{M}^{n+}/\text{M}}$ = Reduction potential

$E_{\text{M}^{n+}/\text{M}}^{\circ}$ = Standard reduction potential

T = Temperature in K

n = No. of e⁻ in balanced cell reaction

F = 96500 C

For cell

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{2.303RT}{nF} \log \left[\frac{\text{Product}}{\text{Reactant}} \right]$$

(Q.4) The resistance of 1N solution of CH₃COOH is 250 ohm. The cell constant is 1.15 cm⁻¹. Calculate the equivalent conductance of solution.

(3 Marks)

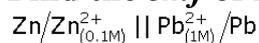
(Ans)

$$\begin{aligned}\text{Conductivity} &= \frac{1}{R} \times \text{cell constant} \\ &= \frac{1}{250} \times 1.15 = 4.6 \times 10^{-3}\end{aligned}$$

$$\begin{aligned}\Lambda_{\text{eq}} &= \frac{\text{conductivity} \times 1000}{N} \\ &= \frac{4.6 \times 10^{-3} \times 1000}{1.0} \\ &= 46 \times \text{ohm}^{-1} \text{cm}^2 \text{eq}^{-1}\end{aligned}$$

(Q.5)

Find the *emf* of following cell -



$$E^{\circ}_{\text{Zn}/\text{Zn}^{2+}} = -0.76\text{V} \text{ and } E^{\circ}_{\text{Pb}^{2+}/\text{Zn}} = 0.12\text{V}$$

(3 Marks)

(Ans) From the cell representation it is clear that zinc is anode and Pb is cathode

$$\begin{aligned}E^{\circ}_{\text{cell}} &= E^{\circ}_{\text{C}} - E^{\circ}_{\text{A}} \\ &= -0.12 - (-0.76) \\ &= -0.12 + 0.76 \\ &= +0.64 \text{ V}\end{aligned}$$

$$\text{Given } [\text{Zn}^{2+}] = 0.1\text{M}, [\text{Pb}^{2+}] = 1.0\text{V}, n=2$$

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.0591}{n} \log \left[\frac{[\text{Zn}^{2+}]}{[\text{Pb}^{2+}]} \right]$$

$$E_{\text{cell}} = 0.64 - \frac{0.0591}{2} \log \left[\frac{0.1}{1.0} \right]$$

$$= 0.64 - 0.02955 \times 1$$

$$= 0.64 + 0.02955$$

$$= 0.669 \text{ V}$$

(Q.6) The resistance of 0.5 M CH₃COOH solution is 100 ohm. The cell constant is 0.035 cm⁻¹.

Calculate molar conductivity of solution. (3 Marks)

(Ans)

$$\begin{aligned}\text{Electrolytic Conductance} &= \frac{1}{R} \times \text{cell constant} \\ &= \frac{1}{100} \times 0.035 \\ &= 3.5 \times 10^{-4} \text{ohm}^{-1} \text{cm}^{-1}\end{aligned}$$

$$\begin{aligned}\text{Molar Conductance} &= \frac{1000 \times \text{Electrolytic Conductance}}{\text{Concentration}} \\ &= \frac{1000 \times 3.5 \times 10^{-4}}{0.5} \\ &= 7.0 \text{ohm}^{-1} \text{cm}^2 \text{mol}^{-1}\end{aligned}$$

(Q.7) An unknown metal M displaces Ni from NiCl₂ solution but it does not displace Mn from MnCl₂ solution. Arrange metal M, Ni & Mn in correct order of reducing power. (3 Marks)

(Ans) (i) Oxidation potential of M is more than Ni because M displaces Ni²⁺ from NiCl₂.

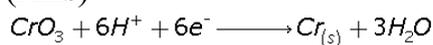
(ii) Oxidation potential of M is less than Mn²⁺ because M cannot displace Mn²⁺ from MnCl₂. Order of oxidation potential is Ni < M < Mn. More the oxidation potential means stronger reducing power. Correct order of reducing powers is Mn > M > Ni

(Q.8) Chromium metal can be plated out from acidic solution containing CrO₃ according to following reaction-



Calculate the mass of chromium that will be plated out by 12000 C of charge. (3 Marks)

(Ans)



\therefore 6 mole of e⁻ deposit = 1 mole of Cr = 52g of Cr

Quantity of electricity on 6 moles of e⁻ = 6 × 96500 = 579000C

\therefore 12,000 C of charge deposits = $\frac{52}{579000} \times 12000$
= 1.077g of Cr

(Q.9) Predict if the following reaction is feasible or not ,



Given $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$ and $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$

(3 Marks)

(Ans) E°_{cell} must be positive for cell reaction to be feasible. In the given reaction, Ag is oxidized. So, it is acting as anode and Cu is reduced so, it is

$$\begin{aligned} E^\circ_{\text{cell}} &= E^\circ_{(C)} - E^\circ_{(A)} \\ &= (+0.34\text{V}) - (+0.80\text{V}) \\ &= 0.34 \text{ V} - 0.80 \text{ V} \\ &= - 0.46 \text{ V} \end{aligned}$$

acting as cathode. Since E°_{cell} is having negative value, so the reaction is not feasible.

TOPIC -ELECTROCHEMISTRY

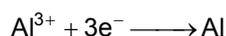
3 Marks Question-

Q.1. How much charge is required to reduce?

(a) 1 mole of Al^{3+} to Al and

(b) 1 mole of MnO_4^- to Mn^{2+} ?

Sol. (a) Reduction reaction is:

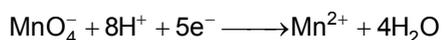


Thus, 3 moles of e^- are needed to reduce 1 mole of Al^{3+} .

$$Q = 3 \times F$$

$$= 3 \times 96500 = 289500 \text{ coulomb}$$

(b) The reduction reaction is :

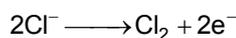


$$Q = 5 \times F$$

$$= 5 \times 96500 = 482500 \text{ coulomb}$$

Q.2. An electric current of 100 Amp is passed through a molten liquid of sodium chloride for 5 hours. Calculate the volume of chlorine gas liberated at the electrode at N.T.P.

Sol. The reaction taking place at anode is:-



$$\text{Number of eq. of chloride} = \frac{W}{E} = \frac{I \times t}{F}$$

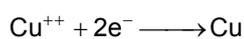
$$\text{Number of moles of chlorine} = \frac{I \times t}{F \times 2}$$

$$\text{Volume of Cl}_2 \text{ liberated at NTP} = \frac{22.4 \times I \times t}{2 \times F}$$

$$= \frac{22.4 \times 100 \times 5 \times 60 \times 60}{2 \times 96500} = 208.91 \text{ Lit.}$$

Q.3.. An ammeter and a copper voltameter are connected in series through which a constant current flows. The ammeter shows 0.52 amp. If 0.635 grams of copper is deposited in one hour, what is the percentage error of the ammeter?

Sol. The electrode is



$$\text{Deposited wt} = \frac{E \times I \times t}{F}$$

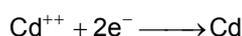
$$\text{or, } I = \frac{\text{wt} \times F}{E \times t} = \frac{0.635 \times 96500 \times 2}{63.5 \times 1 \times 60 \times 60} = 0.536$$

Difference in current = 0.536 – 0.52

$$\% \text{ error} = \frac{0.016 \times 100}{0.536} = 2.98\%$$

Q.4.. Cadmium amalgam is prepared by electrolysis of a solution of CdCl_2 using a mercury cathode. Find how long a current of 5 amp. should be passed in order to prepare 12% Cd – Hg amalgam on a cathode of 2 g mercury. [Atomic mass of Cd = 112.40].

Sol. 2 g Hg require Cd to prepare 12% amalgam = $\frac{12 \times 2}{88} = 0.273 \text{ g}$



Charge required to deposit 0.273 g of Cd = $\frac{2 \times 96500}{112.40} \times 0.273$ coulomb

Charge = amp. \times second

$$\therefore \text{Second} = \frac{2 \times 96500 \times 0.273}{112.40 \times 5} = 93.75$$

Q.5. The equivalent conductivity of $\frac{N}{10}$ solution of acetic acid at 25°C is $14.3 \text{ ohm}^{-1} \text{ cm}^2 \text{ eq}^{-1}$. Calculate the degree of dissociation of CH_3COOH if $\Lambda_\infty \text{ CH}_3\text{COOH}$ is $390.71 \text{ ohm}^{-1} \text{ cm}^2 \text{ eq}^{-1}$.

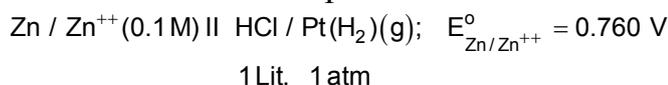
Sol. $\Lambda_\infty \text{ CH}_3\text{COOH} = 390.71 \text{ ohm}^{-1} \text{ cm}^2 \text{ eq}^{-1}$

$$\Lambda_{\text{CH}_3\text{COOH}} = 14.3 \text{ ohm}^{-1} \text{ cm}^2 \text{ eq}^{-1}$$

Degree of dissociation, $\alpha = \frac{\Lambda}{\Lambda_\infty} = \frac{14.3}{390.71}$

$$= 0.0366 \text{ i.e. } 3.66\% \text{ dissociation}$$

Q.6. Calculate the minimum amount of NaOH required to be added in R.H.S. to consume all the H^+ present in R.H.S. of the cell of emf +0.701 volt at 25°C before its use. Also report the emf of the cell after addition of NaOH.



Sol. Cell reaction is:-



Applying Nernst equation:

$$E_{\text{cell}} = E^\circ - \frac{0.0591}{2} \log \frac{[\text{Zn}^{++}]}{[\text{H}^+]^2}$$

$$0.701 = 0.760 - \frac{0.0591}{2} \log \frac{[\text{Zn}^{++}]}{[\text{H}^+]^2}$$

$$\therefore \log \frac{[\text{Zn}^{++}]}{[\text{H}^+]^2} = \frac{0.0591 \times 2}{0.0591} = 2$$

$$\therefore \frac{[\text{Zn}^{2+}]}{[\text{H}^+]^2} = 10^2$$

$$\therefore [\text{H}^+]^2 = \frac{0.1}{10^2} = 10^{-3}$$

$$\therefore [\text{H}^+] = 0.0316 \text{ mol lit}^{-1}$$

Thus 0.0316 mol / lit of NaOH is required to neutralise H^+ ions.

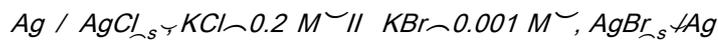
$$\begin{aligned} \text{Mass of NaOH} &= 0.0316 \times \text{Molecular mass of NaOH} \\ &= 0.0316 \times 40 = 1.264 \text{ g} \end{aligned}$$

After addition of NaOH, the solution becomes neutral i.e. the concentration of H^+ ions in cathodic solution becomes 10^{-7} .

Applying again Nernst equation

$$\begin{aligned} E_{\text{cell}} &= E_{\text{cell}}^{\circ} - \frac{0.0591}{2} \log \frac{[\text{Zn}^{++}]}{[\text{H}^+]^2} \\ &= 0.760 - \frac{0.0591}{2} \log \frac{0.1}{(10^{-7})^2} = 0.3759 \text{ volts} \end{aligned}$$

Q7.. For the galvanic cell



Calculate the emf generated and assign correct polarity to each electrode for the spontaneous process after taking into account the cell reaction at 25°C.

Given $K_{sp} AgCl = 2.8 \times 10^{-10}$, $K_{sp} AgBr = 3.3 \times 10^{-13}$

Sol.

$$E_{cell} = E_{cell}^{\circ} - \frac{0.0591}{1} \log \frac{[Ag^+]_{LHS}}{[Ag^+]_{RHS}}$$

$$E_{cell} = \frac{-0.0591}{1} \log \frac{[Ag^+]_{LHS}}{[Ag^+]_{RHS}} \quad [E_{cell}^{\circ} = 0]$$

or $E_{cell} = 0.0591 \log \frac{[Ag^+]_{RHS}}{[Ag^+]_{LHS}}$

$$= 0.0591 \log \frac{K_{sp} AgBr / [Br^-]}{K_{sp} AgCl / [Cl^-]}$$

$$= 0.0591 \log \frac{3.3 \times 10^{-13}}{0.001} \times \frac{0.2}{2.8 \times 10^{-10}}$$

$$= -0.0371 \text{ Volts}$$

Q.8. The observed emf of the cell

$Pt / H_2 \text{ 1 atm} \curvearrowright H^+ \sim 3 \times 10^{-4} M \parallel H^+ \sim M_1 \curvearrowleft H_2 \text{ 1 atm} \curvearrowright Pt$ is 0.154 V. Calculate the value of M_1 and pH of cathodic solution.

Sol.

$$E_{cell} = 0.0591 \log \frac{M_1}{3 \times 10^{-4}}$$

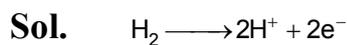
or, $\log \frac{M_1}{3 \times 10^{-4}} = \frac{0.154}{0.0591} = 2.6058$

or, $\frac{M_1}{3 \times 10^{-4}} = 4.034 \times 10^2$

$\therefore M_1 = 4.034 \times 10^2 \times 3 \times 10^{-4} = 0.121 M$

$\therefore pH = -\log[H^+] = -\log(0.121) = 0.917$

Q.9. In a fuel cell H_2 and O_2 react to produce electricity. In the process H_2 gas is oxidised at the anode and O_2 is reduced at the cathode. If 67.2 Lit. of H_2 at NTP reacts in 15 minutes, what is the average current produced? If the entire current is used for electro – deposition of Cu from Cu^{++} , how many gram of Cu are deposited.



$$67.2 \text{ Lit of H}_2 \text{ correspond} = \left(\frac{2 \times 96500}{22.4} \times 67.2 \right) \text{ coulomb.}$$

$$\text{Time} = 15 \times 60 \text{ second}$$

$$\text{Average current} = \frac{2 \times 96500 \times 67.2}{22.4 \times 15 \times 60} = 643.3 \text{ amp}$$

$$\text{Mass of copper deposited by} \left(\frac{2 \times 96500}{22.4} \times 67.2 \right) \text{ coulomb}$$

$$= \frac{63.5 \times 2 \times 96500 \times 67.2}{2 \times 96500 \times 22.4} = 190.5 \text{ g}$$

Q.10. Neglecting the liquid – liquid junction potential. Calculate the emf of the following cell at 25°C $\text{H}_2(1 \text{ atm}) / 0.5 \text{ M HCOOH} \parallel 1 \text{ M CH}_3\text{COOH} / (1 \text{ atm}) \text{ H}_2$. K_a for HCOOH and CH_3COOH are 1.77×10^{-4} and 1.8×10^{-5} respectively.

Sol. $[\text{H}^+] \text{ in HCOOH} = \sqrt{K_a \times c} = \sqrt{1.77 \times 10^{-4} \times 0.5} = 0.9407 \times 10^{-2} \text{ M}$

$$[\text{H}^+] \text{ in CH}_3\text{COOH} = \sqrt{K_a \times c} = \sqrt{1.8 \times 10^{-5} \times 1} = 4.2426 \times 10^{-3} \text{ M}$$

$$E_{\text{cell}} = 0.0591 \log \frac{[\text{H}^+]_{\text{RHS}}}{[\text{H}^+]_{\text{LHS}}}$$

$$= 0.0591 \log \frac{4.2426 \times 10^{-3}}{0.9407 \times 10^{-2}} = -0.0204 \text{ Volt}$$

5 Marks Question

Q.1.(a) State and explain Kohlrausch law of independent migration of ions.

(b) The molar conductivity of 0.025 mol L^{-1} methanoic acid is $46.1 \text{ S cm}^2 \text{ mol}^{-1}$. Calculate its degree of dissociation and dissociation constant. Given $\lambda_{\text{H}^+}^{\circ} = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$ and $\Lambda_{\text{HCOO}^-}^{\circ} = 54.6 \text{ S cm}^2 \text{ mol}^{-1}$.

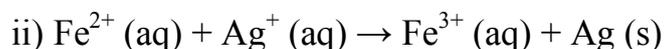
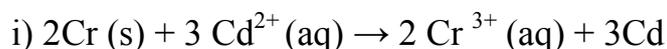
Q.2.(a) Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

(b) Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5} \text{ S cm}^{-1}$. Calculate its molar conductivity and if Λ° for acetic acid is $390.5 \text{ S cm}^2 \text{ mol}^{-1}$, what is the dissociation constant.

Q.3. (a) Give a brief account of corrosion and its mechanism.

(b) How is cathodic protection of iron different from its galvanisation.

Q.4. the standard cell potentials of galvanic cell in which the following reactions take place:



Calculate the rG° and equilibrium constant of the reaction.

Q.5. (a) Explain working of $\text{H}_2\text{-O}_2$ fuel cell

(b) For the equilibrium, $2\text{H}_2 (\text{g}) + \text{O}_2 (\text{g})$



Calculate $\log K$ for it ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$).

ELECTROCHEMISTRY

3 MARKS QUESTION

i) 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?

Ans. $t = 600 \text{ s}$ charge = current \times time = $1.5 \text{ A} \times 600 \text{ s} = 900 \text{ C}$

According to the reaction: $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- = \text{Cu}(\text{s})$

We require $2F$ or $2 \times 96487 \text{ C}$ to deposit 1 mol or 63 g of Cu. For 900 C, the mass of Cu deposited = $(63 \text{ g mol}^{-1} \times 900 \text{ C}) / (2 \times 96487 \text{ C mol}^{-1})$

2. How much electricity is required for the following reduction

i) 1 mol of Al^{3+} to Al

ii) 1 Mol of Cu^{2+} to Cu

iii) 1 mol of MnO_4^- to Mn^{2+}

Ans. i) $3F$ ii) $2F$ iii) $5F$

3. Determine the value of equilibrium constant and ΔG° for the following reaction

$\text{Ni}(\text{s}) + 2\text{Ag}^+(\text{aq}) \rightleftharpoons \text{Ni}^{2+}(\text{aq}) + 2\text{Ag}(\text{s})$ ($E^\circ = 1.05\text{V}$)

Ans. $\Delta G^\circ = -nFE^\circ = -2.303RT \log K_c$

$n = 2, F = 96500\text{C}$

$K_c = 3.411 \times 10^{35}$

4. Calculate the standard electrode potential of Ni^{2+}/Ni electrode if emf of the $\text{Ni}^{2+}/\text{Ni}(0.01)/\text{Cu}^{2+}(0.1)/\text{Cu}(\text{s})$ is 0.059. Given $E^\circ = 0.34\text{V}$

Ans. $E_{\text{cell}} = 0.059\text{V}$ $E^\circ_{\text{Cu}} = 0.34\text{V}$

$E_{\text{cell}} = E^\circ_{\text{cell}} - 0.059/n \log 0.01/0.1$

$E^\circ_{\text{cell}} = 0.0295\text{V}$

$E^\circ_{\text{anode}} = 0.3105\text{V}$

Q.5. Three electrolyte cell A, B, C containing solution $\text{ZnSO}_4, \text{AgNO}_3, \text{CuSO}_4$ respectively are connected in series. A steady current of 1.5 amp was passed through them until 1.45 gm of silver deposited at cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited?

Ans. mass of copper deposited = 0.426g

Mass of Zinc deposited = 0.439g

Q.6. How much electricity in terms of faraday is required to produce

i) 20.0 g of Ca from molten CaCl_2 ii) 40.0 g of Al from molten Al_2O_3

ans. i) $1F$ ii) $4.44 F$

Q.7. Consider the reaction: $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 8\text{H}_2\text{O}$ What is the quantity of electricity in coulombs needed to reduce 1 mol of $\text{Cr}_2\text{O}_7^{2-}$

Ans. $3F$

Q.8. An unknown metal M displaces Ni from NiCl_2 solution but it does not displace Mn from MnCl_2 solution. Arrange metal M, Ni & Mn in correct order of reducing power.

(Ans) (i) Oxidation potential of M is more than Ni because M displaces Ni^{2+} from NiCl_2 . (ii)

Oxidation potential of M is less than Mn^{2+} because M cannot displace Mn^{2+} from MnCl_2 . Order of oxidation potential is $\text{Ni} < \text{M} > \text{Ni}$

Q.9. The value of Molar conductance at infinite dilution for HCl, NaCl & CH_3COONa are 426.1, 126.5 & 91.0 $\text{S cm}^2 \text{ mol}^{-1}$ respectively. Calculate the molar conductivity of acetic acid at infinite dilution.

Ans. $\lambda_m^0 \text{CH}_3\text{COOH} = 390.6 \text{ S cm}^2 \text{ mol}^{-1}$

Q.10. Why does the conductivity of an electrolyte decreases with dilution whereas molar conductivity increases?

(Ans) Since conductivity is the conductance of 1 cm³ of the solution. On diluting the concentration of ions per cm³ decreases as a result the conductivity decreases. But in case of molar conductivity, we have two terms $\lambda_m = k \times V$ On diluting the volume containing 1 mole of electrolyte increases as a result the product of k and V also increases

Chapter 4 chemical kinetics

3 marks questions.

Q1: A first order gas reaction $A_2B_2(g) \rightarrow 2A(g) + 2B(g)$ at the temperature 400°C has the rate constant, $k = 2.0 \times 10^{-4} \text{ s}^{-1}$. What percentage of A_2B_2 is decomposed on heating for 900 s.

Ans:- Using the formula: $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$

substituting the values : $2 \times 10^{-4} \text{ s}^{-1} = \frac{2.303}{900} \log \frac{[R]_0}{[R]}$

$$\log \frac{[R]_0}{[R]} = 2 \times 10^{-4} \times 900 / 2.303 = 0.0781$$

$$\log [R] / [R]_0 = -0.0781$$

$$[R] / [R]_0 = \text{Antilog } 1.9219$$

$$[R] / [R]_0 = 0.835$$

$$[R] = 0.835 [R]_0$$

If, $[R]_0 = 100$,

Then, $[R] = 83.5$

$$[R]_0 - [R] = 100 - 83.5 = 16.5$$

i.e. ,16.5 % of initial concentration has changed into products

Q3:- The rate constant for first order reaction is 60/s. How much time will it take to reduce the concentration of the reaction to 1/10 of its initial value ?

1. Ans:-

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

$$t = \frac{2.303 \log \frac{[R]_0}{1/10[R]_0}}{60}$$

$$t = \frac{2.303 \log 10}{60}$$

$$t = \frac{2.303}{60} = 3.38 \times 10^{-2} \text{ s}^{-1}$$

Q4:- Rate constant K for first order reaction has been found to be $2.54 \times 10^{-3} \text{ s}^{-1}$
-1. Calculate its three-fourth life.

Ans:- $t = \frac{2.303}{K} \log \frac{[R]_0}{[R]}$ ————— (i) $K = 2.54 \times 10^{-3} \text{ s}^{-1}$; $[R] = [R]_0/4$

Substituting these values in equation (i) , we get

$$T_{3/4} = \frac{2.303}{2.54 \times 10^{-3}} \log \frac{[R]_0}{[R]_0/4}$$

$$= 0.9066 \times 10^3 \log 4$$

$$= 0.9066 \times 10^3 \times 0.6021 \text{ s}$$

$$= 5.46 \times 10^2 \text{ s}$$

Q5:- For the reaction $R \rightarrow P$, 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.

$$\text{Ans:- Average rate of reaction} = -\frac{\Delta[R]}{\Delta t}$$

$$= -\frac{[R]_2 - [R]_1}{t_2 - t_1}$$

$$= -\frac{0.02 - 0.03}{25} \text{ M min}^{-1}$$

$$= -\frac{-0.01}{25} \text{ M min}^{-1}$$

$$= 4 \times 10^{-4} \text{ M min}^{-1}$$

$$= \frac{4 \times 10^{-4}}{60} \text{ M s}^{-1}$$

$$= 6.67 \times 10^{-6} \text{ M s}^{-1}$$

Q6:- The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate E_a .

Ans:- It is given that $T_1 = 298 \text{ K}$

$$\therefore T_2 = (298 + 10) \text{ K}$$

$$= 308 \text{ K}$$

We also know that the rate of the reaction doubles when temperature is increased by 10° .

Therefore, let us take the value of $k_1 = k$ and that of $k_2 = 2k$

Also, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

Now, substituting these values in the equation:

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

We get:

$$\log \frac{2k}{k} = \frac{E_a}{2.303 \times 8.314} \left[\frac{10}{298 \times 308} \right]$$

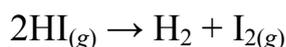
$$\Rightarrow \log 2 = \frac{E_a}{2.303 \times 8.314} \left[\frac{10}{298 \times 308} \right]$$

$$\Rightarrow E_a = \frac{2.303 \times 8.314 \times 298 \times 308 \times \log 2}{10}$$

$$= 52897.78 \text{ J mol}^{-1}$$

$$= 52.9 \text{ kJ mol}^{-1}$$

Q7:- The activation energy for the reaction



is $209.5 \text{ kJ mol}^{-1}$ at 581K . Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy?

Ans:- In the given case:

$$E_a = 209.5 \text{ kJ mol}^{-1} = 209500 \text{ J mol}^{-1}$$

$$T = 581 \text{ K}$$

$$R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$$

Now, the fraction of molecules of reactants having energy equal to or greater than activation energy is given as:

$$x = e^{-E_a/RT}$$

$$\Rightarrow \ln x = -E_a / RT$$

$$\Rightarrow \log x = -\frac{E_a}{2.303 RT}$$

$$\Rightarrow \log x = \frac{209500 \text{ J mol}^{-1}}{2.303 \times 8.314 \text{ JK}^{-1} \text{ mol}^{-1} \times 581} = 18.8323$$

$$\text{Now, } x = \text{Anti log}(18.8323)$$

$$= \text{Anti log } \overline{19.1677}$$

$$= 1.471 \times 10^{-19}$$

Q8:- A reaction is first order in A and second order in B.

(i) Write the differential rate equation.

(ii) How is the rate affected on increasing the concentration of B three times?

(iii) How is the rate affected when the concentrations of both A and B are doubled?

Ans:-i) (i) The differential rate equation will be

$$-\frac{d[\text{R}]}{dt} = k[\text{A}][\text{B}]^2$$

ii) If the concentration of B is increased three times, then

$$\begin{aligned} -\frac{d[R]}{dt} &= k[A][3B]^2 \\ &= 9 \cdot k[A][B]^2 \end{aligned}$$

Therefore, the rate of reaction will increase 9 times.

(iii) When the concentrations of both A and B are doubled,

$$\begin{aligned} -\frac{d[R]}{dt} &= k[A][2B]^2 \\ &= k[2A][2B]^2 \\ &= 8 \cdot k[A][B]^2 \end{aligned}$$

Therefore, the rate of reaction will increase 8 times.

Q9:- Calculate the half-life of a first order reaction from their rate constants given below:

(i) 200 s^{-1} **(ii)** 2 min^{-1} **(iii)** 4 years^{-1}

Ans:- **(i)** Half life, $t_{1/2} = \frac{0.693}{k}$

$$= \frac{0.693}{200 \text{ s}^{-1}}$$

$$= 3.47 \text{ s (approximately)}$$

(ii) Half life, $t_{1/2} = \frac{0.693}{k}$

$$= \frac{0.693}{2 \text{ min}^{-1}}$$

$$= 0.35 \text{ min (approximately)}$$

(iii) Half life, $t_{1/2} = \frac{0.693}{k}$

$$= \frac{0.693}{4 \text{ years}^{-1}}$$

$$= 0.173 \text{ years (approximately)}$$

Q10:- The half-life for radioactive decay of ^{14}C is 5730 years. An archaeological artifact containing wood had only 80% of the ^{14}C found in a living tree. Estimate the age of the sample.

$$k = \frac{0.693}{t_{1/2}}$$

Ans:- Here, $t_{1/2}$

$$= \frac{0.693}{5730} \text{ years}^{-1}$$

It is known that,

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

$$= \frac{2.303}{\frac{0.693}{5730}} \log \frac{100}{80}$$

= 1845 years (approximately)

Hence, the age of the sample is 1845 years.

Q11:- During nuclear explosion, one of the products is ^{90}Sr with half-life of 28.1 years. If $1\mu\text{g}$ of ^{90}Sr was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10 years and 60 years if it is not lost metabolically.

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{28.1} \text{ y}^{-1}$$

Ans:-Here,

It is known that,

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

$$\Rightarrow 10 = \frac{2.303}{\frac{0.693}{28.1}} \log \frac{1}{[R]}$$

$$\Rightarrow 10 = \frac{2.303}{0.693} (-\log [R])$$

$$\frac{10 \times 0.693}{2.303 \times 28.1}$$

$$\Rightarrow \log [R] = -\frac{10 \times 0.693}{2.303 \times 28.1}$$

$$\Rightarrow [R] = \text{antilog} (-0.1071)$$

$$= \text{antilog} (\bar{1}.8929)$$

$$= 0.7814\mu\text{g}$$

Therefore, $0.7814 \mu\text{g}$ of ^{90}Sr will remain after 10 years.

Again,

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

$$\Rightarrow 60 = \frac{2.303}{0.693} \log \frac{1}{[R]}$$

$$\Rightarrow \log [R] = -\frac{60 \times 0.693}{2.303 \times 28.1}$$

$$\begin{aligned} \Rightarrow [R] &= \text{antilog}(-0.6425) \\ &= \text{antilog}(\bar{1}.3575) \\ &= 0.2278 \mu\text{g} \end{aligned}$$

Therefore, 0.2278 μg of ^{90}Sr will remain after 60 years.

Q12.- Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law, with $t_{1/2} = 3.00$ hours. What fraction of sample of sucrose remains after 8 hours?

Ans:- For a first order reaction,

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

It is given that, $t_{1/2} = 3.00$ hours

$$k = \frac{0.693}{t_{1/2}}$$

Therefore,

$$= \frac{0.693}{3} \text{ h}^{-1}$$

$$= 0.231 \text{ h}^{-1}$$

$$\text{Then, } 0.231 \text{ h}^{-1} = \frac{2.303}{8 \text{ h}} \log \frac{[R]_0}{[R]}$$

$$\Rightarrow \log \frac{[R]_0}{[R]} = \frac{0.231 \text{ h}^{-1} \times 8 \text{ h}}{2.303}$$

$$\Rightarrow \frac{[R]_0}{[R]} = \text{antilog}(0.8024)$$

$$\Rightarrow \frac{[R]_0}{[R]} = 6.3445$$

$$\begin{aligned} \Rightarrow \frac{[R]}{[R]_0} &= 0.1576 \text{ (approx)} \\ &= 0.158 \end{aligned}$$

Hence, the fraction of sample of sucrose that remains after 8 hours is 0.158.

Chapter 4 chemical kinetics

3 marks questions.

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Ans:- Using the formula: $k = 2.303 / t \log [R]_o / [R]$

substituting the values : $2 \times 10^{-4} \text{ s}^{-1} = 2.303 / 900 \log [R]_o / [R]$

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Q4:- Rate constant K for first order reaction has been found to be $2.54 \times 10^{-3} \text{ s}^{-1}$. Calculate its three-fourth life.

Ans:- $t = 2.303 / K \log [R]_o / [R]$ ————— (i) $K = 2.54 \times 10^{-3} \text{ s}^{-1}$; $[R] = [R]_o / 4$

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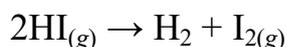
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(i) 200 s^{-1} **(ii)** 2 min^{-1} **(iii)** 4 years^{-1}

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$$= \frac{2.303}{\frac{0.693}{5730}} \log \frac{100}{80}$$

= 1845 years (approximately)

Hence, the age of the sample is 1845 years.

Q11:- During nuclear explosion, one of the products is ^{90}Sr with half-life of 28.1 years. If $1\mu\text{g}$ of ^{90}Sr was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10 years and 60 years if it is not lost metabolically.

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{28.1} \text{ y}^{-1}$$

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$$\frac{10 \times 0.693}{2.303 \times 28.1}$$

$$\Rightarrow \log [R] = -\frac{10 \times 0.693}{2.303 \times 28.1}$$

$$\Rightarrow [R] = \text{antilog} (-0.1071)$$

$$= \text{antilog} (\bar{1}.8929)$$

$$= 0.7814\mu\text{g}$$

Therefore, $0.7814 \mu\text{g}$ of ^{90}Sr will remain after 10 years.

Again,

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

$$\Rightarrow 60 = \frac{2.303}{\frac{0.693}{28.1}} \log \frac{1}{[R]}$$

$$\Rightarrow \log [R] = -\frac{60 \times 0.693}{2.303 \times 28.1}$$

$$\Rightarrow [R] = \text{antilog}(-0.6425)$$

$$= \text{antilog}(\bar{1}.3575)$$

$$= 0.2278 \mu\text{g}$$

Therefore, 0.2278 μg of ^{90}Sr will remain after 60 years.

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It is given that, $t_{1/2} = 3.00$ hours

$$k = \frac{0.693}{t_{1/2}}$$

Therefore,

$$= \frac{0.693}{3} \text{ h}^{-1}$$

$$= 0.231 \text{ h}^{-1}$$

$$\text{Then, } 0.231 \text{ h}^{-1} = \frac{2.303}{8 \text{ h}} \log \frac{[R]_0}{[R]}$$

$$\Rightarrow \log \frac{[R]_0}{[R]} = \frac{0.231 \text{ h}^{-1} \times 8 \text{ h}}{2.303}$$

$$\Rightarrow \frac{[R]_0}{[R]} = \text{antilog}(0.8024)$$

$$\Rightarrow \frac{[R]_0}{[R]} = 6.3445$$

$$\Rightarrow \frac{[R]}{[R]_0} = 0.1576 \text{ (approx)}$$

$$= 0.158$$

Hence, the fraction of sample of sucrose that remains after 8 hours is 0.158.

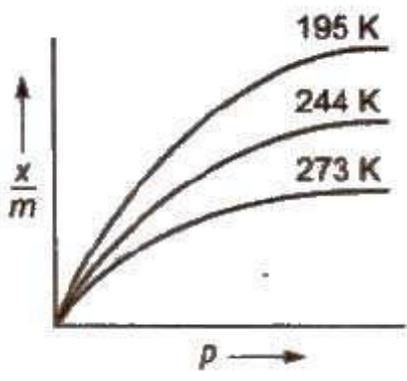
CHEMICAL KINETICS

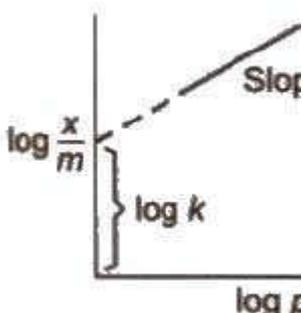
(THREE MARKS QUESTIONS)

- (i) Define half life period.
(ii) The half-life period of reaction is 10 minutes. How long it will take for concentration of reactant to be reduced to 10% of original?
- Explain the term Activation energy and threshold energy? How temperature affects the rate of reaction?
- What do you understand by integrated rate equation? Deduce the integrated rate equation for first order reaction?
- A chemical reaction is of second order w.r.t. a reactant. How will the rate of reaction be affected if the concentration of this reactants : (a) Doubled; (b) Reduced to 1/8th.
- From the following data for a chemical reaction between A and B at 300 K

[A] mol/L	[B] mol/L	Initial rate (mol L ⁻¹ sec ⁻¹)
2.5×10^{-4}	3×10^{-5}	5×10^{-4}
2.5×10^{-4}	6×10^{-5}	4×10^{-3}
1×10^{-3}	6×10^{-5}	1.6×10^{-2}

- Calculate (i) the order of reaction with respect to A and with respect to B. (ii) the rate constant 300K
- (i) Distinguish between elementary and complex reaction?
(ii) What are the factors affecting the rate of chemical reaction?
 - The decomposition of phosphine $4\text{PH}_3(\text{g}) \rightarrow \text{P}_4(\text{g}) + 6\text{H}_2(\text{g})$ has rate law;
Rate = $k [\text{PH}_3]$. The rate constant is $6.0 \times 10^{-4} \text{ s}^{-1}$ at 300K and activation energy is $3.05 \times 10^5 \text{ J mol}^{-1}$. Calculate the value of the rate constant at 310K. ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$).
 - The decomposition of hydrocarbon follows the equation $k = (4.5 \times 10^{11} \text{ s}^{-1}) e^{-28000 \text{ K/T}}$. Calculate E_a .
 - Show that for a first order reaction, time required for 99% completion is twice for the time required for the completion of 90% of reaction.
 - The rate of reaction triples when the temperature changes from 20°C to 50°C.
Calculate the energy of activation. [$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$, $\log 3 = 0.48$]

SURFAC CHEMISTRY		
3 MARKS QUESTIONS		
1	1. Define following. i) Micelle ii)FOAM iii)Gel	3
ANS	i) The substance at low concentration behave as strong electrolytes, molecules above CM.C. aggregate and aggregated particle having size of colloidal range. ii) The colloid in which dispersed phase is gas and dispersion medium is liquid. iii) The colloid in which dispersed phase is liquid and dispersion medium solid.	
2	What do you understand about adsorption isotherm? Show graph.	3
ANS	<p>Adsorption Isotherms</p> <p>It is the plot of the mass of gas adsorbed per gram of adsorbent (x/m) versus equilibrium pressure at constant temperature.</p> <p>Freundlich Adsorption Isotherm</p> <p>It gave an empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature. It can be expressed by the equation.</p> $x/m = kp^{1/n} \dots (i)$ <p>Where, x is the mass of the gas adsorbed on mass m of the adsorbent at pressure p, k and n are constants which depend on the nature of the adsorbent and the gas at a particular temperature.</p>  <p>At low pressure, $n = 1$, i.e., $x/m = kp$</p> <p>At high pressure, $n > 1$, i.e., $x/m = k$</p>	

	<p>(independent of p) Taking logarithm</p> $\log \frac{x}{m} = \log k + \frac{1}{n} \log p$ <p>Plot of $\log \frac{x}{m}$ vs $\log p$ is a straight line with slope $\frac{1}{n}$ and intercept on y-axis = $\log k$.</p> <p>The factor $\frac{1}{n}$ can have values between 0 and 1.</p> <p>From Eq. (i)</p> 	
3	<p>What is hardy Schulz rule? Which of the following electrolyte will coagulate most easily to positively charged colloid and why? a) NaCl b) Na₂SO₄ c) Na₃PO₄</p>	3
ANS	<p>Coagulating power of a coagulating ion is directly proportional to the charge on the ion. Na₃PO₄ will coagulate a positively charged colloid most easily because it has most negative valence.</p>	
4	<p>Write short notes on followings:- (a) Tyndall effect (b) Brownian Movement (c) Hardy Schulze Rule</p>	3
ANS	<p>(a) Tyndall effect - scattering of light by colloidal particles by which path of beam becomes clearly visible. this effect is known as tyndall effect. (b) Brownian movement - zig-zag motion of colloidal particles. (c) Hardy Schulze Law - Coagulating value of a coagulating ion is directly proportional to the charge on the ion. e.g: Na⁺ < Ca⁺⁺ < Al³⁺ for negatively charged sol. Cl⁻ < CO₃²⁻ < PO₄³⁻ < [Fe(CN)₆]⁴⁻ for positive sol.</p>	
5	<p>(i) Explain what is observed when (ii) an electrolyte, NaCl is added to hydrated ferric oxide sol . (iii) electric current is passed through a colloidal sol .</p>	3
ANS	<p>(i) The positively charged colloidal particles of Fe(OH)₃ get coagulated by the oppositely charged Cl⁻ ions provided by NaCl. (ii) On passing direct current, colloidal particles move towards the oppositely charged electrode where they lose their charge and get coagulated .</p>	

	(iii) Scattering of light by the colloidal particles takes place and the path of light becomes visible .	
6	What do you mean by activity and selectivity of catalysts ? Explain with suitable example.	3
ANS	<p>: Activity of catalyst : The ability of a catalyst to increase the rate of a reaction is called its activity .For exp . a mixture of H₂ and O₂ does not react at all, however in presence of Pt catalyst the mixture reacts explosively .</p> $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ <p>Selectivity of a catalyst : The ability of a catalyst to direct a reaction to yield a particular product is called the activity of a catalyst .</p> <p>eg. CH₃CH₂OH → CH₃CHO + H₂ (dehydrogenation reaction takes place in presence of Cu catalyst at 573 K .)</p> <p>CH₃CH₂OH → CH₂=CH₂ + H₂O (dehydration reaction takes place in presence of Al₂O₃ catalyst.)</p>	
7	Explain the following terms : (i) Electrophoresis (ii) Coagulation (iii) Dialysis	3
ANS	<p>: (i) Electrophoresis : The movement of colloidal particles towards oppositely charged electrode in an electric field is called electrophoresis .</p> <p>(ii) Coagulation : The process of aggregation of colloidal particles into an insoluble precipitate by the addition of suitable electrolyte is called coagulation .</p> <p>(iii) Dialysis : This is a process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane .</p>	
8	<p>a) State Hardy Schulze rule</p> <p>b) Why are powdered substances more effective adsorbent than their crystalline forms ?</p> <p>c) How does a delta form at the meeting place of sea and river water ?</p>	3
ANS	<p>a) The greater the charge of the coagulating ion more is the coagulation .</p> <p>b) Powdered substances have greater surface area as compared to their crystalline forms . Greater the surface area , greater is the adsorption .</p> <p>c) River water is a colloidal solution of clay and sea water contains lot of electrolytes . The point at which river and sea meet is the site for coagulation. Deposition of coagulated clay results in delta formation .</p>	

9	<p>a) What is the role of diffusion in heterogenous catalysis ?</p> <p>b) What is the difference between multimolecular and macromolecular colloids ? Give one example of each .</p>	3
ANS	<p>a) The gaseous molecules diffuse on to the surface of the solid catalyst and get adsorbed . After the required chemical changes the products diffuse away from the surface of the catalyst leaving the surface free for more reactant molecules to get adsorbed and undergo reaction .</p> <p>b) : Multimolecular colloids : In this type of colloids, colloidal particles are aggregates of atoms or molecules each having size less than 1 nm, e.g. sulphur sol , gold sol . Macromolecular colloids : In this type of colloids, colloidal particles are themselves large molecules of colloidal dimensions, e.g. starch , proteins etc</p>	
10	How do size of particles of adsorbent, pressure of gas and prevailing temperature influence the extent of adsorption of a gas on a solid ?	3
ANS	<p>(i) Smaller the size of the particles of the adsorbent, greater is the surface area and greater is the adsorption .</p> <p>(ii) At constant temperature , adsorption first increases with increase of pressure and then attains equilibrium at a high pressure .</p> <p>(iii) In physical adsorption , it decreases with increase of temperature but in chemisorption , first it increases and then decreases .</p>	

SURFACE CHEMISTRY

3 MARK QUESTIONS

Q1. Write short notes on followings:-

- (a) Tyndall effect
- (b) Brownian Movement
- (c) Dialysis

Ans.

(a) Tyndall effect - scattering of light by colloidal particles by which path of beam becomes clearly visible. This effect is known as Tyndall effect.

(b) Brownian movement - zig-zag motion of colloidal particles.

(c) It is a process of removing a dissolved substance from a colloidal solution by means of diffusion through a suitable membrane.

Q2.(i) Why is alum added to water for purification ?

(ii) Explain why deltas are formed where river & sea water meet.

(iii) Cottrell's smoke precipitator is fitted at the mouth of the chimney used in factories.

Ans.(i) For coagulating sand & soil particles.

(ii) River water gets coagulated by electrolytes in sea water so as to form deltas.

(iii) It removes poisonous gases by adsorption & smoke free from poisonous gases comes out.

Q3.(i) What is collodion ? What is its use ?

(ii) The colloidal solution of gold prepared by different methods have different colours.

Why?

(iii) A sol is prepared by addition of excess AgNO_3 solution to KI solution.

What charge

is likely to develop on the colloidal particles ?

Ans. (i) Cellulose dispersed in ethanol. Used for making membranes for ultrafiltration.

(ii) Due to difference in the size of colloidal particles.

(iii) Positive

Q4. Define following terms -

- i) Micelle
- ii) Foam
- iii) Gel

Ans.

- i) The substance at low concentration behaves as strong electrolytes, molecules above C.M.C. aggregate and aggregated particles having size of colloidal range.
- ii) The colloid in which dispersed phase is gas and dispersion medium is liquid.
- iii) The colloid in which dispersed phase is liquid and dispersion medium is solid.

Q5. What types of colloidal sols are formed in the following :

- (i) Sulphur vapours are passed through cold water.
- (ii) White of an egg is mixed with water.
- (iii) Soap solution.

Ans.(i) Multimolecular colloids because sulphur molecules associate together to form multimolecular colloids.

(ii) Macromolecular colloids because protein molecules present in the white of the egg are macromolecules soluble in water.

(iii) Associated Colloids because RCOO^- ions associate together to form micelles.

Q6. Differentiate between Physical adsorption and Chemical adsorption.

Ans.

Physical adsorption	Chemical adsorption
<ul style="list-style-type: none">1. It arises because of van der Waals' forces.2. It is not specific in nature.3. It is reversible in nature.4. Enthalpy of adsorption is low ($20-40 \text{ kJ mol}^{-1}$) in this case5. No appreciable activation energy is needed.6. It results into multimolecular layers on adsorbent surface under high pressure.	<ul style="list-style-type: none">1. It is caused by chemical bond formation.2. It is highly specific in nature.3. It is irreversible.4. Enthalpy of adsorption is high ($80-240 \text{ kJ mol}^{-1}$) in this case5. High activation energy is sometimes needed.6. It results into unimolecular layer.

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Q7. What is hardy Schulz rule? Which of the following electrolyte will coagulate most easily to positively charged colloid and why?

a) NaCl b) Na₂ SO₄ c) Na₃PO₄

Ans. Coagulating power of a coagulating ion is directly proportional to the charge on the ion.

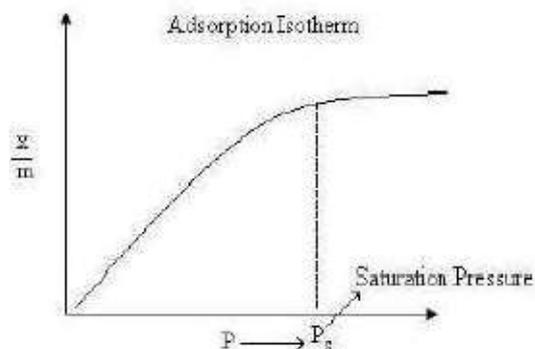
Na₃PO₄ will coagulate a positively charged colloid most easily because it has most negative valence.

Q8. (a) What do you understand about adsorption isotherm? Show graph.

(b) In reference to Freundlich adsorption isotherm write the expression for the adsorption of gases on solids in the form of an equation.

Ans.

(a) The variation in the amount of gas adsorbed by the adsorbent with pressure at constant temperature can be expressed by means of a curve termed as adsorption isotherm.



(b) **Freundlich adsorption isotherm**: Empirical relationship between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.

$$x/m = k \cdot P^{1/n} \quad (n > 1)$$

where x is the mass of the gas adsorbed on mass m of the adsorbent at pressure P, k and n are constants which depend on the nature of the adsorbent and the gas at a particular temperature.

Q9. Define the following terms –

- (i) Kraft temperature
- (ii) Critical micelle concentration
- (iii) Zeta Potential

(i) Kraft temperature (T_k)- Temperature above which the formation of micelles takes place.

(ii) Critical micelle concentration (CMC) – Concentration above which the formation of micelles takes place.

(iii) Zeta Potential – The potential difference between the fixed layer and the diffused layer of opposite charges is called Zeta potential.

Q10..(i) What is collodion ? What is its use ?

(ii) The colloidal solution of gold prepared by different methods have different colours.

Why?

(iii) A sol is prepared by addition of excess AgNO_3 solution to KI solution. What

charge is likely to develop on the colloidal particles ?

Ans. (i) Cellulose dispersed in ethanol. Used for making membranes for ultrafiltration.

(ii) Due to difference in the size of colloidal particles.

(iii) Positive

SURFACE CHEMISTRY

3 Marks:

1. Differentiate between physisorption & Chemisorptions?

Ans.

Physisorption	chemisorptions
It arises because of van der waal's forces	It is caused by chemical bond formation
Enthalpy of adsorption is low (20-40 kJ/mol)	Enthalpy of adsorption is high (80-240 kJ/mol)
Multimolecular	Unimolecular

2. What is the difference between multimolecular & macromolecular colloids? Give one example of each. How are associated colloids different from these two types of colloids?

Ans. Multimolecular colloids: In this type of colloids, colloidal particles are aggregates of atoms or molecules each having size less than 1 nm. Eg sulphur sol

Macromolecular colloids: Colloidal particles are themselves large molecules of colloidal dimension. Eg. Starch, protein

Associated colloids: These are the substances which at low concentration behave as normal electrolyte but at higher concentration exhibit colloidal behaviour due to the formation of aggregates. Eg soaps & detergents

3. Explain the following terms with examples (i) Aerosol (ii) Alcosol (iii) Hydrosol.

Ans. Alcosol: Alcohol as dispersion medium eg collodion

Aerosol: Colloidal solution of a solid or liquid in a gas: eg smoke

Hydrosol: It is a colloidal sol of a solid in water as the dispersion medium. Eg starch sol

4. Write short notes on followings:-

(i) Tyndall effect

(ii) Brownian movement

(iii) Hardy Schulze Rule

Ans-(a) Tyndall effect - scattering of light by colloidal particles by which path of beam becomes clearly visible. This effect is known as Tyndall effect

(b) Brownian movement - zig-zag motion of colloidal particles.

(c) Hardy Schulze Law - Coagulating value of a coagulating ion is directly proportional to the charge on the ion.

e.g: $\text{Na}^+ < \text{Ca}^{++} < \text{Al}^{3+}$ for negatively charged sol.

$\text{Cl}^- < \text{CO}_3^{2-} < \text{PO}_4^{3-} < [\text{Fe}(\text{CN})_6]^{4-}$ for positive

5. What is lyophobic & lyophilic sol? Give one example of each. Why is lyophobic sol easily coagulated?

Ans. Lyophobic sols: Particles of dispersed phase have no affinity for dispersion medium. These are not easily prepared & need stabilising agents for their

preservation. Eg gold, sulphur, $\text{Fe}(\text{OH})_3$ etc. Lyophilic sol: Particles of dispersed phase have greater affinity for the dispersion medium. They are self stabilised because of strong attractive forces operating between suspended particles & the dispersion medium. eg gum, gelatine, starch etc

The stability of lyophobic sol is only due to the presence of charge on colloidal particles. If charge is removed by addition of electrolyte, the particles come nearer to each other & coagulated.

6. Differentiate between homogeneous solution, colloidal solution & suspension, giving a suitable example of each.

Ans.

Properties	homogeneous solution	colloidal solution	suspension
Particle size	Less than 1 nm	Between 1 nm to 1000 nm	More than 1000 nm
Settling of particles	Do not settle	Settle on coagulation	Settle under gravity
Filtration	Not possible	Possible by ultra filtration	Possible by ordinary filter paper & ultra filter
Example	Glucose in water	Starch in water	Sand in water

7. Explain what is observed when:

(i) An electric current passed through a colloidal solution.

(ii) Cottrell's smoke precipitator is fitted at the mouth of chimney used in factories.

(iii) When a beam of light is passed through a colloidal solution

Ans: (i) Electrophoresis

(ii) Cottrell's smoke precipitator neutralise the charge on unbrunt carbon particles, coming out of chimney & they get precipitated & settle down at the floor of the chamber.

(iii) Tyndall effect (scattering effect)

8. What are emulsions? What are their different types? Give one example of each.

Ans: Emulsions are the colloidal solution of liquid in liquid.

These are of two types:

Oil in water: Dispersed phase is oil & Dispersion medium is water. Eg Milk

Water in oil: Dispersed phase is water & Dispersion medium is oil. Eg butter

9. Explain the following terms:

(i) Electrophoresis (ii) Peptization

(iii) Coagulation

Ans: **Peptization**- Process of converting a precipitate into colloidal sol, by shaking it with dispersion medium in the presence of a small amount of electrolyte.

Electrophoresis - Movement of Colloidal particles towards opposite electrode in presence of external electric field.

Coagulation – The process of setting of colloidal particles is called coagulation of the sol.

10. Describe briefly any three methods by which coagulation of lyophobic sol is carried out.

Ans. (1) Electrophoresis: During electrophoresis the colloidal particles move towards charged electrodes, get discharged & coagulated.

(ii) Addition of electrolyte: When excess of electrolyte is added to a colloidal sol, the sol interacts with ions carrying a charge opposite to that of the colloidal solution. This causes neutralization leading to their coagulation.

(iii) Mixing of two oppositely charged colloidal sols. (Mutual coagulation)

METALLURGY

SHORT ANSWER TYPE QUESTION

(3 marks)

Q.1- Explain the following:-

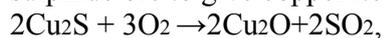
(i) Zinc but not copper is used for recovery of Ag from the complex $[\text{Ag}(\text{CN})_2]^-$.

(ii) Partial roasting of sulphide ore is done in the metallurgy of copper.

(iii) Extraction of Cu from pyrites is difficult than that from its oxide ore through reduction.

A.1- (i) Zn is more powerful reducing agent in comparison to copper. Zn is also cheaper than Cu.

(ii) Partial roasting of sulphide ore forms some oxide. This oxide then reacts with remaining sulphide ore to give copper i.e. self-reduction occurs.



(iii) Though carbon is good reducing agent for oxide but it is poor reducing agent for sulphides. The reduction of metal sulphide does not have large negative value.

Q.2- Explain the method for obtaining pig iron from magnetite.

A.2- Extraction of iron from Magnetite takes place in following steps:-

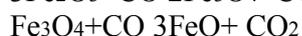
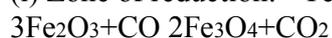
(i) Concentration of ore: - It is done by Gravity separation followed by magnetic separation process.

(ii) Calcination: - It involve heating when the volatile matter escapes leaving behind metal oxide.
 $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} \rightarrow \text{Fe}_2\text{O}_3 + x\text{H}_2\text{O}$.

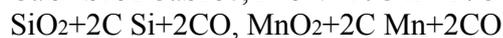
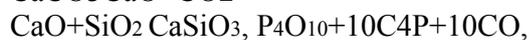
(iii) Roasting: - It involves heating of ore in presence of air, thus moisture, CO_2 , SO_2 , As_2O_3 removed And FeO oxidized to Fe_2O_3 .

(iv) Smelting of roasted ore: - A mixture of ore, coke & CaCO_3 is smelted in long BLAST FURNACE. Following reaction takes place at different temperature zones:-

(i) Zone of reduction: - Temperature range 250°C - 700°C



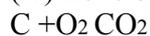
(ii) Zone of slag formation:- Temperature range 800°C - 1000°C



(iii) Zone of fusion:- Temperature range 1150°C - 1350°C



(iv) Zone of fusion:- Temperature range 1450°C - 1950°C



Thus, Pig iron is obtained from Blast Furnace.

Q.3- Describe the principles of extraction of copper from its ore .

Q.4- Name the principal ore of aluminium and describe how Al is extracted from its ore.

A.4- Important ores -(i) Bauxite $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (ii) Corundum Al_2O_3 . Bauxite is commercially important ore of Al.

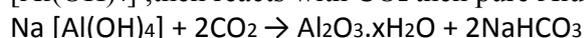
Extraction from Bauxite ore involves the following two stages:-

(i) Purification of bauxite to get pure alumina (Al_2O_3)

(ii) Electrolysis of pure alumina in molten cryolite

Step:-1 Bauxite is treated with NaOH .Following reaction takes place:-

$\text{Al}_2\text{O}_3 + 2\text{NaOH} + 3\text{H}_2\text{O} \rightarrow 2\text{Na} [\text{Al}(\text{OH})_4]$ and impurities of Fe_2O_3 , TiO_2 & SiO_2 are removed . Na $[\text{Al}(\text{OH})_4]$, then reacts with CO_2 then pure Alumina is obtained.



Step:-2 Electrolytic reduction of pure alumina takes place in iron box (cathode) with cryolite (Na_3AlF_6) & fluorspar CaF_2 . Graphide rods act as anode. Following reactions take place:-

At cathode:- $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$, At Anode:- $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$

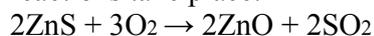
By this process 98.8% pure Aluminum is obtained.

Q.5- Describe the principles of extraction of Zinc from zinc blende .

A.5- Important ores of Zn:-Zinc blende - ZnS , Calamine- ZnCO_3 , and Zincite – ZnO . ZnS is commercially important ore of Zn. Various stages involved in the extraction of Zn from ZnS are as following:-

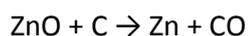
(i) Concentration of ore:-It is concentrated by Froth flotation process followed by gravity

separation process.(ii) Roasting: - The concentrated ore is roasted in presence of air. Following reactions take place:-



The mass obtained during roasting is porous and is called porous clinker.

(iii) Reduction of ZnO to Zn : - ZnO is made into bricketts with coke and clay and heated at 1163K . Zn formed distills off and is collected by rapid cooling of zinc vapours.



Q.6 - Name the metals which are associated with the following terms in the extraction from the ores. i) Bessemer converter ii) blast furnace iii) aluminium thermic process iv) magnetic separation

(v) Zone Refining (vi) Mond Process

A-6 i) Bessemer converter – copper, iron ii) blast furnace- iron iii) aluminium thermic processes – iron, chromium, manganese. iv) magnetic separation- titanium, tin chromium, manganese. (v) Gallium, Germanium (vi) Nickel

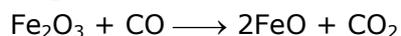
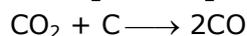
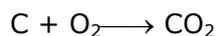
Q-7. What is the thermodynamic consideration in the choice of reducing agent in metallurgy.?

A-7. For the reaction / process to be in favourable direction the ΔG should be negative the more is the negative value the more is the tendency for the reaction to occur. ΔG is related to ΔH and ΔS through the relationship

$\Delta G = \Delta H - T \Delta S$, So for every reaction ΔG depends upon the T. Thus ΔG decides about the temperature and the choice of any reducing agent in the metallurgy.

Q.8. What is actual reducing agent of haematite in blast furnace? Give reactions involved

Ans8. Carbon monoxide is actual reducing agent of haematite in blast furnace.



Q.9A. Why is the formation of sulphates in calcinations sometimes advantageous?

B. Why do metal sulphides occur mainly in rocks and metal halides occur mostly in lakes and seas?

C. Silver ores and native gold have to be leached with metal cyanides. Suggest a reason for this.

A-9 A. Sulphates are usually water soluble and the gangue (impurities) remain insoluble. So the desired metal is leached away in soluble sulphate from insoluble gangue.

B. Metal sulphides are insoluble in water and therefore, they occur mostly in the rocks. On the other hand, metal halides are highly soluble in water. So they get dissolved in the rain water and are carried in the lakes and seas.

C. Silver and gold have a tendency to form the complex ions with the cyanide ion. Such complex ions are soluble. Thus gold and silver portion, of the ore can be brought into the solution thereby removing the all undesirable material.

Q.10 a. Copper can be extracted by hydro metallurgy but not zinc. Explain 2

b. Name the common elements present in anode mud in the electrolytic refining of copper. Why are they so present? 1

A.10 a. Copper dissolves in aqueous solution, as it can easily form complexes. From the solution, copper can be precipitated by adding a strong electropositive metal like zinc. On the other hand zinc being a strong reducing agent, can't be extracted by this method. Zinc has less tendency to form soluble complexes.

b. The anode mud contains Ag, Au, Se, Te. These elements are less reactive than copper and do not undergo oxidation at anode & hence settle down as such.

METALLURGY

3 Marks Questions

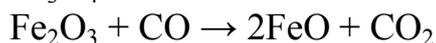
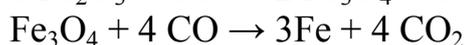
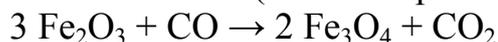
1. Write the principle behind the froth floatation process. What is the role of collectors in this process?

Ans. The mineral particles become wet by oils while the gangue particles by water.

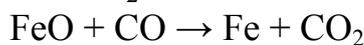
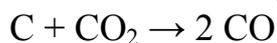
Collectors (e. g., pine oils, fatty acids, xanthates, etc.) enhance non-wettability of the mineral particles and froth stabilisers (e. g., cresols, aniline) stabilise the froth.

2. Write down the reactions taking place in different zones in the blast furnace during the extraction of iron. How pig iron different from cast iron?

Ans. At 500 – 800 K (lower temperature range in the blast furnace) –



At 900 – 1500 K (higher temperature range in the blast furnace



3. What chemical principle is involved in choosing a reducing agent for getting the metal from its oxide ore? Consider the metal oxide, Al_2O_3 and Fe_2O_3 , and justify the choice of reducing agent in each case.

Ans. The reducing agent forms its oxide when the metal oxide is reduced. The role of reducing agent is to provide ΔG° negative and large enough to make the sum of ΔG° of the two reactions (oxidation of the reducing agent and reduction of the metal oxide) negative.

For Al_2O_3 Mg above 1400 °C and for Fe_2O_3 , CO in the temperature range 500°C – 800°C.

4. What are the chief ores of zinc? Write chemical reactions taking place in the extraction of zinc from zinc blende.

Ans. Zinc blende ZnS Enrichment by froth floatation.



5. What is meant by the term chromatography? What criterion is followed for the selection of the stationary phase in chromatography?

Ans. This method is based on the principle that different components of a mixture are differently adsorbed on an adsorbent. Different components are adsorbed at different levels on the column. Later the adsorbed components are removed by using suitable solvents.

The stationary phase is selected in such a way that the components of the sample have different solubility's in the phase. Hence, different components have different rates of movement through the stationary phase and as a result, can be separated from each other

6. State the principle involved in refining of metals by each of the following methods:

(i) Zone refining (ii) Vapour phase refining (iii) Electrolytic refining.

Ans. (i) This method is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal.

(ii) In this method, the metal is converted into its volatile compound and collected elsewhere. It is then decomposed to give pure metal.

(iii) A strip of the same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of the same metal. The more basic metal remains in the solution and the less basic ones go to the anode mud.

7. Explain the role of the following:

(i) Iodine in the refining of titanium

(ii) NaCN in the in the extraction of gold.

(iii) Carbon in the extraction of aluminium.

Ans. (i) $Zr + 2I_2 \rightarrow ZrI_4$

$ZrI_4 \rightarrow Zr + 2I_2$

(ii) In the metallurgy of gold, the metal is leached with a dilute solution of NaCN in the presence of air (for O₂) from which the metal is obtained later by replacement.

(iii) The oxygen liberated at anode reacts with the carbon of anode producing CO and CO₂. This way for each kg of aluminium produced, about 0.5 kg of carbon anode is burnt away.

8. (i) The value of $\Delta_f G^\circ$ for the formation of Cr₂O₃ is -540 kJmol⁻¹ and that of Al₂O₃ is -827

kJmol⁻¹. Is the reduction of Cr₂O₃ possible with Al?

(ii) Out of C and CO which is better reducing agent for ZnO?

Ans. (i) The value of $\Delta_f G^\circ$ for the formation of Cr₂O₃ from Cr (-540 kJmol⁻¹) is higher than that of Al₂O₃ from Al (-827 kJmol⁻¹). Therefore, Al can reduce Cr₂O₃ to Cr. Hence, the reduction of Cr₂O₃ with Al is possible.

$2Cr(s) + 3/2 O_2 \rightarrow Cr_2O_3 \quad \Delta G^\circ = -540 \text{ kJmol}^{-1} \quad (a)$

$2Al(s) + 3/2 O_2 \rightarrow Al_2O_3 \quad \Delta G^\circ = -827 \text{ kJ mol}^{-1} \quad (b)$

Subtracting (a) from (b)

$2Al(s) + Cr_2O_3 \rightarrow Al_2O_3 + 2Cr \quad \Delta G^\circ = -287 \text{ kJmol}^{-1}$

As the value of ΔG° for reduction of Cr₂O₃ is negative so the reduction of Cr₂O₃ with Al is possible.

(ii) C is better reducing agent for ZnO.

9. (i) Why is the reduction of a metal oxide easier if the metal formed is in liquid state at the temperature of reduction?

(ii) Although thermodynamically feasible, in practice, magnesium metal is not used for the reduction of alumina in the metallurgy of aluminium. Why?

Ans. (i) The entropy is higher if the metal is in liquid state than when it is in solid state. The value of entropy change (ΔS) of the reduction process is more on +ve side when the metal formed is in liquid state and the metal oxide being reduced is in solid state. Thus the value of ΔG^0 becomes more on negative side and the reduction becomes easier.

(ii) Temperatures above the point of intersection of Al_2O_3 and MgO curves, magnesium can reduce alumina. But the temperature required would be so high that the process will be uneconomic and technologically difficult.

10. Explain the following:-

(i) Name the common elements present in the anode mud in electrolytic refining of copper.

(ii) Copper can be extracted by hydrometallurgy but not zinc, explain.

(iii) What criterion is followed for the selection of the stationary phase in chromatography?

Ans. (i) In electrolytic refining of copper, the common elements present in anode mud are selenium, tellurium, silver, gold, platinum, and antimony.

(ii) The E^0 of zinc ($\text{Zn}^{2+}/\text{Zn} = -0.76\text{V}$) is lower than of $\text{Cu}^{2+}/\text{Cu} = +0.34\text{V}$. On the other hand Zn can displace Cu from solution of Cu^{2+} ions. Therefore to displace Zn from solution of Zn^{2+} ions, we need a metal more reactive than Zn. ($E^0\text{Al}^{3+}/\text{Al} = -1.66\text{V}$, Mg ($E^0\text{Mg}^{2+}/\text{Mg} = -2.37\text{V}$), Ca ($E^0\text{Ca}^{2+}/\text{Ca} = 2.87\text{V}$), K ($E^0\text{K}^+/\text{K} = -2.93\text{V}$) etc. But all these metals react with water forming corresponding ions with evolution of H_2 gas hence Al, Mg cannot be used to displace Zn from Zn^{2+} ions thus can be extracted by hydrometallurgy but not Zn.

(iii) The stationary phase is selected in such a way that the components of the sample have different solubilities in the phase. Hence, different components have different rates of movement through the stationary phase and as a result, can be separated from each other.

HALOGEN FAMILY.

Three Marks Questions

1. Arrange the following in the increasing order of the property mentioned.

(i) HOCl, HClO₂, HClO₃, HClO₄ (Acidic strength)

(ii) HF, HCl, HBr, HI (Acidic strength)

(iii) MF, MCl, MBr, MI (ionic character)

Ans.(i) Acidic strength: HOCl < HClO₂ < HClO₃ < HClO₄

(ii) Acidic strength: HF < HCl < HBr < HI

(iii) Ionic character: MI < MBr < MCl < MF

2. Deduce the molecular shape of BrF₃ on the basis of VSEPR theory.

Ans. There are two lone pairs and three bonds hence as per VSEPR theory it has trigonal bipyramidal shape.

3 . Why are halogens colored?

Ans: All halogens are coloured. This is due to absorption of radiations in visible region which results in the excitation of outer electrons to higher energy level. By absorbing different quanta of radiation, they display different colours.

For example, F₂, has yellow, Cl₂, greenish yellow, Br₂, red and I₂, violet colour.

4 What is "aqua regia"? How does it dissolve gold and platinum into it?

Ans : Aqua regia (3 parts of concentrated HCl and 1 part of concentrated HNO₃ are mixed)



5. When HCl reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride. Why?

Ans: Its reaction with iron produces H₂.



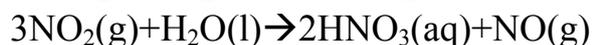
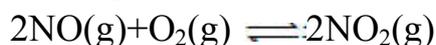
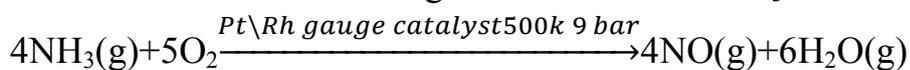
Liberation of hydrogen prevents the formation of ferric chloride.

Nitrogen Family

Three Marks Questions

1. Explain manufacturing of HNO_3 by Ostwald's process.

Ans. - The reaction involving manufacture of HNO_3 are as follows



2. (i) NH_3 is more basic than PH_3 . Explain

(ii) Write the condition which favors the production of ammonia by Haber's process.

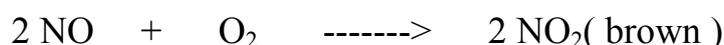
(iii) Nitric oxide becomes brown when released in air.

Ans.

(i) Due to small size of Nitrogen there is more electron density at Nitrogen atom

(ii) High conc. Of reactants, low temperature and high pressure

(iii) NO has one unpaired electron and hence is very reactive It readily combine with oxygen of the air to form nitrogen dioxide which has brown colour.



3.(i) Arrange the following in order of increasing base strength. NH_3 , PH_3 , AsH_3 , SbH_3 , BiH_3 .

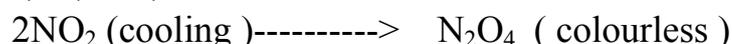
(ii) $\text{Pb}(\text{NO}_3)_2$ on heating gives a brown gas which undergoes dimerization on heating. Identify the gas Write reaction also.

(iii) On adding the NaOH to ammonium sulphate, a colourless gas with pungent odour is evolved which form a blue coloured complex with Cu^{2+} ion. Identify the gas.

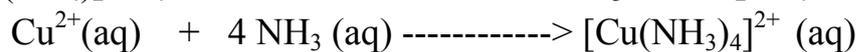
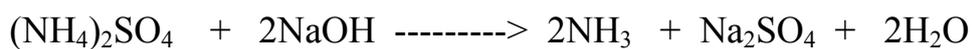
Ans.

(i) $\text{NH}_3 > \text{PH}_3 > \text{AsH}_3 > \text{SbH}_3 > \text{BiH}_3$. The tendency of hydrides to accept a proton decreases and hence the basic strength decreases down the group

(ii) Lead nitrate on heating gives NO_2 (nitrogen dioxide). It is a brown gas which on cooling undergoes dimerization to form dinitrogen tetra oxide (N_2O_4) which is colorless.



(iii) Ammonium sulphate react with NaOH to evolve NH_3 gas which has pungent odour and forms blue colour complex with Cu^{2+} ion as shown below:



Tetraamminecopper(II) ion

(Blue coloured complex)

4. Write three differences between white and red phosphorous.

White phosphorous

Red

phosphorous

- | | |
|---|---|
| 1. It is translucent waxy solid | 1. It has iron grey Lustre. |
| 2. It is poisonous and glows in dark | 2. It is non poisonous and does not glow in dark. |
| 3. It is less stable and more reactive. | 3. It is more stable and less reactive. |

NOBLE GASES

Three marks questions.

Q1 How are XeF_2 , XeF_4 , XeF_6 obtained?

Ans. Xe (excess) + F_2 -----> XeF_2 , at 673 K and 1 bar

$\text{Xe} + 2 \text{F}_2$ (1:5) -----> XeF_4 , at 873 K and 7 bar

$\text{Xe} + 3 \text{F}_2$ (1:20) -----> XeF_6 , at 573 K and 60 - 70 bar

Q2 How are XeO_3 and XeOF_4 prepared?

Ans. $\text{XeF}_6 + 3\text{H}_2\text{O}$ -----> $\text{XeO}_3 + 2\text{HF}$

$\text{XeF}_6 + \text{H}_2\text{O}$ -----> $\text{XeOF}_4 + 2\text{HF}$

Q3 Describe the noble gas species which is isostructural with ICl_4^- , IBr_2^- , BrO_3^- .

Ans. XeF_4 , XeF_2 , XeO_3

Q4 Draw the shapes of XeF_2 , XeF_4 , XeF_6 .

Ans. Linear, square planar, distorted octahedral

Q5 Draw the shapes of XeO_4 , XeOF_2 .

Ans. Tetrahedral, T-Shape

Q6 Draw the shapes of XeO_2F_2 , XeOF_4 , KrF_2 .

Ans. See-saw, square pyramidal, linear.

Q7 Write the reaction for the hydrolysis of XeF_2 , XeF_4 , XeF_6 .

a) $2\text{XeF}_2 + 2\text{H}_2\text{O}$ -----> $2\text{Xe} + 4\text{HF} + \text{O}_2$

b) $6\text{XeF}_4 + 12\text{H}_2\text{O}$ -----> $4\text{Xe} + 24\text{HF} + 3\text{O}_2 + 2\text{XeO}_3$

$\text{XeF}_6 + \text{H}_2\text{O}$ -----> $\text{XeOF}_4 + 2\text{HF}$

$\text{XeF}_6 + 2\text{H}_2\text{O}$ -----> $\text{XeO}_2\text{F}_2 + 4\text{HF}$

$\text{XeF}_6 + 3\text{H}_2\text{O}$ -----> $\text{XeO}_3 + 2\text{HF}$

Q8 Complete the reactions:-

$\text{XeF}_2 + \text{H}_2\text{O}$ ----->

$\text{XeF}_4 + \text{H}_2\text{O}$ ----->

$\text{XeF}_6 + 3\text{H}_2\text{O}$ ----->

Ans.

a) $2\text{XeF}_2 + 2\text{H}_2\text{O}$ -----> $2\text{Xe} + 4\text{HF} + \text{O}_2$

b) $6\text{XeF}_4 + 12\text{H}_2\text{O}$ -----> $4\text{Xe} + 24\text{HF} + 3\text{O}_2 + 2\text{XeO}_3$

c) $\text{XeF}_6 + 3\text{H}_2\text{O}$ -----> $\text{XeO}_3 + 2\text{HF}$

Q9 Name the noble gases used

in MRI systems for clinical diagnosis.

[Ans. He]

for advertisement display.

[Ans. Ne]

c) for arc welding of metals.

[Ans. Ar]

Q10 What is the hybridization of central atom in XeF_2 , XeF_4 , XeF_6 .

Ans sp^3d , sp^3d^2 , sp^3d^3

Oxygen family

3 MARKS QUESTIONS (OXYGEN FAMILY)

1) Why sulphur hexafluoride is used as gaseous insulator.

Ans) SF₆ is colourless, odourless and non-toxic gas at room temperature .The inertness of SF₆ is due to be it the presence of S atom which does not allow thermodynamically favorable reaction like hydrolysis. Because of its inertness and good dielectric properties,SF₆ is used or a gaseous insulator in high voltage generator.

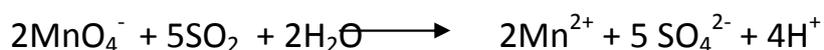
2) How is the presence of SO₂ detected?

Ans) SO₂ is pungent smelling gas it can detected by the following two tests first two tests:

(i) SO₂ turns acidified K₂Cr₂O₇ green due to reduction of Cr₂O₇²⁻ to Cr³⁺ ion.



ii) SO₂ turns the pink violet colour of KMnO₄ colourless due to reduction of MnO₄⁻ to Mn²⁺ ions.



3) What happens when Sulphur dioxide is passed into aqueous solution of Fe³⁺ salt ?

Ans) SO₂ acts as reducing agent and hence reduces an aqueous solution of Fe(III) salt to (II)salt.



4) How is O_3 estimated quantitatively?

Ans 4) When Ozone react with an excess of potassium iodide solution buffered with borate buffer (pH 9.2) iodine is liberated which can be treated against a standard solution of sodium thiosulphate this is quantitative method for estimating ozone gas.

5) Why is dioxygen a gas but Sulphur a solid?

Ans 5) Because of its small size oxygen is capable of forming a pπ-pπ bond and exist as a diatomic O_2 molecule the intermolecular forces in oxygen weak vanderwaal forces due to which it is a gas at room temperature on the other hand the Sulphur due to its larger size prefers to form S-S single bond and existence of diatomic S_8 molecule having puckered ring structure because of a large size of the force of attraction holding the S_8 molecule together are much stronger. Hence sulphur is a solid at room temperature.

6) Sulphur exhibits greater tendency for catenation than Selenium .explain

Ans 6) As we move from sulphur to Selenium, the atomic size increases and hence the strength of E-E bond decreases. Thus S-S bond is stronger than Se-Se bond. Consequently, Sulphur shows greater tendency for catenation than Selenium.

7) Why does O_3 act as a powerful oxidizing agent.

Ans 7) Due to the ease with which it liberates atoms of nascent oxygen, it acts as a powerful oxidizing agent. $O_3 \rightarrow O_2 + [O]$

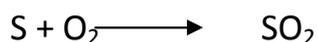
8) Why the electron gain enthalpy with negative sign is less for oxygen than that of sulphur?

Ans 8) This is due to smaller size of oxygen the electron cloud is distributed to a small region of space making electron density high which repels the incoming electrons.

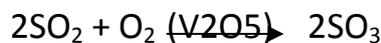
9) Describe the manufacture of H_2SO_4 by contact process.

Ans 9) sulphuric acid is manufactured by contact process which involves 3 steps

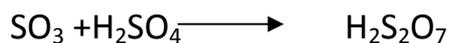
i) Burning of sulphur or sulphide ore in the air to produce SO_2



ii) Conversion of SO_2 to SO_3 by the reaction with oxygen in the presence of catalyst V_2O_5

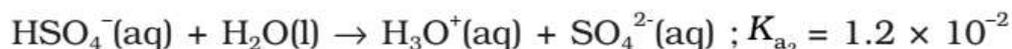


iii) Absorption of SO_3 into H_2SO_4 to give oleum ($\text{H}_2\text{S}_2\text{O}_7$).



10) The solutions of H_2SO_4 in water the second dissociation constant K_{a2} is less than the first dissociation constant K_{a1} . explain.

Ans 10) Because HSO_4^- Ion (formed after loss of H^+) has much less tendency to donate a Proton to water as compared to H_2SO_4 .

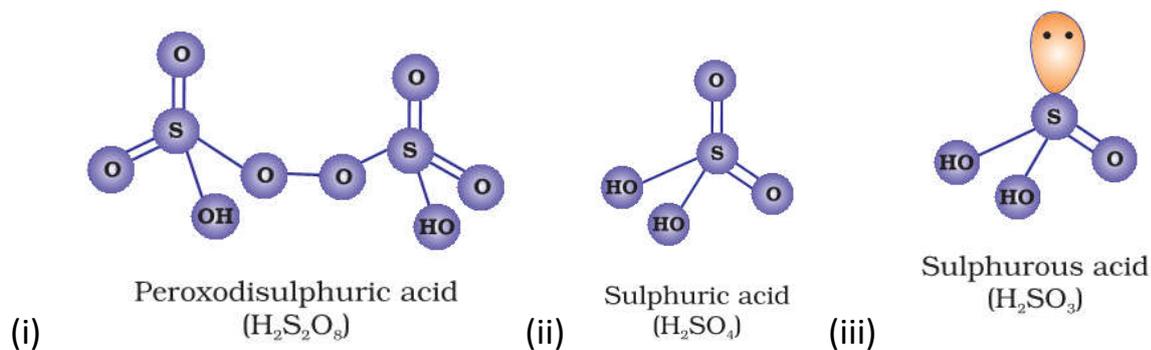


The larger value of K_{a1} ($K_{a1} > 10$) means that H_2SO_4 is largely dissociated into H^+ and HSO_4^- . Greater the value of dissociation constant (K_a), the stronger is the acid.

11) Out of H_2O and H_2S , which one has higher bond angle and why?

Ans 11) Bond angle of H_2O is large, because oxygen is more electronegative than sulphur. Therefore, bond pair electron of O-H bond will be closer to oxygen and there will be more bond pair-bond pair repulsion between bond pairs of two O-H bonds.

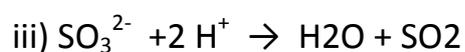
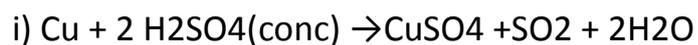
12) Draw the structure of (i) $\text{H}_2\text{S}_2\text{O}_8$ (ii) H_2SO_4 (iii) H_2SO_3



13) Complete the following equations



Ans: 13)



14) Mention three areas in which H_2SO_4 plays an important role.

Ans 14) i) H_2SO_4 is used in the manufacture of fertilizers, ammonium sulphate, superphosphates.

ii) it is used in storage batteries

iii) it is used in detergent industry.

INNER TRANSITION ELEMENTS

(THREE MARKS QUESTIONS)

1..what are alloys ? Name an important alloy which contains some of lanthanoid metals. Mention its uses.

Ans: alloy are homogenous mixture of two or more metals . Misch metal is an alloy ,which contains 45% lanthanoid metals (iron 5% ,traces of S,C,Ca,Al).

Use-

Used to produce bullets ,shells and lighter flint. 3% misch metal to mg used in making jet engine parts.

2.. What is lanthanoid contraction? What is the cause and consequences of lanthanoid contraction?

Ans.The steady decrease in atomic size (from 183 pm to 173 pm)and in ionic radii(from 103pm to 85 pm) of lanthanoid elements with increasing atomic number is called Lanthanoid contraction.

Reason:-

On moving left to right in lanthanoid series 1)nuclear charge increases by 1 unit.

2)one electron is added in 4f.

However 4f electrons shield each other from nuclear charge poorly due to highly diffused shape of f-orbital therefore nuclear charge becomes more effective and causes very gradual decrease in size.

Consequences:-

1.Resemblance of 2nd and 3rd transition series.

2.Similarity among lanthanoids.

3.Bascity difference.

3. Why Ce(IV) is a good analytical reagent?

Ans. E° value for $\text{Ce}^{+4}/\text{Ce}^{+3}$ is + 1.74 v which suggest that it can oxidise water. However, the reaction rate is very slow and hence, Ce(IV) is a good analytical reagent. *Pr, Nd, Tb and Dy also exhibit +4 state but only in oxides.

4. 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.

Ans: Ir^{103} is the last actinoid. Its electronic configuration is $[\text{Rn}]^{86}5f^46d^17s^2$. the possible oxidation state is +3.

Transition Element (d BLOCK Elements)

(Three Marks Question)

Q. 1 For the first row of transition metals the E^0 values are: $-E^0$ values V, Cr, Mn, Fe, Co, Ni, Cu M^{2+}/M -1.18 -0.91 -1.18 -0.44 -0.28 -0.25 +0.34 Explain the irregularity in the above values.

Ans. i) From V to Cr E^0 value becomes less negative because I.E and enthalpy of atomisation both increase.

ii) And then from Cr to Mn it becomes more negative due to dip in M.P. of Mn. Now From Mn to Fe its value again decreases due to increase in Enthalpy of atomisation and I.E of Fe.

iii) From Fe to Ni the value becomes less and less negative and in the end Cu its positive, as enthalpy of atomisation and I.E both increase.

Q. 2 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.

(iii) Of the d^4 species, Cr(II) is strongly reducing while manganese (III) is strongly oxidizing.

Ans. (i) In lower oxidation state transition metal has less positive charge as a result it has

a tendency to give electron. While in higher oxidation state due to high positive charge it shows a tendency to gain electron (Lewis acids).

(ii) A transition metal exhibits higher oxidation states in oxides and fluorides because oxygen and fluorine are the most electronegative elements and thus easily can unpair electrons of metal atom.

(iii) Because oxidizing and reducing property depends on E^0 value. Since E^0 value of Cr^{3+}/Cr^{2+} is negative while that of Mn^{3+}/Mn^{2+} is positive, as a result Cr(II) act as reducing agent and Mn(III) is strong oxidizing.

Q.3 Explain giving reasons:

(i) Transition metals and many of their compounds show paramagnetic behaviour.

(ii) The enthalpies of atomization of the transition metals are high.

(iii) The transition metals generally form colored compounds.

Ans.

i) Transition metals and many of their compounds show paramagnetic behavior due

to presence of unpaired electrons in (n-1) d orbital.

(ii) The enthalpies of atomization of the transition metals are high because of large

number of unpaired electrons in their atoms, they have stronger inter atomic interaction and hence strong metallic bonding is present between atoms.

(iii) The transition metals generally form coloured compounds due to presence of

unpaired electrons in(n-1) d orbital and thus they can undergo d-d transition.

Q.4 Give reasons for the following:

(i) Fe has higher melting point than Cu.

(ii) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is coloured while $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is colourless.

Ans.

(i) This is because Fe ($3d^6 4s^2$) has four unpaired electrons in 3d-subshell. While Cu

($3d^{10}, 4s^1$) only one unpaired electron in 4s shell. Hence metallic bonding is stronger

in Fe than those in Cu.

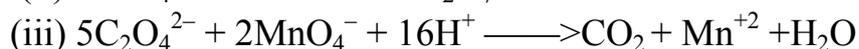
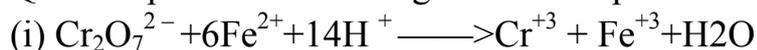
(ii) The oxidation state of Ti in $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is +3 and its configuration is $[\text{Ar}] 3d^1$ i.e

one unpaired electron and hence it is coloured. Whereas the oxidation state of Sc in

$[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is +3 and its configuration is $[\text{Ar}] 3d^0$ i.e no unpaired electron and hence

it is colourless.

Q.5 Complete the following chemical equations:



Q.6 (a) Mn^{3+} is a good oxidising agent.

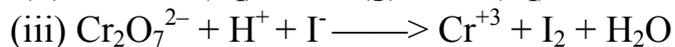
(b) Write two characteristics of the transition elements.

(c) Which of the 3d-block elements may not be regarded as the transition elements and why?

Ans- (1) d4 to d5 , stability of half filled d orbital.

(2) show catalytic properties and exhibit variable oxidation state.

Q.7 Complete the following chemical equations for reactions:



Q.8 . How would you account for the following :-

(1) $\text{Co}(\text{ii})$ is stable in aqueous solution but in presence of complexing reagents it is easily oxidised.

(2) the d^1 configuration is very unstable in ions

(3) Which metal in first series of transition metal exhibits +1 oxidation state most frequently and why?

Ans.- i) $\text{Co}(\text{ii})$ is oxidised to $\text{Co}(\text{iii})$ because $\text{Co}(\text{iii})$ is more stable .

ii) because after losing electron it become more stable.

iii) Cu exhibits +1 oxidation state ,bylosing one electron ,the cation ion aquires a stable configuration of d orbital.

Transition elements

3 marks questions

Q1. Why is the enthalpy of atomization increases upto the middle of transition series and then decreases?

A1. the enthalpy of atomization increases upto the middle of transition series and then decreases due to firstly increase in no. of unpaired e⁻s then decrease the in no. of unpaired e⁻s

Q2. Out of V and Mn which exhibit more oxidation state?

A2. Mn

Q3. What is the reason of transition elements to exhibit variable oxidation state?

A3. Due to participation of (n-1)d as well as ns electrons in bond formation.

Q4. Which is stronger reducing agent Cr²⁺ or Fe²⁺?

A4. Cr²⁺

Q5. Why is Cr²⁺ reducing and Mn³⁺ oxidizing when both have d4 configuration?

A5. On oxidation configuration of Cr²⁺ changes from d4 to d3, which is half filled t_{2g}³ subshell, while on the other hand from Mn²⁺ to Mn³⁺ result in the half filled (d5) configuration which has extra stability.

Q6. The E₀ value of Zn²⁺/Zn and Mn²⁺/Mn are quite low why?

A6. As hydration enthalpy of Zn²⁺/Zn and Mn²⁺/Mn is high.

Q7. Transition metals tend to be less reactive. Explain

A7. Due to strong interatomic interaction.

Q8. Why does Mn(II) ion show maximum paramagnetic character amongst bivalent ions of first transition series?

A8. Due to participation of (n-1)d as well as ns electrons in bond formation

Q9. Calculate the magnetic moment of Fe³⁺ (Z=26) ion.

A9. magnetic moment of $\text{Fe}^{3+} = \sqrt{5 \cdot (5+2)} = 5.9\text{BM}$.

Q10. Give one example of any compound in which oxidation state of Ni is zero.

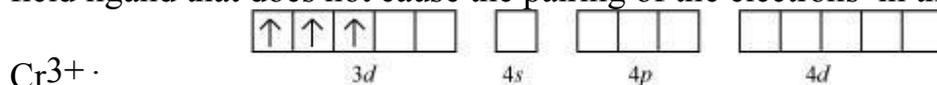
A10. $[\text{Ni}(\text{CO})_4]$

COORDINATION CHEMISTRY

3-marks Questions

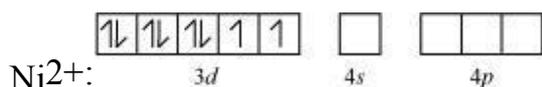
Q.1. $[\text{Cr}(\text{NH}_3)_6]^{3+}$ is paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic. Explain why?

ANS. Cr is in the +3 oxidation state i.e., d^3 configuration. Also, NH_3 is a weak field ligand that does not cause the pairing of the electrons in the 3d orbital.



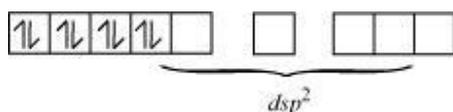
Therefore, it undergoes d^2sp^3 hybridization and the electrons in the 3d orbitals remain unpaired. Hence, it is paramagnetic in nature.

In $[\text{Ni}(\text{CN})_4]^{2-}$, Ni exists in the +2 oxidation state i.e., d^8 configuration.



CN^- is a strong field ligand. It causes the pairing of the 3d orbital electrons. Then, Ni²⁺

Undergoes dsp^2 hybridization.



Q2. a) Explain the reason behind a colour of some gem stone with the help of example.

b) Why is the silver plating of copper, $\text{K}[\text{Ag}(\text{CN})_2]$ is used instead of AgNO_3 ?

Ans. (a) The colours of many gem stones are due to the presence of transition metal ions & colour are produced due to d-d transition. For example the mineral

corundum Al_2O_3 is colourless when pure but when various M^{3+} transition metal ions are present in trace amounts various gem stones are formed. Ruby is Al_2O_3 containing about 0.5 – 1% Cr.

Ans.(b) This is because if AgNO_3 is used Cu will displace Ag^+ from AgNO_3 . The deposit so obtained is black, soft, non-adhering.

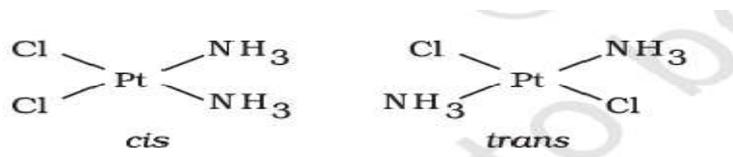
To get a good shining deposit, $[\text{Ag}(\text{CN})_2]^-$ are used as it is a stable complex, the conc. of Ag^+ is very small in the solution. As such no displacement of Ag^+ ions with Cu is possible.

Q3 i) Draw the geometrical isomers of complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

ii) What type of isomerism is shown by complex $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Br}$

iii) Write coordination isomer of $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{C}_2\text{O}_4)_3]$

Ans .i)



ii) Ionisation isomerism and Geometrical isomerism

iii) $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{C}_2\text{O}_4)_3]$

Q4 Give an example of coordination compound in

i). Biological system

ii). Medicinal chemistry

iii). Analytical chemistry

Ans i) Haemoglobin

ii) Cisplatin

iii) EDTA

Q.5. $[\text{Co}(\text{CN})_6]^{3-}$ and $[\text{CoF}_6]^{3-}$ both are octahedral complexes. Write

three differences between them .

Ans . (i) former is inner d complex while latter is outer d complex

(ii) former have d^2sp^3 hybridisation while later shows sp^3d^2 hybridisation.

(iii) former is diamagnetic while later is highly paramagnetic in nature .

Q.6.Explain on the basis of valence bond theory that $[Ni(CN)_4]^{2-}$ ion with square planar structure is diamagnetic and the $[NiCl_4]^{2-}$ ion with tetrahedral geometry is paramagnetic.

Ans.It is so because CN^- ions are strong field ligand and pair up the two unpaired electrons in the d orbitals leaving no unpaired electron in d orbitals and only one 3d orbital vacant which leads to dsp^2 hybridization and square planar geometry. Thus due to absence of unpaired electrons, $[Ni(CN)_4]^{2-}$ ion with square planar structure is diamagnetic.

On the other hand Cl^- ions are weak ligands and do not pair up the two unpaired electrons in the d-orbital . This leads to sp^3 hybridization in $[NiCl_4]^{2-}$ ion with 2 unpaired electrons . Therefore $[NiCl_4]^{2-}$ ion with tetrahedral geometry is paramagnetic in nature .

Q7- A metal ion Mn^{+} having d^4 configuration combines with three bidentate ligands to form a complex compound assuming crystal field splitting energy $>$ Pairing energy

i) Write the electronic configuration of valence electrons of metal Mn^{+} according to CFT

ii) What type of hybridization is shown by Mn^{+}

iii) Name the type of isomerism exhibited by this complex

Ans. i) $t_2g^4e_g^0$

ii) d^2sp^3

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Q8. $\text{CoSO}_4 \cdot \text{Cl} \cdot 5\text{NH}_3$ exists in two isomeric forms A and B. Isomer A reacts with AgNO_3 to give white ppt, but does not react with BaCl_2 . Isomer B gives white ppt with BaCl_2 but does not react with AgNO_3 . Answer the following questions

i) Identify A and B and write their structural formula

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Ans- i) 'A' is $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$

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Q9. Complete the table

S.NO.	Complex ion	Hybridisation	Geometry	Magnetic behaviour
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10-What is meant by unidentate, didentate and ambidentate ligands? Give two examples for each.

Ans- A ligand may contain one or more unshared pairs of electrons which are called the donor

sites of ligands. Now, depending on the number of these donor sites, ligands can be classified as follows:

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Ligands that can attach themselves to the central metal atom through two different atoms are called ambidentate ligands. For example:

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(The donor atoms are N and O)

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COORDINATION CHEMISTRY

3-marks Questions

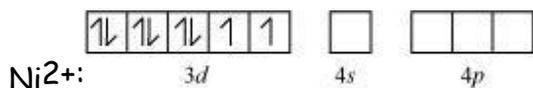
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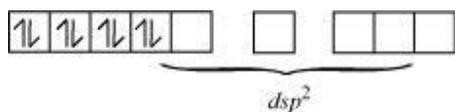
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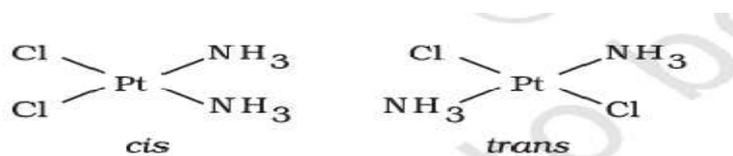
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(The donor atoms are N and O)

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(The donor atoms are C and N)

HALOALKANES AND HALOARENES

3 MARK QUESTION-

Q.1. What happens when(write equation)-

- (a) 1-Bromobutane react with aq. KOH
- (b) But-1-ene react with HBr in presence of peroxide
- (c) Chloroethane react with AgCN

Ans.(i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br} + \text{aq. KOH} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} + \text{KBr}$

(ii) $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2 + \text{HBr (with peroxide)} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$

(iii) $\text{CH}_3\text{CH}_2\text{Cl} + \text{AgCN} \rightarrow \text{CH}_3\text{CH}_2\text{NC} + \text{AgCl}$

Q.2. Classify the following as primary, secondary or tertiary alkyl halide-

- (a) $(\text{CH}_3)_2\text{CHCH}(\text{Cl})\text{CH}_3$
- (b) $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{I}$
- (c) $\text{CH}_3\text{C}(\text{Cl})(\text{C}_2\text{H}_5)\text{CH}_2\text{CH}_3$

Ans. (a) secondary

(b) primary

(c) tertiary

Q.3. Which is -

- (a) better nucleophile Br^- or I^-
- (b) ambident nucleophile CN^- or Cl^-
- (c) show nucleophilic substitution $\text{C}_6\text{H}_5\text{Cl}$ or CH_3Cl

Ans. . (a) I^-

(b) CN^-

(c) CH_3Cl

Q.4. Give reason why-

- (i) Aryl halides are less reactive towards nucleophilic substitution reaction than Alkyl halides
- (ii) Chloromethane react with KCN to form ethanenitrile as the main product but with AgCN it form methyl carbylamines
- (iii) Alkyl chloride react with aqueous KOH leads to the formation of alcohols but in presence of alcoholic KOH leads to formation of alkenes.

Ans. .(i) Aryl halide are less reactive because its C-X bond has partial double bond character due to resonance.

(ii) Because KCN is ionic while AgCN is covalent in nature.

(iii) Because aq. KOH contains OH^- ions which are strong nucleophiles but Alc. KOH contains alkoxide ions which are more stronger base and will remove H^+ .

Q.5. Draw the isomers of compound having molecular formula $C_5H_{11}Br$.

Ans. NCERT-XII page no. 285

Q.6. How will you distinguish between the following pairs-

(i) Chloroform and Carbon tetrachloride

(ii) Chloromethane and Iodomethane

(iii) Chloromethane and Chlorobenzene

Ans. (i) On adding aniline and KOH, Chloroform gives foul smell of isocyanide while Carbon tetrachloride does not react.

(ii) On adding aq. NaOH followed by adding dil. HNO_3 and $AgNO_3$, Chloromethane gives white ppt. while Iodomethane gives yellow ppt.

(iii) On adding aq. NaOH followed by adding dil. HNO_3 and $AgNO_3$ Benzyl Chloride gives white ppt. while Chlorobenzene does not react.

Q.7. Write the equation for the following name reaction-

(a) Williamson's ether synthesis

(b) Wurtz-Fittig reaction

(c) Swart reaction

Ans. (a) Williamson's reaction



(b) Wurtz-Fittig reaction-



(c) Swart reaction-



Q.8. How can you convert the following-

(a) But-1-ene into 1-Bromobutane

(b) 2-Bromobutane into But-2-ene

(c) Chloromethane into Ethane

Ans. (a) $CH_3-CH_2-CH=CH_2 + HBr$ (with peroxide) $\longrightarrow CH_3-CH_2-CH_2-CH_2-Br$

(b) $CH_3-CH_2-CH(Br)CH_3 + alc. KOH \longrightarrow CH_3-CH=CH-CH_3 + KBr + H_2O$

(c) $2CH_3Cl + 2Na$ (with dry ether) $\longrightarrow CH_3-CH_3 + 2NaCl$

Q.9. Write the difference between

(i) enantiomers and diastereomers

(ii) retention and inversion of configuration.

(iii) electrophilic and nucleophilic substitution reactions

Q.10. An alkyl halide X having molecular formula $C_6H_{13}Cl$ on treatment with potassium tert-butoxide gives two isomeric alkenes Y and Z but alkene y is symmetrical. Both alkenes on hydrogenation give 2, 3-dimethylbutane. Identify X, Y and Z.

ALKYL HALIDES AND HALOARENES

3 marks questions

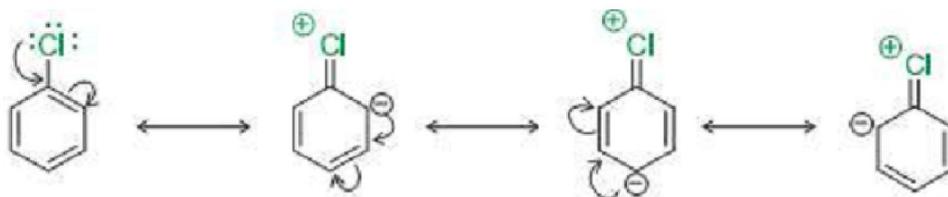
1. Chlorobenzene is less reactive towards nucleophilic substitution reaction. Give any

three justifications.

Ans: Chlorobenzene is less reactive towards nucleophilic substitution due to –

(i) Resonance, C-Cl bond acquires a double bond character

and becomes stronger than a single bond.



(ii) Due to sp^2 hybridisation in C of C-X bond, the carbon becomes more electronegative and holds the electron pair of C-X bond more tightly decreasing the bond length

(iii) Instability of phenyl cation.

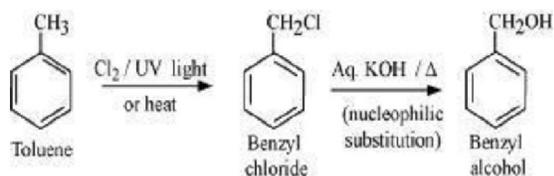
(iv) Repulsion for incoming nucleophile from electron rich ring

Q2 How do you convert the following

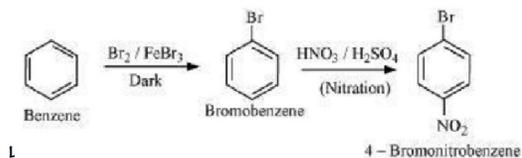
(i) Toluene to benzylalcohol (ii) Benzene to 4-bromonitrobenzene

(iii) Benzylalcohol to 2-phenylethanoic acid

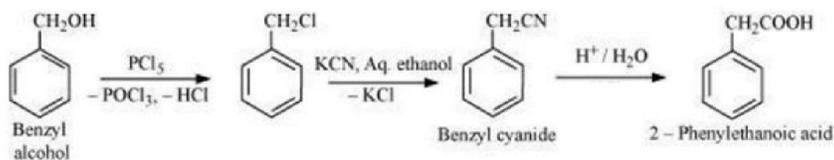
Ans: (i)



(ii)



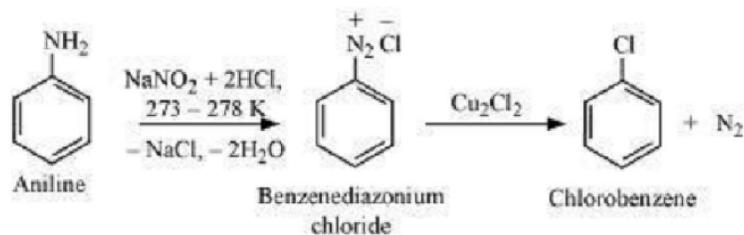
(iii)



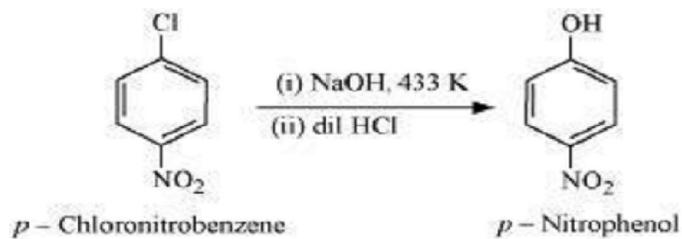
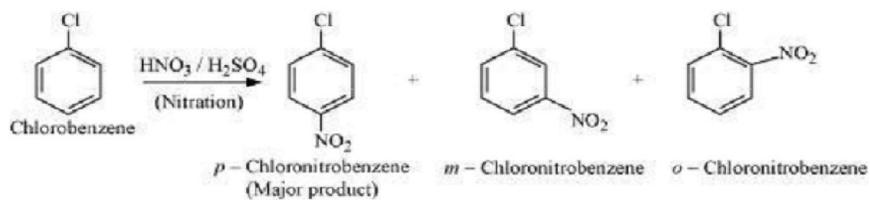
Q3. How are the following conversions carried out?

(i) Aniline to chloro benzene (ii) Chloro benzene to p-nitrophenol

Ans: (i)



(ii)

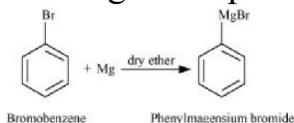


Q4. What happens when

(i) bromobenzene is treated with Mg in the presence of dry ether,

(ii) chlorobenzene is subjected to hydrolysis ?

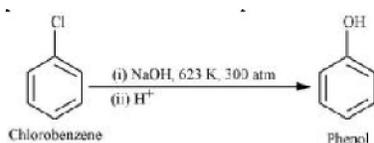
Ans:(i) When bromobenzene is treated with Mg in the presence of dry ether,



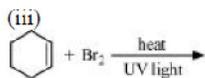
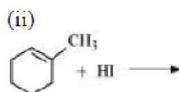
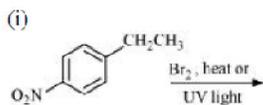
phenylmagnesium bromide is formed.

(ii) Chlorobenzene does not undergo hydrolysis under normal conditions.

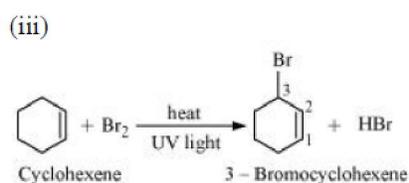
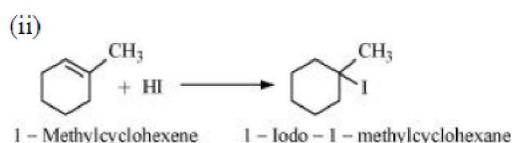
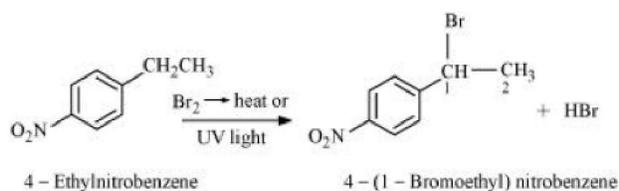
However, it undergoes hydrolysis when heated in an aqueous sodium hydroxide solution at a temperature of 623 K and a pressure of 300 atm to form phenol.



Q5. Draw the structures of major monohalo products in each of the following reactions



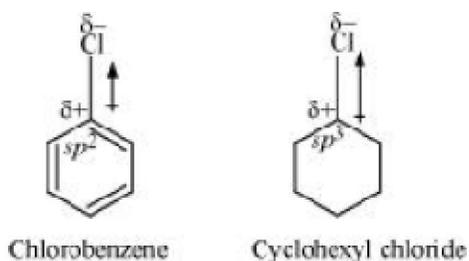
Ans:



Q6. Explain why the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride?

SOL: In chlorobenzene, the Cl-atom is linked to a sp^2 hybridized carbon atom. In cyclohexyl chloride, the Cl-atom is linked to a sp^3 hybridized carbon atom. Now, sp^2 hybridized carbon has more s-character than sp^3 hybridized carbon atom. Therefore, the former is more electronegative than the latter. Therefore, the density of electrons of C-Cl bond near the Cl-atom is less in chlorobenzene than in cyclohexyl chloride.

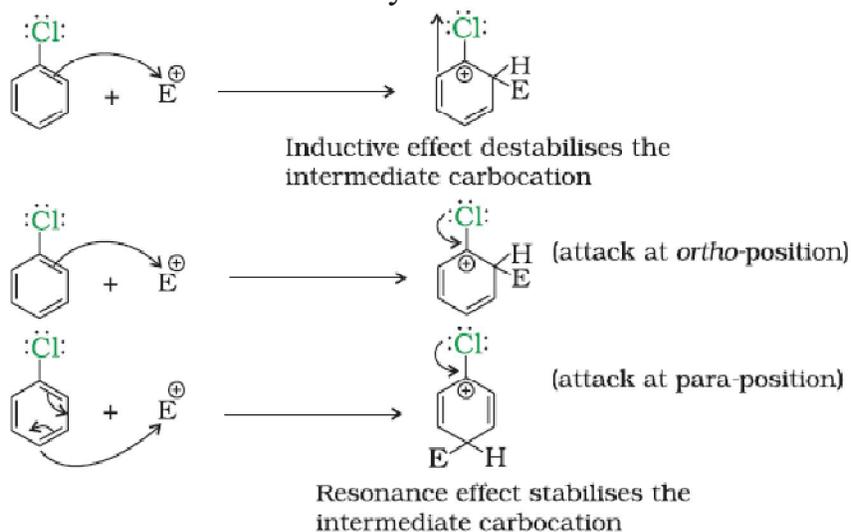
Moreover, the -R effect of the benzene ring of chlorobenzene decreases the electron density of the C-Cl bond near the Cl-atom. As a result, the polarity of the C-Cl bond in chlorobenzene decreases. Hence, the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride



Q7. Although chlorine is an electron withdrawing group, yet it is *ortho*-, *para*-directing in electrophilic aromatic substitution reactions. Why?

Ans: Chlorine withdraws electrons through inductive effect and releases electrons through resonance. Through inductive effect, chlorine destabilises the intermediate carbocation formed during the electrophilic substitution

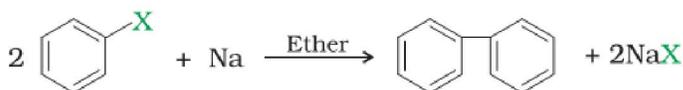
Through resonance, halogen tends to stabilise the carbocation and the effect is more pronounced at *ortho*- and *para*- positions. The inductive effect is stronger than resonance and causes net electron withdrawal and thus causes net deactivation. The resonance effect tends to oppose the inductive effect for the attack at *ortho*- and *para* positions and hence makes the deactivation less for *ortho*- and *para* attack. Reactivity is thus controlled by the stronger inductive effect and orientation is controlled by resonance effect.

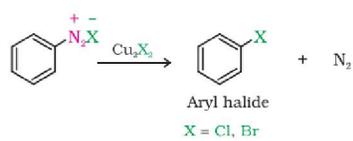
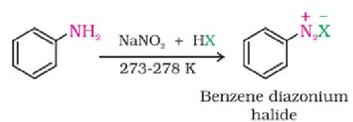


Q8. Write:

(i) Fittig Reaction (ii) Sandmeyer Reaction (iii) Balz-Schiemann reaction

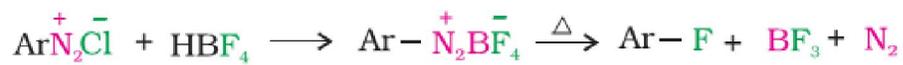
Ans: (i)





(ii)

(iii)



ALCOHOLS

3-Marks

Q.1- Dehydration of alcohols to alkenes is always carried out with conc. H_2SO_4 and not with conc. HCl or HNO_3 . Why?

Ans: Dehydration of alcohols to alkenes occurs through the formation of carbocation intermediate. If HCl is used then chloride ion being a good nucleophile will result into substitution reaction forming alkyl chloride on the other hand, if H_2SO_4 is used then the bisulphate ion being very weak nucleophile cannot result into substitution reaction. Rather the carbocation loses a proton to form elimination product alkene.

Conc. HNO_3 also cannot be used because it is a strong oxidizing agent and will preferably result into the oxidation of alcohols to aldehydes, ketones or carboxylic acid.

Q.2- Show how will you synthesize:

(i) 1-phenylethanol from a suitable alkene.

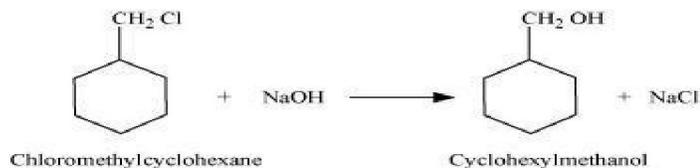
(ii) cyclohexyl methanol using an alkyl halide by an $\text{S}_\text{N}2$ reaction.

(iii) pentan-1-ol using a suitable alkyl halide?

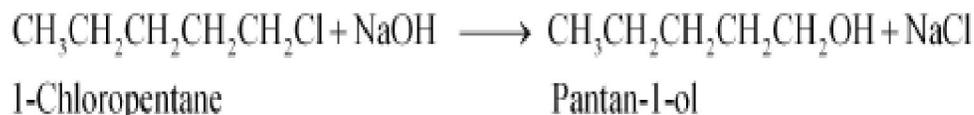
ANS.(i) By acid-catalyzed hydration of ethylbenzene (styrene), 1-phenylethanol can be synthesized.



(ii) When chloromethyl cyclohexane is treated with sodium hydroxide, cyclohexyl methanol is obtained.



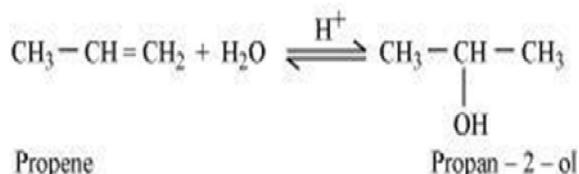
(iii) When 1-chloropentane is treated with NaOH , pentan-1-ol is produced.



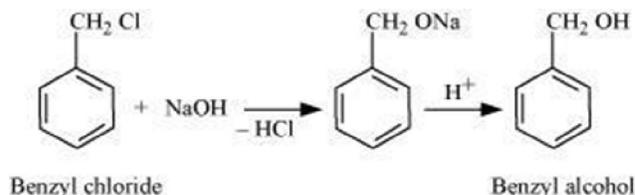
Q.3-How is the following conversions carried out?

(i) Propene \rightarrow Propan-2-ol (ii) Benzyl chloride \rightarrow Benzyl alcohol (iii) Ethyl magnesium chloride \rightarrow Propan-1-ol.

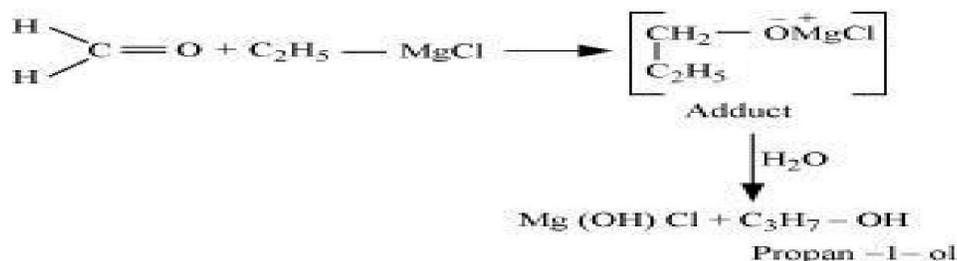
Ans. (i) If propene is allowed to react with water in the presence of an acid as a catalyst, then propan-2-ol is obtained.



(ii) If benzyl chloride is treated with NaOH (followed by acidification) then benzyl alcohol is produced.

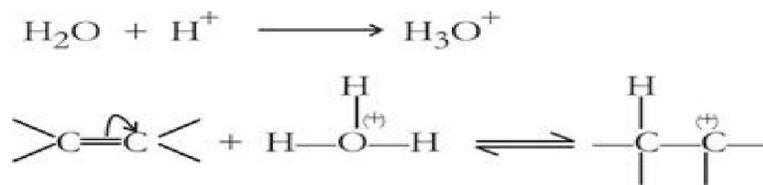


(iii) When ethyl magnesium chloride is treated with methanol, an adduct is produced which gives propan-1-ol on hydrolysis.

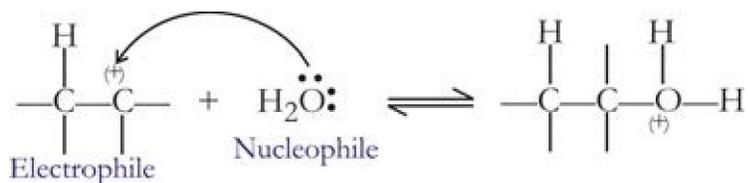


Q.4- Write the mechanism of hydration of ethene to form ethanol.

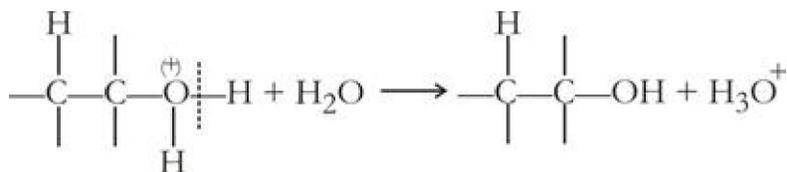
Ans. Mechanism: Step 1. Protonation



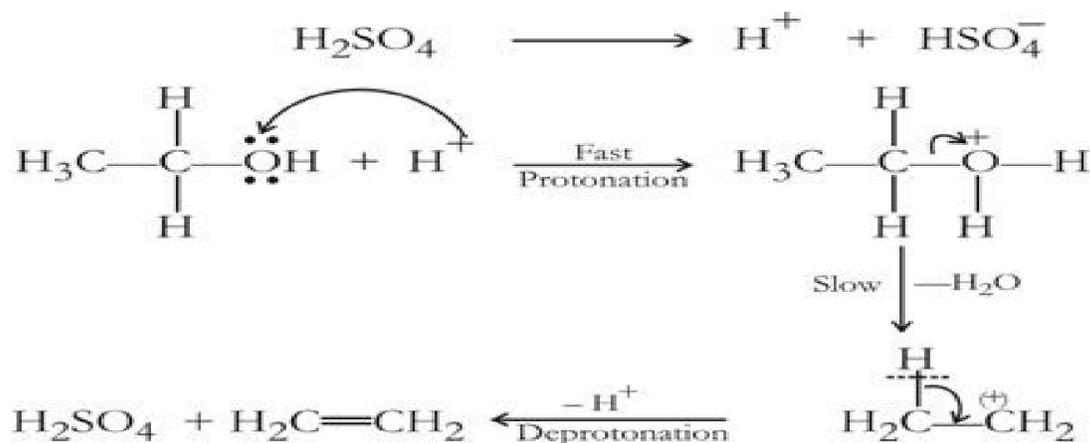
Step 2. Nucleophilic attack of water on carbocation



Step 3. Deprotonation

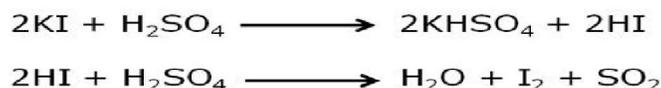


Q.5- Write the mechanism of dehydration of ethanol using Conc. H_2SO_4 at 443 K.



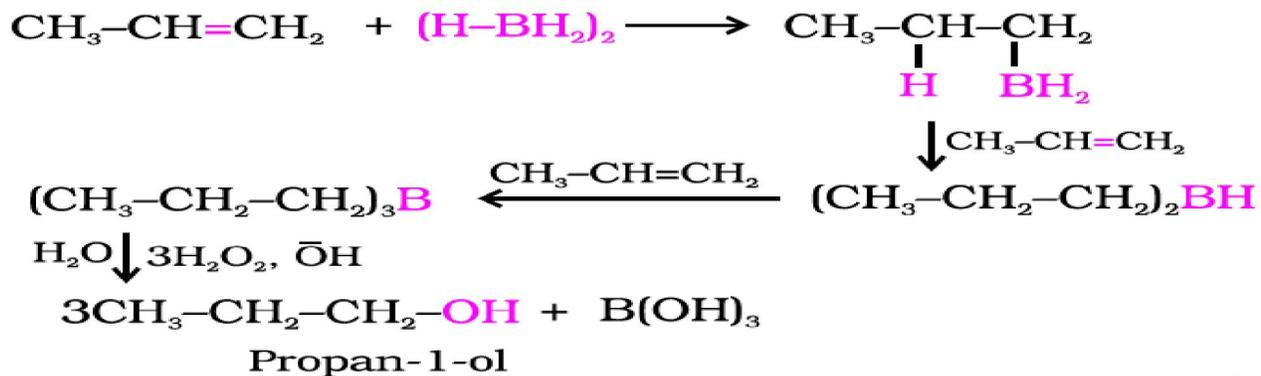
Q.6-Why is sulphuric acid not used during the reactions of alcohols with KI?

Ans. Sulphuric acid is an oxidizing agent. It oxidizes HI produced during the reaction, to I₂.



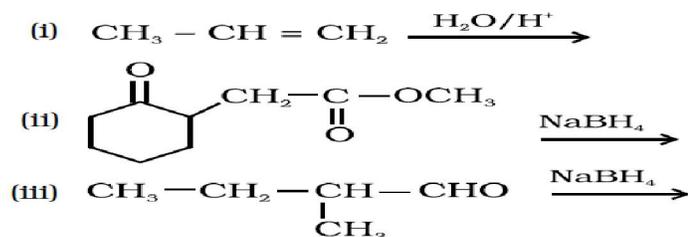
Q.7-What is meant of hydroboration-oxidation reaction? Illustrate it with an example.

Ans. **By hydroboration-oxidation:** Diborane (BH₃)₂ reacts with alkenes to give trialkylboranes as addition product. This is oxidised to alcohol by hydrogen peroxide in the presence of aqueous sodium hydroxide.

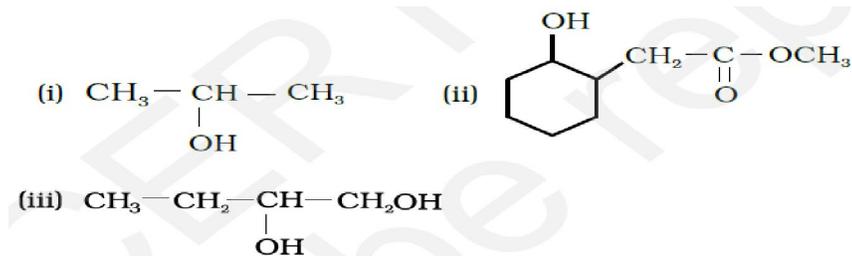


The addition of borane to the double bond takes place in such a manner that the boron atom gets attached to the sp² carbon carrying greater number of hydrogen atoms. The alcohol so formed looks as if it has been formed by the addition of water to the alkene in a way of Anti-Markovnikov's rule. In this reaction, alcohol is obtained in excellent yield.

Q.8-Write the structures of the products of the following reactions.

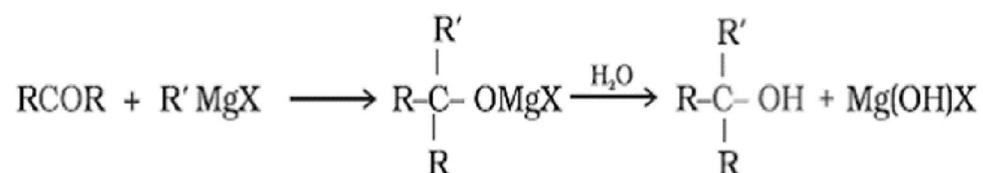
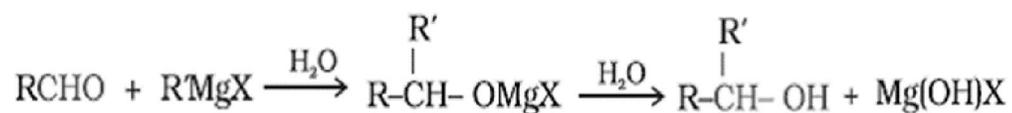
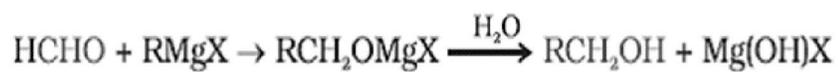


Ans.



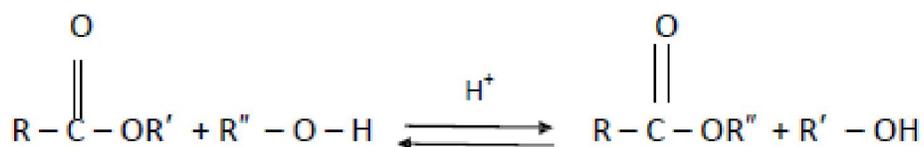
Q.9- How are primary, secondary and tertiary alcohols prepared from Grignard reagents?

Ans.



Q.10- Write short notes on transesterification.

Ans. When an ester is treated with excess of another alcohol other than the one from which ester has been derived in presence of corresponding sodium or potassium alkoxide or an acid $\text{H}_2\text{SO}_4/\text{HCl}$ as catalyst a new ester is formed.

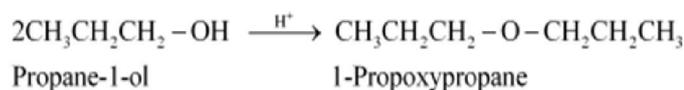


ETHERS

3-Marks

1- How is 1-propoxypropane synthesised from propan-1-ol? Write mechanism of this reaction.

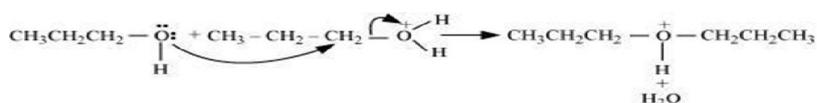
Ans. 1-Propoxypropane can be synthesized from Propan-1-ol by dehydration. Propan-1-ol undergoes dehydration in the presence of protic acids (such as H_2SO_4 , H_3PO_4) to give 1-propoxypropane. The mechanism of this reaction involves the following three steps:



Step 1: Protonation



Step 2: Nucleophilic attack

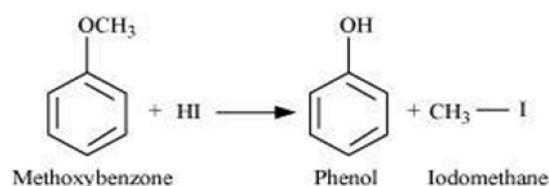
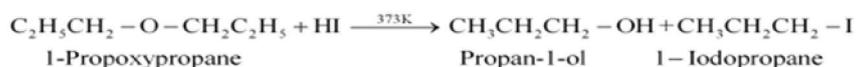


Step 3: Deprotonation

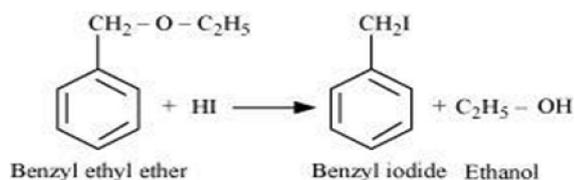
2- Write the equation of the reaction of hydrogen iodide with:

(i) 1-propoxypropane (ii) Methoxybenzene and (iii) Benzyl ethyl ether

Ans.(i)



(ii)

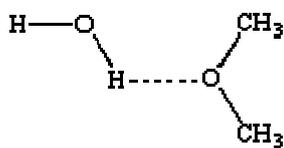


(iii)

3-Give reasons:

i. ethers are less likely to be soluble in water than the alcohol with the same molecular weight.

Ans: Ethers can act as a hydrogen-bond acceptor, as shown in the figure below. But, they can't act as hydrogen-bond donors



ii. ethers are aprotic solvents.

Ans: They do not have any ionisable hydrogens.

iii. Zeisel test.(acetic acid and hydrogen iodide)

4. Write Structures of:

i. 1,2-dimethoxy ethane
benzene.

ii. 2- methoxypropane

iii. 3-methyl butoxy

Ans: i. $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_3$

ii. $\text{CH}_3\text{OCH}(\text{CH}_3)_2$

iii. $\text{C}_6\text{H}_5\text{OCH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

5. Predict the products of the following reactions:

i. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_3 + \text{HBr}$

ii. $(\text{CH}_3)_3\text{COC}_2\text{H}_5 + \text{HI}$

iii. $\text{C}_6\text{H}_5\text{OC}_2\text{H}_5 + \text{conc. H}_2\text{SO}_4 + \text{conc. HNO}_3$

Ans: i. $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{CH}_3\text{OH}$

ii. $(\text{CH}_3)_3\text{Cl} + \text{C}_2\text{H}_5\text{OH}$

iii. $\text{C}_6\text{H}_4(\text{p-NO}_2)\text{OC}_2\text{H}_5$

6. Illustrate with examples the limitation of Williamson synthesis for the preparation of certain type of ethers.

Ans: Williamson's synthesis cannot be employed for tertiary alkyl halides as they yield alkenes instead of ethers. For example: the reaction of CH_3ONa with $(\text{CH}_3)_3\text{CBr}$ gives exclusively 2-methyl propene.

ii. Aryl halides and vinyl halides cannot be used as substrates because of their low reactivity in nucleophilic substitution.

7. Give reasons :

i. p-nitro anisole is major product of nitration of anisole.

ii. Ethers can be protonated easily.

iii. aliphatic ethers are more volatile than aromatic ethers.

Ans: i. It is more stable over o-isomer due to less repulsion.

ii. Due to high electron density over ethereal oxygen atom.

iii. Due to lower molar masses.

8. Write 3 uses of ethers.

i. Solvent in reactions

ii. anaesthetic agent

iii. Sedating agent

9. Answer in reference to ethers.

i. Hybridization of O-atom in ethers.

ii. alpha H-atoms are acidic in nature.

iii. alternate name of unsymmetrical ether.

Ans: i. sp^3 ii. their C-atom is attached with more electronegative O-atom.

iii. Mixed ethers.

10. Give 3 examples of aliphatic polyethers.

i. Paraformaldehyde. ii. Polyethyleneglycol iii. Polytetrahydrofuran.

TOPIC: PHENOL

Three Marks Questions:

1 Give chemical test to distinguish between

- (a) C_6H_5OH and $C_6H_{11}OH$
- (b) phenol and Benzyl alcohol.
- (c) Phenol and alcohol

Ans.(a) Add a few drops of blue litmus separately to the solutions of both the compounds taken in two test tubes. The solution which changes the colour of blue litmus to red is that of phenol. The solution which does not bring about any colour change is that of cyclohexanol.

- (b) Phenols give violet colour with ferric chloride while benzyl alcohol does not give this
- (c) Phenol gives a characteristic violet/red coloration with neutral $FeCl_3$ while alcohol (e.g., ethyl alcohol) does not respond to this test.

2. Account for the following:

- (a) phenol has higher boiling point than of comparable masses hydrocarbon.
- (b) O-nitrophenol is more acidic than o- methoxyphenol
- (c) Phenol does not give protonation reaction readily

Ans: (a) Because of intermolecular H-bonding in phenol , it has higher boiling point.

(b) $-NO_2$ group is an electron withdrawing group and tend to decrease the electron density on $-OH$ thereby increasing its tendency to lose H^+ ions ,consequently increasing the acidic nature .but in o-methoxyphenol, $-OCH_3$ group has +I effect and hence less is acidic .

(c) C-OH in phenol is stabilized due to resonance and electron pair at oxygen atom in phenol is not readily available to proton ,thus protonation not occurs readily.

3.Account for the following:

- (a) How can we produce nitro phenol from phenol?
- (b)What product obtained when the reactions of alcohol/phenol and with acid chloride in the presence of pyridine?
- (c).Phenol has much less pK_a than alcohol, explain.

Ans (a) By nitration of phenol:



(b) Alcohol/ phenol react with acid chloride in the presence of pyridine to form ester.



(c)Because of electron withdrawing nature of benzene, phenoxide ion formed after removal of H^+ is more stable than the alkoxide ion formed. Hence phenol is more acidic than alcohol having high k_a and less pK_a

4. Give three reasons for the acidic behavior of phenol.

Ans: Phenol is acidic in nature because:

- phenol, due to resonance, the positive charge rests on oxygen, making the shared pair of electrons more towards oxygen and hydrogen as H^+
- The carbon attached to OH is sp^2 hybridized and is more electronegative, this decreases the electron density on oxygen, increasing the polarity of O-H bond and ionization of phenol.
- The phenoxide ion formed by loss of H^+ is more resonance stabilized than phenol itself.

5. Do as directed:

(i) Arrange the following compounds in the decreasing order of acid strength.

Propan-1-ol, 2, 4, 6-trinitrophenol, 3-nitrophenol, 3,5-dinitrophenol.

(ii) Give any two chemical tests to know whether a given -OH group is alcoholic or phenolic in nature?

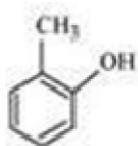
Ans: (i) 2, 4, 6-trinitrophenol > 3,5-dinitrophenol > 3-nitrophenol > propan-1-ol

(ii) (a) Phenolic -OH group gives blue or violet colorations with neutral $FeCl_3$ while alcoholic -OH group does not.

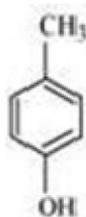
(b) Phenol gives white ppt with Br_2 water whereas alcohol does not.

6. Write IUPAC names of the following compounds:

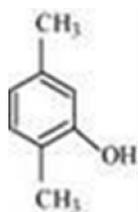
(i)



(ii)



(iii)



Ans:

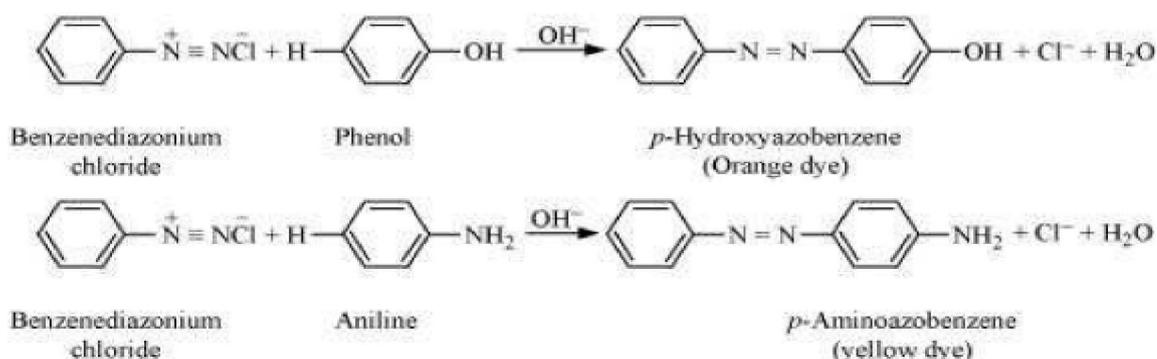
(i) 2-Methylphenol

(ii) 4-Methylphenol

(iii) 2, 5-Dimethylphenol

7. What happens when phenol or aromatic amines react with Arenediazonium? What is the name given for such reaction?

Ans: The reaction of joining two aromatic rings through $-N=N-$ is known as coupling reaction. Arenediazonium salts react with phenols or aromatic amines to form coloured azo compounds.



Such reaction known as Coupling Reaction.

8. Give reason:

(i). Phenol is acidic in nature.

(ii) Phenol has a smaller dipole moment than methanol.

(iii) . *o*- nitrophenol has lower boiling point (is more volatile) than *p* – nitrophenol.

Ans.(i) Phenol is acidic in nature because phenol, due to resonance, the positive charge rests on oxygen making the shared pair of electrons more towards oxygen and hydrogen as H^+ .

(ii) In phenol due to electron rich benzene ring the C-O bond is less polar whereas in methanol the C-O bond is highly polar. Therefore the dipole moment of methanol is higher than phenol.

(iii) *p*- nitrophenol has intermolecular hydrogen bonding which increases the boiling point while in *o*- nitro phenol due to presence of intra molecular hydrogen bonding, there is a decrease in boiling point and increase in volatility.

9. Write structural formula and give IUPAC names.

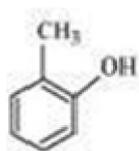
(i) *m*- cresol

(ii) main product formed by action of excess of Br_2 on phenol.

(iii) Benzyl Alcohol

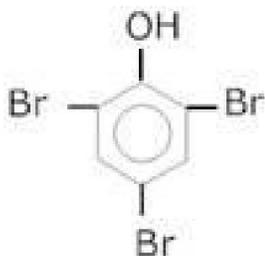
Ans

(i)

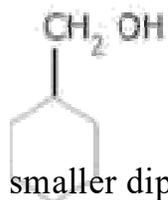


3 methyl alcohol

(ii) 2,4,6-tribromophenol



(iii)



1- Phenyl methanol

10.(i) Phenol has smaller dipole moment than methanol. Why?

(ii) Arrange the following compounds in the increasing order of acid strength.

Propan-1-ol, 2, 4, 6-trinitrophenol, 3-nitrophenol, 3,5-dinitrophenol

(iii) Name the products obtained when anisole is treated with HI?

Ans(i) Due to the electron withdrawing effect of phenyl group present in contrast to the electron releasing group present in alcohols. .

(ii) 2, 4, 6-trinitrophenol > 3,5-dinitrophenol > 3-nitrophenol > propan-1-ol

(iii) . $C_6H_5OCH_3 + HI \rightarrow C_6H_5OH + CH_3I$

Aldehyde and Ketone

3 MARKS QUESTIONS

Q1. Distinguish the following pair of compounds

- Propanal and Propanone
- Acetophenone and benzophenone
- Phenol and benzoic acid

Ans. a) Propanal gives a silver mirror or greyish ppt. on oxidation by Tollen's reagent but propanone does not.

b) Acetophenone gives a positive iodoform test with sodium hypo iodide while benzophenone does not.

c) Benzoic acid on treatment with sodium hydrogen carbonate produces effervescences due to evolution of CO_2 , while phenol does not.

Q2. Give reason:

(i) Ethanoic acid is a weaker acid than benzoic acid.

(ii) Formic acid is a stronger acid than acetic acid.

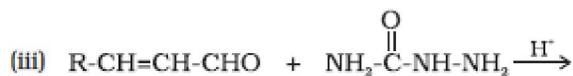
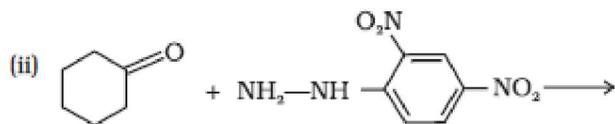
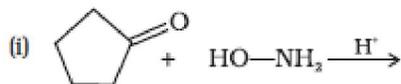
(iii) Chloroacetic acid is a stronger acid than acetic acid.

(i) due to $-I$ effect of phenyl group the conjugate base of benzoic acid is stable.

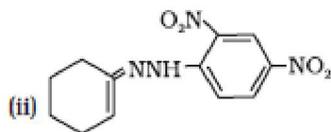
(ii) due to $+I$ effect of $-\text{CH}_3$ group .

(iii) due to $-I$ effect of $-\text{Cl}$ group.

Q3. Predict the major products:



Ans.



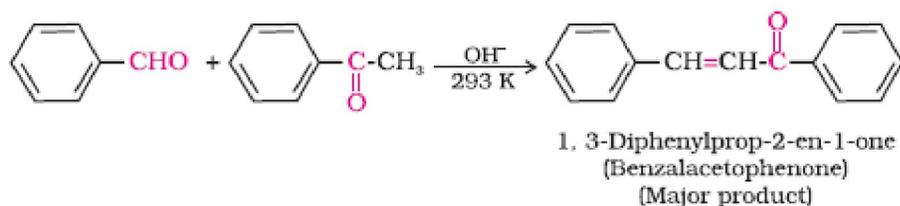
Q4. Write an equation for the following name reactions:

(i) Cross –Aldol condensation.

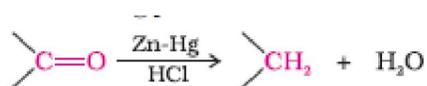
(ii) Stephen reaction

(iii) Clemmensen reaction

Ans. (i)



(iii)



Q5. Answer the following questions

(a) Why does methanal not give aldol condensation while ethanal gives?

(b) Arrange the following in order of increasing boiling points:



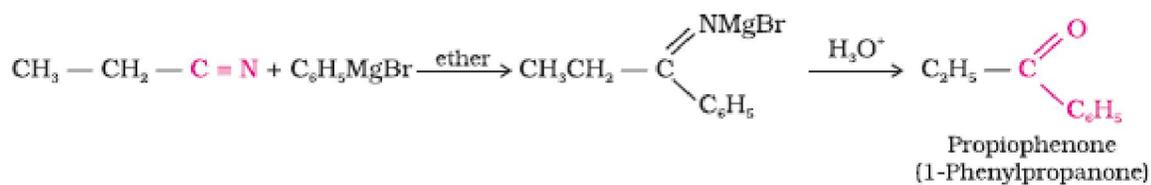
(c) How will you convert Phenyl magnesium bromide to Propiophenone? (Write the equation)

Ans. (a) This is because only those compounds which have alpha hydrogen atoms can undergo aldol condensation. Ethanol possesses alpha -hydrogen and Methanal has no alpha hydrogen atoms, hence does not undergo aldol condensation.



(hydrocarbon) (ether) (aldehyde) (alcohol)

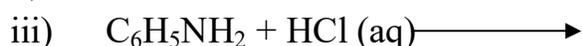
(c)



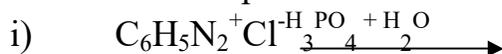
AMINES- Question Bank Amines

3 Marks Questions

1) Complete the following reactions:



2) Write the main products of the following reactions:



3) Write the main products of the following reactions:



4) Account for the following:

(i) pK_b of aniline is more than that of methylamine.

(ii) Ethylamine is soluble in water whereas aniline is not.

(iii) Aniline does not undergo Friedel-Craft's reaction.

5) State reasons for the following:

i) Primary amines have higher boiling points than tertiary amines.

ii) Although $-\text{NH}_2$ group is an ortho and para directing group, nitration of aniline gives along with ortho and para derivatives meta-derivative also.

iii) Aromatic primary amines cannot be prepared by Gabriel phthalimide synthesis.

6) How are the following conversions carried out?

a) Aniline to nitrobenzene

b) Ethanamine to N-Ethylethanamide

c) Chloroethane to propan-1-amine

7) How are the following conversions carried out?

a) Nitrobenzene to benzoic acid

b) Benzene to m-bromophenol

c) Benzoic acid to aniline

8) Accomplish the following conversions:

i) Aniline to 2,4,6-tribromofluorobenzene

ii) Benzyl chloride to 2-phenylethanamine

iii) Chlorobenzene to p-chloroaniline

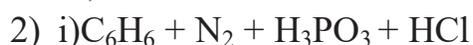
9) Write reactions for following name reactions

A coupling reaction

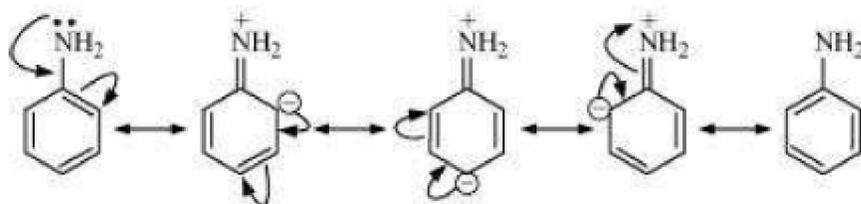
Benzoylation

Nitration of aniline

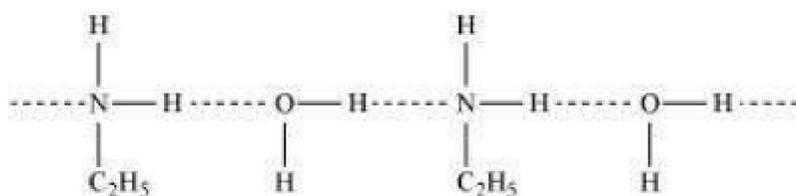
Answers Of 3 Marks Questions



- 4) i) In aniline, lone pair of electrons on N atom is delocalised over the benzene due to which electron density on the nitrogen decreases. On the other hand, electron density on N atom increases in case of methylamine due to +I effect of methyl group. So, aniline is less basic than methylamine and hence pK_b value of aniline is more than that of methylamine.

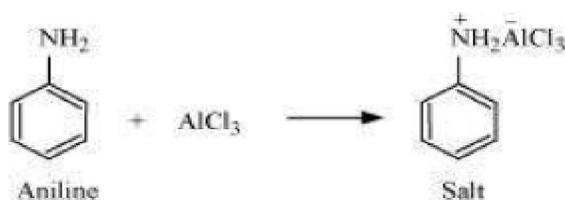


- ii) Ethylamine is soluble in water due to intermolecular hydrogen bonding which is very very less in case of aniline due to large hydrocarbon part in aniline.

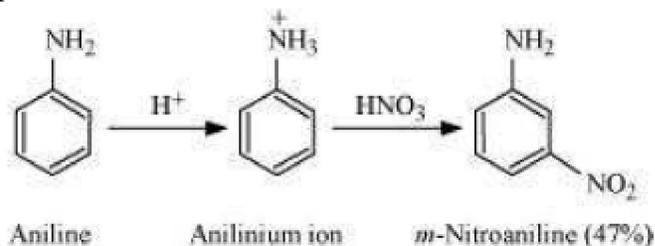


Ethylamine

- iii) Because aniline being Lewis base reacts with AlCl_3 , Lewis acid to form salt. Due to this N of aniline acquires + charge and hence acts as strong deactivating group for further reaction.

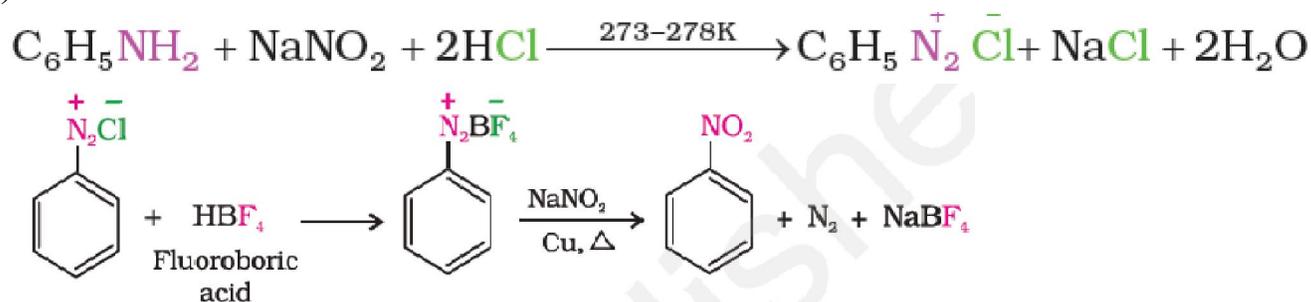


- 5) i) Due to extensive intermolecular H-bonding in case of primary amines which is absent in tertiary amines
 ii) Because nitration is carried in acidic conditions and in acidic conditions aniline gets protonated and is converted to anilinium ion which is meta directing group.

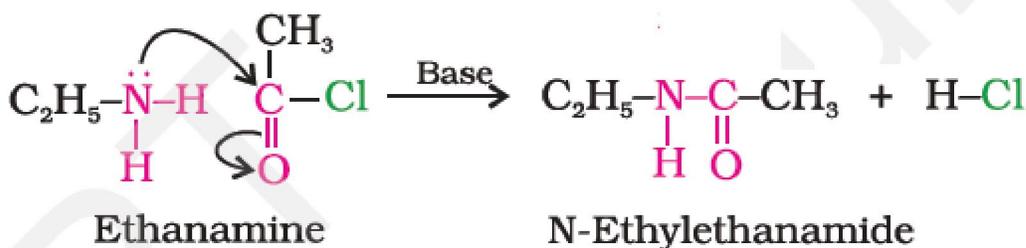


iii) Gabriel phthalimide synthesis is used for the preparation of aliphatic primary amines. It involves nucleophilic substitution (S_N2) of alkyl halides by the anion formed by the phthalimide. But aryl halides do not undergo nucleophilic substitution with the anion formed by the phthalimide. Hence, aromatic primary amines cannot be prepared by this process.

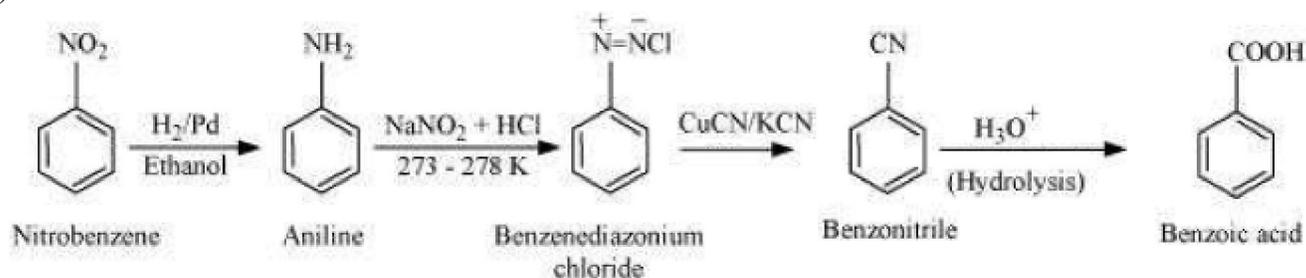
6) i)



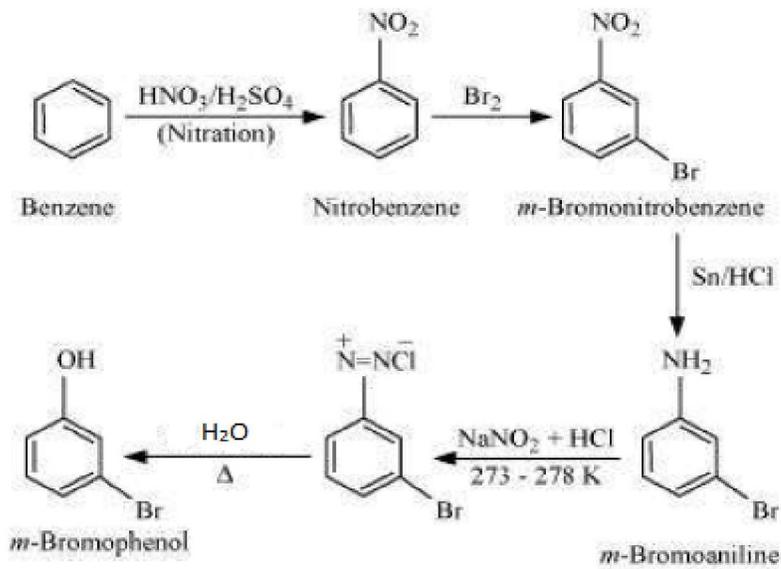
ii)



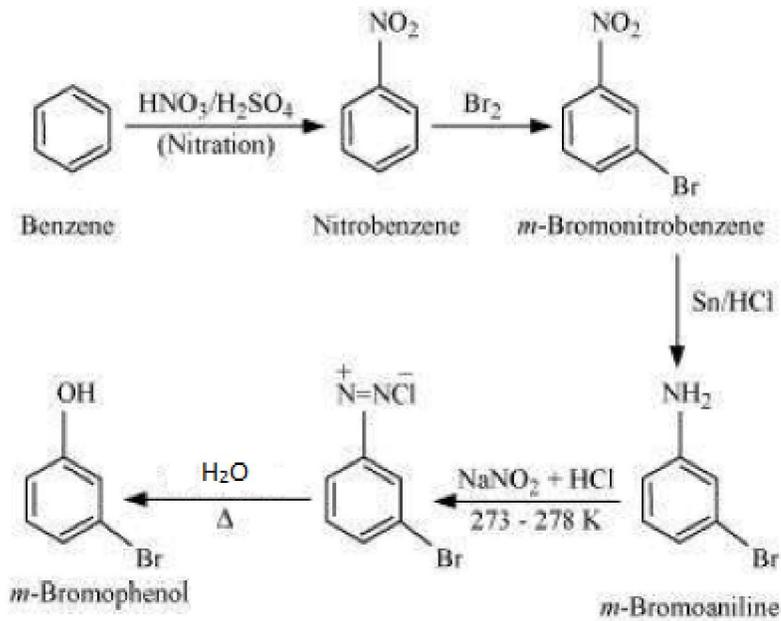
7) i)



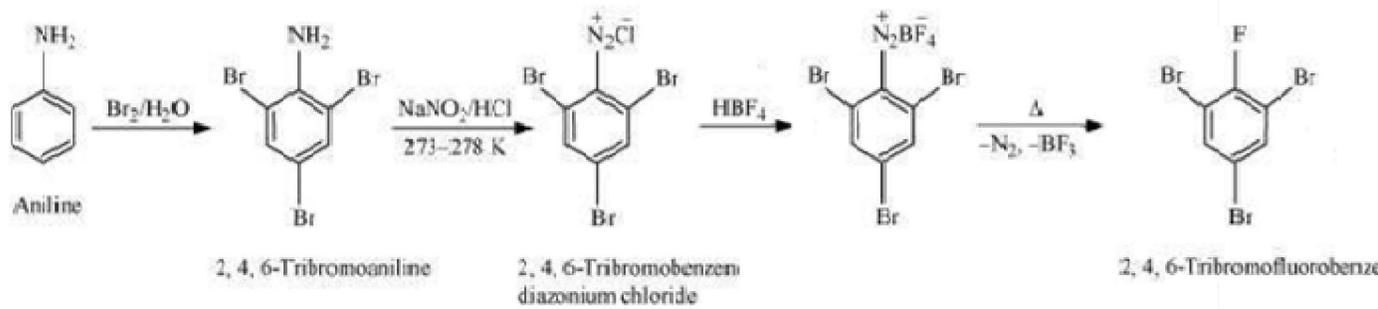
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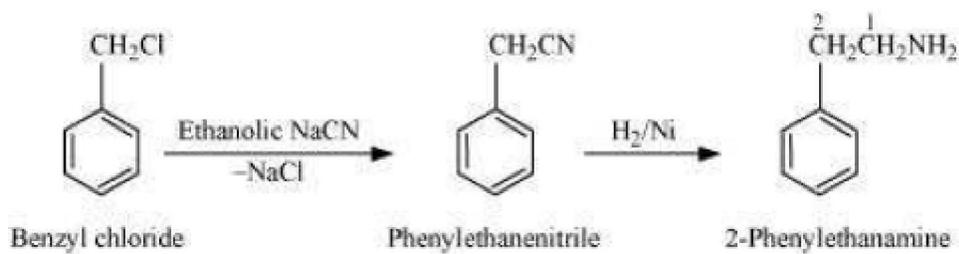
iii)



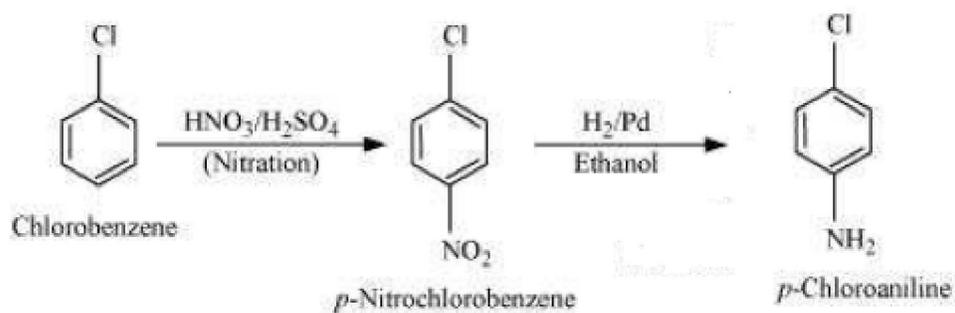
8) i)



ii)



iii)



ALDEHYDE

VERY SHORT ANSWER QUESTIONS

SHORT ANSWER TYPE QUESTION

(3 Marks)

Q1. Distinguish the following pair of compounds

- a) Propanal and Propanone
- c) Benzaldehyde and Acetophenone

Ans.(a) Propanal gives a silver mirror or greyish ppt. on oxidation by Tollen's reagent but propanone does not.



Propanal Tollen's reagent

silver mirror

(b) Benzaldehyde gives a silver mirror or greyish ppt. on oxidation by Tollen's reagent but acetophenone does not.



Acetophenone gives Iodoform test while benzaldehyde does not give.

(2)

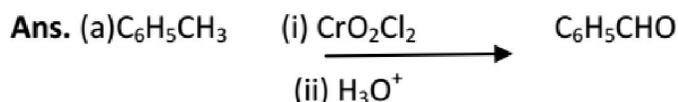
Explain why o-hydroxybenzaldehyde is a liquid at room temperature while p-hydroxybenzaldehyde is a high melting solid.

Due to intramolecular H-bonding, o-hydroxybenzaldehyde exists as discrete molecules, whereas due to intermolecular H-bonding, p-hydroxybenzaldehyde exists as associated molecules. To break these intermolecular H-bonds, a large amount of energy is needed. Consequently, p-hydroxybenzaldehyde has a much higher m.p. and b.p. than that of o-hydroxybenzaldehyde. As a result, o-hydroxybenzaldehyde is a liquid at room temperature while p-hydroxybenzaldehyde is a high melting solid.

3

How will you carry out the following conversions (Write chemical equations):

- Toluene to Benzaldehyde
- Benzene to acetophenone
- Benzoyl chloride to benzaldehyde



or by using CrO_3



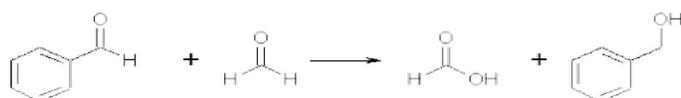
4 Define the following reactions with equation –

- Cannizzaro reaction
- Aldol condensation
- Rosenmund reaction

Ans.(a)

CANNIZARO REACTION

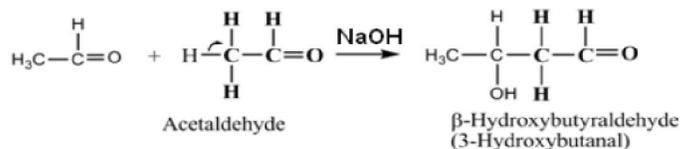
Aldehydes which do not have a α -hydrogen atom undergo self oxidation and reduction (disproportionation) reaction on treatment **with concentrated alkali**, to yield carboxylic acid salt and an alcohol respectively.



(b)

ALDOL CONDENSATION

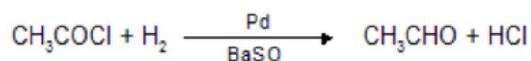
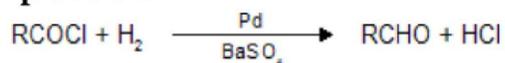
Aldehydes and ketones having at least one α -hydrogen condense in the presence of dilute alkali as catalyst to form β -hydroxy aldehydes (aldol) or β -hydroxy ketones (ketol).



(c)

1. ROSENMUND REDUCTION

Acylchlorides when hydrogenated over catalyst, palladium on barium Sulphate yield aldehydes. Sulphur and Quinoline can be used as **poison**.

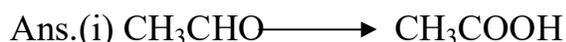


(5). How can you convert the following-

(i) ethanal into ethanoic acid

(ii) ethanal into ethanol

(iii) ethanoic acid into ethanol

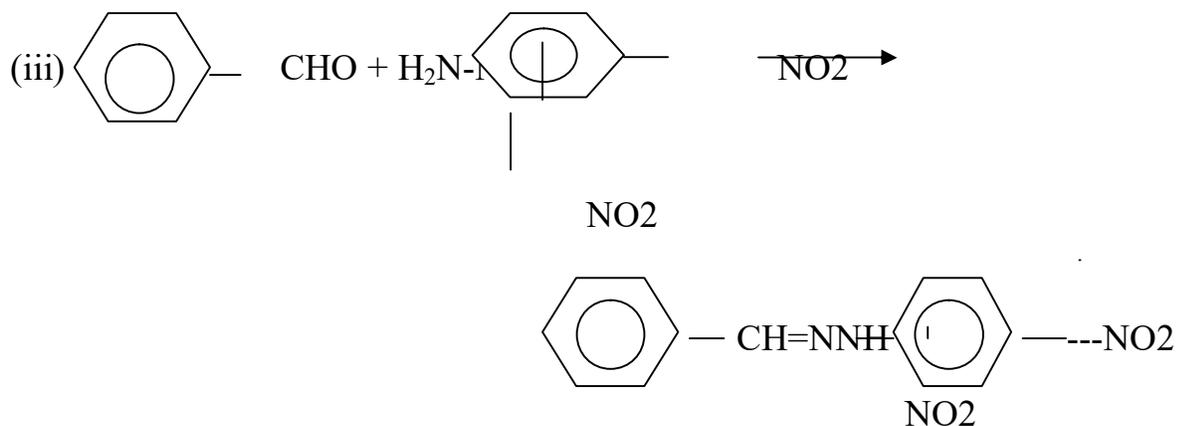


(6) What happens when (write equation)

(i) Ethanal react with HCN

(ii) Formaldehyde reacts with phenyl hydrazine

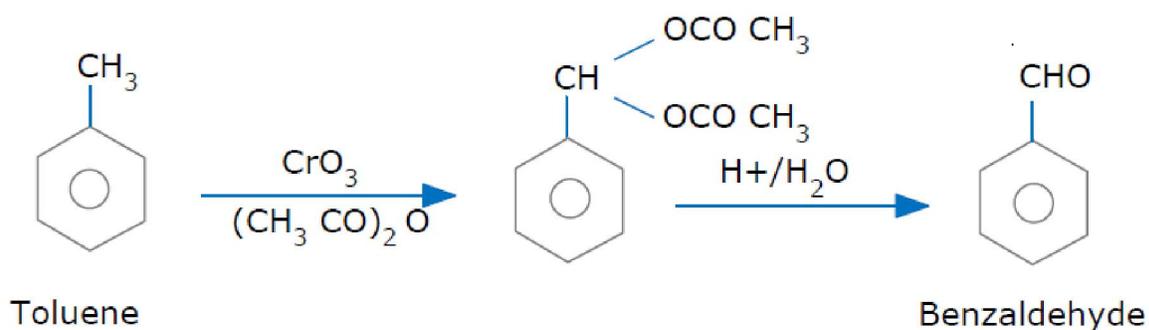
(iii) Benzaldehyde reacts with 2,4-DNP .



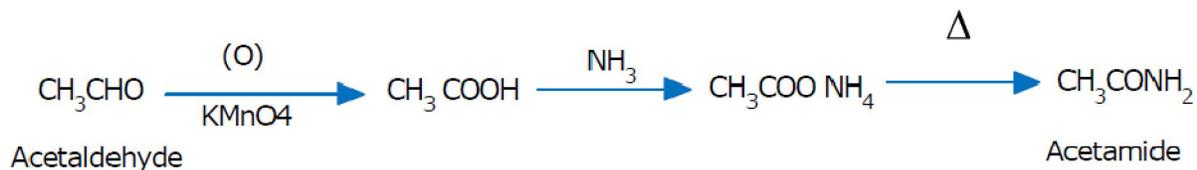
(7) How will you convert the following:

1. Toluene to benzaldehyde
2. Acetaldehyde to Acetamide
3. Acetaldehyde to Acetone

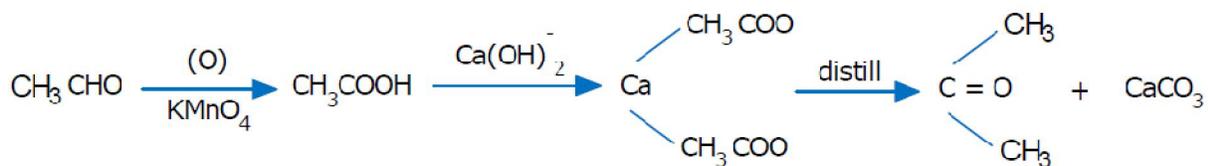
Ans.(a)



(b)

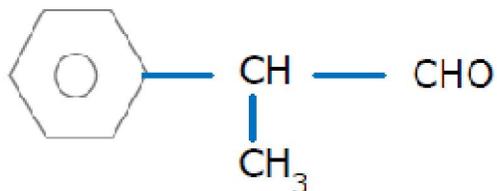


(c)

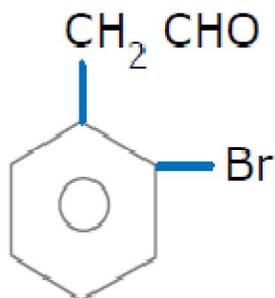


(8) Give IUPAC name of the following

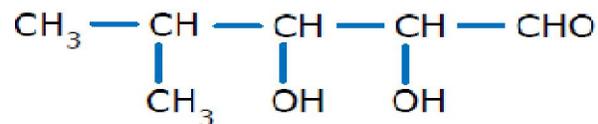
(i)



(ii)



(iii)



Ans. (i) 2-Methyl-2-phenylethanal

(ii) 2-(2-Bromophenyl)ethanol

(iii) 2,3,4-Trihydroxypentanal

(9) Arrange the following:

(i) Ethanal, Propanal, Butanal, Butanone (increasing order of reactivity towards nucleophilic addition reaction)

(ii) Propanal, Propanone, Propanol (increasing order of boiling point)

(iii) p-tolualdehyde, Benzaldehyde, p-nitrobenzaldehyde, Acetophenone, (increasing order of reactivity)

Ans. (i) Butanone < Butanal < Propanal < Ethanal

(ii) Propanal < Propanone < Propanol

(iii) Acetophenone < p-tolualdehyde < Benzaldehyde < p-nitrobenzaldehyde

(10)(i) Give one use of formalin.

(ii) What is the function of BaSO₄ in Rosenmund Reaction?

(iii) What is Rochelle Salt?

Ans. (i) Formalin is used as a disinfectant, preservative for biological specimen and in leather industry.

(ii) BaSO₄ act as catalyst poison which prevent the reduction of aldehyde into alcohol.

(iii) Sodium potassium tartarate.

AMINES(PREPARATION & PHYSICAL PROPERTIES)

3 MARK QUESTION (10)

1. Why aromatic amines can not be synthesized by Gabriel phthalamide reaction?

Ans: In the second step of the reaction, when we use alkyl halide it undergoes nucleophilic substitution reaction whereas the aryl halide does not undergo nucleophilic substitution reaction.

2. What is Hinsberg reagent and where it is used?

Ans: It is an excellent test for distinguishing primary, secondary and tertiary amines. In this test, the amine is shaken well with Hinsberg reagent in the presence of aqueous alkali (either KOH or NaOH). A reagent containing an aqueous sodium hydroxide solution and benzenesulfonyl chloride is added to a substrate.

3. Describe the Hofmann's bromamide reaction.

Ans: Hofmann's bromamide reaction: It involves the reaction of bromine with an acid amide in the presence of an alkali. It results in the formation of a primary amine with one carbon less than the parent compound. Here, the alkyl group migrates from carbonyl, with the elimination of CO_2 .

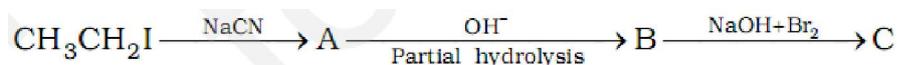
4. An aromatic compound 'A' on treatment with aqueous ammonia and heating forms compound 'B' which on heating with Br_2 and KOH forms a compound 'C' of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the structures and IUPAC names of compounds A, B and C.

Ans: A is Benzoyl chloride $\text{C}_6\text{H}_5\text{COCl}$

B is Benzamide $\text{C}_6\text{H}_5\text{CONH}_2$

C is Aniline $\text{C}_6\text{H}_5\text{NH}_2$

5. Give the structures of A, B and C in the following reaction

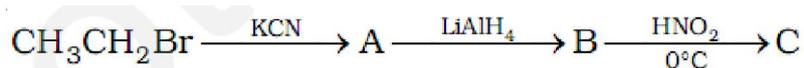


Ans: A is $\text{CH}_3\text{CH}_2\text{CN}$

B is $\text{CH}_3\text{CH}_2\text{CONH}_2$

C is $\text{CH}_3\text{CH}_2\text{NH}_2$

6. Give the structures of A, B and C in the following reaction



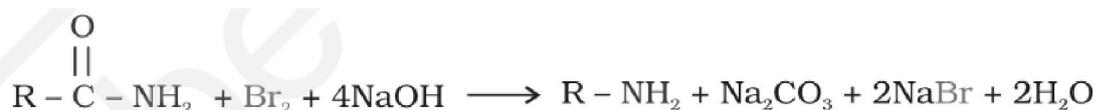
Ans: A is $\text{CH}_3\text{CH}_2\text{CN}$

B is $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

C is $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$

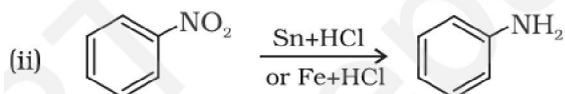
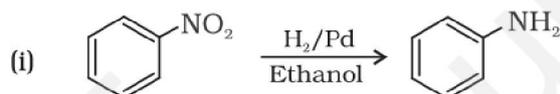
7. Write short notes on Hofmann's bromamide reaction.

Ans: Hoffmann developed a method for preparation of primary amines by treating an amide with bromine in an aqueous or ethanolic solution of sodium hydroxide.



8. Suggest two ways by which aniline can be prepared by the reduction of nitro group.

Ans: Nitro compounds are reduced to amines by passing hydrogen gas in the presence of finely divided nickel, palladium or platinum and also by reduction with metals in acidic medium.



9. Why is iron scrap and hydrochloric acid preferred for the reduction of nitrobenzene to aniline?

Ans: Reduction with iron scrap and hydrochloric acid is preferred because FeCl_2 formed gets hydrolysed to release hydrochloric acid during the reaction. Thus, only a small amount of hydrochloric acid is required to initiate the reaction.

10. Write chemical equations for the following conversion



Ans: $\text{CH}_3\text{CH}_2\text{Cl} \xrightarrow{\text{Ethanolic NaCN}} \text{CH}_3\text{CH}_2\text{C}\equiv\text{N} \xrightarrow{\text{reduction}} \text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

TOPIC CARBOHYDRATE QUESTION BANK

QUESTION OF 3 MARKS AND THEIR ANSWERS

1. What is glycogen? How is it different from starch ? How is starch structurally different from cellulose ?

Answer- The carbohydrate are stored in animal body as glycogen. It is also known as animal starch. It is highly branched than starch. Starch is a polymer of α D glucose whereas cellulose is a polymer of β - D glucose.

2. Write the product formed when α D glucose reacts with: (i) $\text{H}_2\text{N-OH}$ (ii) HI (iii) Br_2 water

Answer- (i) Hydroxylamine will form. (ii) n-Hexane will form (iii) Gluconic acid will form.

3. Account for the following: (i) Glucose and fructose give the same osazone.

(ii) Six carbon atom in glucose are present in a straight chain.

(iii) Five $-\text{OH}$ groups are present in glucose molecule .

Answer-(I) During osazone formation, the reaction occurs only at C1 and C-2. As glucose and fructose differ from each other only in the arrangement of atom at C-1 and C-2, therefore they give the same osazone.

(ii) On prolonged heating with HI glucose gives n-hexane.

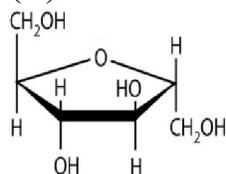
(iii) Glucose gives pentaacetat derivative on acetylation with acetic anhydride. This confirms the presence of five $-\text{OH}$ group.

4. (a) Despite having an aldehyde group glucose does not give 2,4 DNP test. What does this indicate. (b) Draw the Haworth structure of α D glucopyranose.

(c) What is the significance of D and (+) here.

Answer-(a) This indicates that the aldehyde group in glucose is not free.

(B)



(c) D gives the configuration means that the -OH group at C-5 is on the right hand side. And (+) sign indicate that the isomer is dextrorotatory.

5. A non-reducing disaccharide A on hydrolysis with dilute acid gives an equimolar mixture of D (+) glucose and D (-) fructose.



$$[\alpha]_D = +66.5 \quad +52.5 \quad -92.4$$

Identify A. What is the mixture of D(-) fructose and (+) D glucose known as? Name the linkage that held the two units in the disaccharide.

Answer- A is Sucrose. Invert sugar. It is a glycosidic linkage.

6. What happens when D-Glucose is treated with the following reagents: (i) HNO₃ (ii) Acetic anhydride (iii) HCN

Answer- (i) Gluconic acid will produce. (ii) Glucose pentaacetate will produce (iii) Glucose cyanohydrin will produce.

7. Explain the structure of fructose. SOLVED BY STUDENTS.

8. Write the classification of carbohydrates and give example of every type of carbohydrate with its formula.

Answer-Classification of Carbohydrates:- A. Based on hydrolysis :-

i) Monosaccharides:- glucose, fructose, etc.

ii) Oligosaccharides:- having 2 to 10 monosaccharide units. Sucrose, maltose (disaccharides)

iii) polysaccharides starch, cellulose, glycogen, gums, etc.

B. Based on Reducing property:-

i) Reducing sugars:- glucose, maltose

ii) Non-reducing sugars:- sucrose

C Based on Functional Group:- If a monosaccharide contains an aldehyde group, it is known as an aldose and if it contains a keto group, it is known as a ketose

9. Define the following:

(i) Invert sugar (ii) anomers (iii) Mutarotation

Answer-(i) Sucrose is dextrorotatory but after hydrolysis it gives laevo and dextrorotatory monosaccharide in which laevorotation is more than dextrorotatory thus it is known as inversion of sugar

(ii) The two cyclic hemiacetal forms of glucose differ in the configuration of the hydroxyl group at C1 called anomeric carbon. Such isomers @ form and b form are called anomers.

(iii) The spontaneous change of specific rotation of an optically active substance with time is called mutarotation.

10. Write three such behavior of glucose which can not be explain by open chain structure of glucose molecule. What alternative structure has been proposed for the glucose molecule ?

Answer- The following reactions of glucose cannot be explained by its open chain structure.-

(i) Despite having the aldehyde group glucose does not give 2, 4-DNP test, Schiff's test and it does not form the hydrogen sulphite addition product with NaHSO_3 .

(ii) The pentacetate of glucose does not react with hydroxylamine indicating the absence of free—CHO group.

(iii) When D-glucose is treated with methanol in the presence of dry hydrogen chloride gas, it gives two isomeric mono methyl derivatives known as α -D glucoside and methyl β -D glucoside. These glucosides do not react with hydrogen cyanide or with hydroxylamine.

NUCLEIC ACIDS

(3 Marks Questions)

Q1 What are nucleic acids ? Mention their two important functions ?

Nucleic acids are biopolymers of nucleotides.

FUNCTIONS

RNA: i) Proteins synthesis by various RNA molecules in the cell. DNA :ii) Heredity ie the transmission of inherent characters of one generation to next.

Q 2. Write the important structural and functional differences between DNA and RNA.

Answer The structural differences between DNA and RNA are as follows:

Sr No	Character	DNA	RNA
1	The sugar moiety	DNA molecules contains β -D-2 deoxyribose.	RNA molecules contains β -D-ribose.
2	Nitrogen Bases	DNA contains uracil (U). It does not contain thymine (T). ie ATGC	RNA contains thymine (T). It does not contain uracil (U). ie AUGC
3	Structure	Double stranded helical	Single stranded
4	Biological function	Transfer of heridity information	Protein synthesis

Q3. What are the different types of RNA found in the cell?

Answer (i) Messenger RNA (m-RNA) (ii) Ribosomal RNA (r-RNA) (iii) Transfer RNA (t-RNA)

Q 4. Define the terms: 1) Codon 2) Gene 3) Genetic code

Ans. Codon---The Triplet of nucleotide coding a particular amino acid. Total 64,61 for inner amino acids and 3 for terminal amino acids.

Gene— Sequence of the nucleotides in DNA coding a particular protein.

Genetic code-- the relation between the nucleotide triplet and the amino acid.

Q 5.Name the sugar present in DNA? How it structurally differs from RNA sugar? How many carbon does it contain?

Ans. Deoxyribose sugar.

It differs in the presence of oxygen atom at C₂.

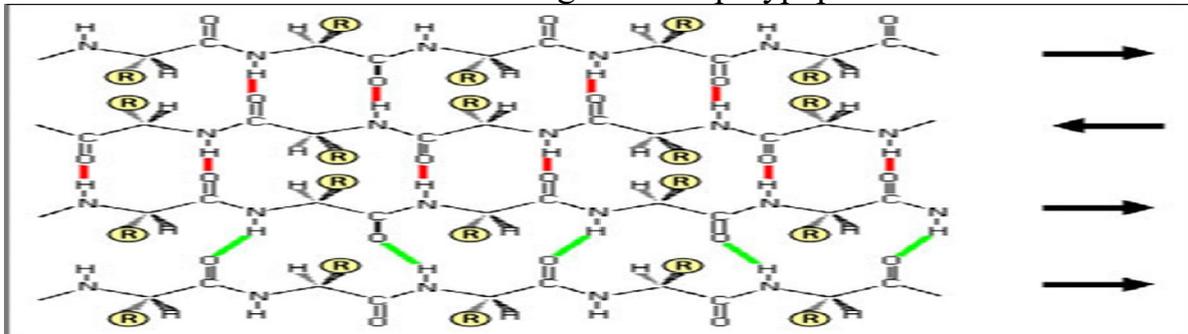
It contains five carbon atoms.

TOPIC- PROTEIN AND VITAMINS

THREE MARKS QUESTIONS

Q1 Explain β -pleated sheet structure of protein?

Ans-- The basic unit of a beta-sheet is called a beta-strand- beta-sheets can form various higher-level structures, such as a beta-barrel- unlike alpha-helix, sheets can be formed from discontinuous regions of a polypeptide chain.



Q2 Explain three condition of denaturation of protein?

Ans-1) High temperatures- cause protein unfolding, aggregation

2) Low temperatures - some proteins are sensitive to cold denaturation

3) Heavy metals (e.g., lead cadmium, etc.) - Highly toxic; efficiently induce the 'stress response.

Q3 What is the effect of denaturation on the structure of protein explain?

Ans-1) Loss of secondary structure.

2) Loss of tertiary structure- the far- and near

3) Loss of activity

Q4 Amino acid may be acidic, alkaline neutral explain?

Ans-When in amino acid, number of $-\text{COOH}$ group is more than $-\text{NH}_2$ group it is acidic, When in amino acid number of $-\text{COOH}$ group is less than $-\text{NH}_2$ group it is basic and when in amino acid, number of $-\text{COOH}$ group is one and $-\text{NH}_2$ group is also one than it is neutral.

Q5 Except vitamin B_{12} all vitamins of group B are required to be taken regularly in our diet explain?

Ans-Vitamin B complex are soluble in water and hence these vitamins cannot be normally stored in our body and are required to be taken daily in our diet but vitamin B_{12} is stored in the liver of human body hence it is not to be taken daily in our diet.

Q6 (a) What type of linkage is present in protein?

(b) The K_a and K_b value of α -amino acid are very low why?

Ans-(1) Protein contains peptide linkage (-CO-NH-)

(2) In α -amino acid the acidic group is $-\text{NH}_3^+$ instead of $-\text{COOH}$ and carboxylic acid is basic group $-\text{COO}^-$ instead of NH_2 group as in amines that is why they have low value of K_a and K_b

Q7 Write three importance of protein?

Ans- : 1) Defencive protein-Protection against disease

2) Tranport-Hemoglobin, the iron-containing protein of vertebrate blood, transports oxygen from the lungs to other parts of the body.

3) Storage-Casein, the protein of milk, is the major source of amino acids for baby mammals.

Q8 (a) Define isoelectric point

(b) At what pH glycine has isoelectric point.

(c) What is the ultimate product of the digestion of protein,

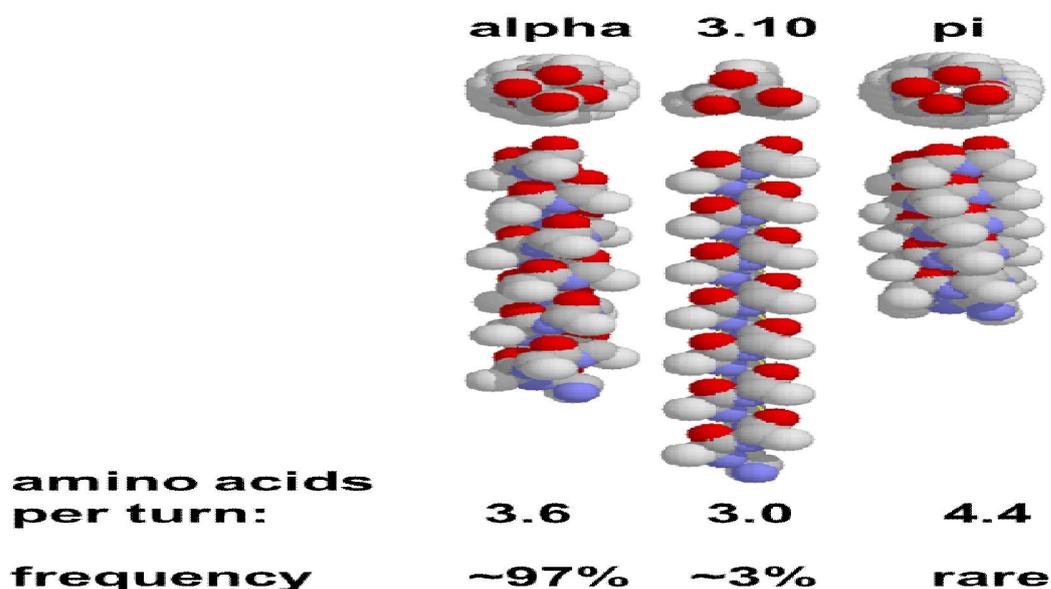
Ans- (a) Iso-electric point is the pH at which zwitter ion formed by the amino acid neither move towards (+) nor towards (-) electrode under the influence of electric field.

(b) Iso-electric point of glycine is-pH=6.1

(c) The ultimate product of the digestion of protein is amino acids.

Q9 What type of bonding helps in stabilising α -helix structure of protein, draw diagram?

Ans- α -helix structure of protein have bonding between $-\text{CO}-$ and $-\text{NH}-$ of each turn as - alpha helices are about 10 residues on average



Q10 Write 3 function of vitamins?

Ans- Vitamins have diverse biological function:-

- 1) Hormone-like functions as regulators of mineral metabolism (vit. D),
- 2) Regulators of cell and tissue growth and differentiation (some forms of vit. A)
- 3) Antioxidants (vit. E, C)

POLYMER

QUESTION BANK ---(3MK QUESTIONS)

Q.1. Classify these polymers on the basis of molecular forces: Polythene, Buna-S, PVC, Nylon-6,6.

Ans- Elastomers- Buna-S

Fibers- Nylon-6,6

Thermoplastic- Polythene, PVC

Q.2. How can you differentiate between addition and condensation polymerization

Ans. In addition polymerization the molecules of the same monomer or different monomers add

together on a large scale to form a polymer. The monomers used are unsaturated compounds,

e.g., alkenes, alkadienes and their derivatives.

Condensation polymerisation generally involves a repetitive condensation reaction between two bi-functional monomers. These polycondensation reactions may result in the loss of some simple molecules as water, alcohol, etc., and lead to the formation of high molecular mass condensation polymers. *e.g.* ,Nylon 6,6.

Q.3. What are biodegradable polymers? Why are these polymers preferred?

Ans:- Biodegradable polymers are those which can be degraded by microbes in nature.

We use biodegradable polymers

1. To avoid waste disposal problems
2. In specialty packaging for longer for long shelf life of consumables

Q.4. Define vulcanization .

Ans. Vulcanization is the process of heating rubber or elastomer with cross linking agent like sulphur to increase its mechanical properties and chemical resistance.

(b) the main purpose of vulcanization of rubber is to improve the following drawbacks of natural rubber

- At high temperature ($T > 335\text{K}$) natural rubber becomes soft

- At low temperature ($T < 283$) natural rubber becomes brittle
- Natural rubber is soluble in non-polar solvents
- It is non-resistant to attack by oxidizing agents.

Q.5. Classify the following on the basis of functional groups present in their monomeric unit.

(polyolefins, polydienes, polyacrylates and polyhaloolefins)

1. Polythene
2. PAN, polyethylacrylates, (polymonochlorotrifluoroethene) PCTFE, Teflon, neoprene and Buna-S.

Ans. 1. Polythene : polyolefins,

2. PAN : polyacrylates

3. polyethylacrylates : polyacrylates

4. (polymonochlorotrifluoroethene) PCTFE, : polyhaloolefins

5. Teflon : polyhaloolefins

6. Neoprene : polydienes

Q.6. In which classes does the following polymers belong on the basis of molecular forces?

BuNa-s, Nylon 6,6, Polythene, Bakelite

Ans: 1. BuNa-s --- Elastomers

2. Nylon 6,6 --- Fibres

3. Polythene --- Thermoplastics

4. Bakelite --- Thermosetting

Q.7. How are polymers classified on the basis of structure?

Ans. They are classified as a) Linear polymer—polythene, polyvinylchloride

b) Branched polymers:—low density polymer

c) crosslinks polymers—Bakelite, melamine

Q.8. Classify the following as homopolymer or copolymer?

(polythene, polyvinyl chloride, Nylon 6,6, BuNa-s)

Ans. Polythene—Homopolymer

polyvinyl chloride—Homopolymer

Nylon 6,6—Copolymer

BuNa-s—Copolymer

Q.9. Give full form of 1. PAN 2. PMMA 3. PHBV

Ans. PAN—Polyacrylonitrile

PMMA—Polymethylmethacrylate

PHBV—Poly-Hydroxybutyrate-co- β -Hydroxyvalerate

Q.10. Match the following

A

1. Low density polythene

2. Thermosetting

cables

3. High density polythene

B

a) Manufacture of buckets, pipes

b) Manufacture of wires and

c) Unbreakable crockery

Ans. A-----b

B-----c

C-----a

Topic- Addition Polymers]

3 mark question-

Q1-(i)What are biodegradable polymers?

(ii) Write the name of biodegradable polymer used for stitching of wounds after operation.

(iii) What are the monomer units of this polymer.

Q2-How are low density polythene and high density polythene manufactured? Write their uses also.

Q3-Discuss the main purpose of vulcanization of rubber.

Q4-Write the difference between natural rubber and vulcanized rubber.

Q5-Write the names and the structures of the following polymers-

(1)PVC (2) PAN (PTFE)

Q6-How does the presence of double bonds in rubber molecules influence their structure and reactivity?

Q7-(i)What is plasticizer?

(ii) What is vulcanization of rubber?

(iii)What is the main difference in the structure of natural rubber and gutta-percha?

Q8-How are polymers classified on the basis of structure of polymers?

Q9-What are natural and synthetic polymers? Give two examples of each type.

Q10-Explain the terms polymer and monomer.

CHAPTER 16 Chemistry in everyday life

3MARKS QUESTIONS

1. Explain the following with one example each?

i) Antacid ii) Analgesics iii) food preservatives

ans i) ANTACIDS-These are compounds which neutralize excess acid of stomach. eg-Aluminumhydroxide, Magnesiumhydroxide, ranitidine.

ii) ANALGESICS-They reduce pain without causing impairment of consciousness, mental confusion or some other disturbance of the nervous system.

(a) **Narcotic**- are relieve pain and produce sleep. For example morphine, heroine etc

(b) **Non narcotic** are effective in relieving skeletal pain and antipyretic. it is non addictives

Eg -aspirin, seridon, paracetamol

iii) FOOD PRESERVATIVES-

They prevent spoilage of food to microbial growth. eg-salt, sugar, and sodium benzoate.

2 Define the term Antibiotics? Write the difference between Broad Spectrum and

Narrow Spectrum Antibiotics.

Ans ANTIBIOTICS-These are the chemical substances which are produced by micro-organisms.

NARROW SPECTRUM ANTI-BIOTICS-

These are effective mainly against gram positive or gram negative bacteria. Eg- Penicillin, streptomycin.

BROAD SPECTRUM ANTI-BIOTICS-They kill or inhibit a wide range of micro-organisms. eg- chloramphenicol, tetracycline

3. What are Biodegradable and non-biodegradable detergents? Give one example of each.

Ans BIODEGRADABLE DETERGENTS- The detergents which are linear and can be attacked by

micro-organisms are biodegradable. Eg -sodium lauryl sulphate.

NON-BIODEGRADABLE DETERGENTS-The detergents which are branched and cannot

be decomposed by micro-organisms are called non-biodegradable. eg-sodium 4-(1,3,5,7 tetramethyloctyl)-benzenesulphonate.

4. Define with example 1. Antacid 2. Antihistamine 3. Tranquilizer

Ans 1. Antacid: Chemical substances which remove the excess acid and raise the pH to appropriate level in stomach. Ex. $Mg(OH)_2$.

2. Antihistamines/ antiallergic drugs: are the drugs used to control the allergy effects produced by histamines. Ex. Chloropheniramine.

3. Tranquilizers/psychotherapeutic drugs: Chemical substances used for treatment of stress, mild and severe mental diseases. These relieve anxiety, irritability or excitement by inducing a sense of well being. Ex. Equanil.

5. What causes depression? What drug do you suggest for counteracting depression? How does it decrease depression?

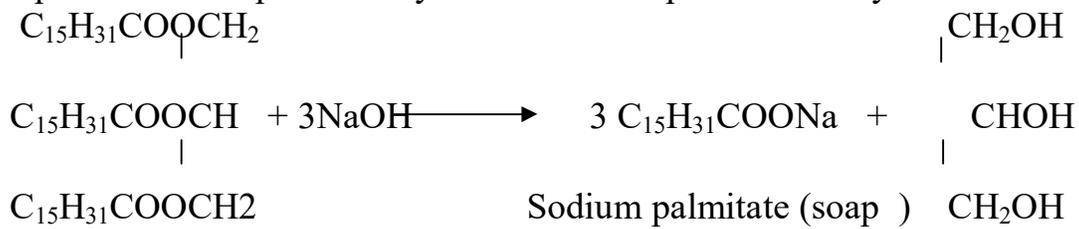
Ans Noradreniline is one of the neurotransmitters. Decrease in the level of noradreniline lowers signal sending activity and this leads to depression. Iproniazid, an antidepressant drug is used for counteracting depression. It inhibits the enzymes which catalyses the degradation of noradreniline. If the enzyme is inhibited, this neurotransmitter is metabolized and can activate its receptor for longer periods of time, thus counteracting the effect of depression.

6. State three ways of controlling microbial diseases.

Ans 1. by a drug which kills the organism in the body (bactericidal)
 2. by a drug which inhibits the growth of organism (bacteriostatic)
 3. by increasing immunity and resistance to infection of the body.

7. What is saponification? Write equation.

Ans preparation of soap from fatty oil with the help of sodium hydroxide



Glycerylpalmitate Glycerol

8. Mention one use each of following drugs

i. Rantidine (ii) Paracetamol (iii) Tincture of iodine

(i) Rantidine : used as an antihistamine (ii) Paracetamol : used as an antipyretic.

(iii) Tincture of iodine : used as an antiseptic

9. Describe the following example in each case. (i) Edible colors (ii) antifertility drugs (iii) Antipyretics

Ans (i) Edible colors: colored chemical substances added to food to improve their appearance. Ex. Tetrazine. But some food dyes are harmful.

(ii) antifertility drugs; The chemical substances which are used to check pregnancy in women or birth control drugs or oral contraceptives are called

ant fertili(iii) Antipyretics: The chemicals used to lower body temperature.

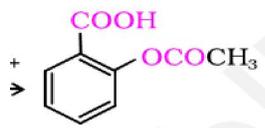
Ex. Paracetamol

10. Whenever a doctor prescribes a medicine of aspirin content directs patient not to take

in empty stomach. Why Give structural formula for Aspirin. What is its IUPAC name?

ans Aspirin contains a carboxylic acid group and hence when it interacts as a drug it

causes acidity and higher acidity caused by it some times may lead to ulcers also



Acetylsalicylic acid
(Aspirin)

IUPAC name: 2 - Carboxyphenylethnoate