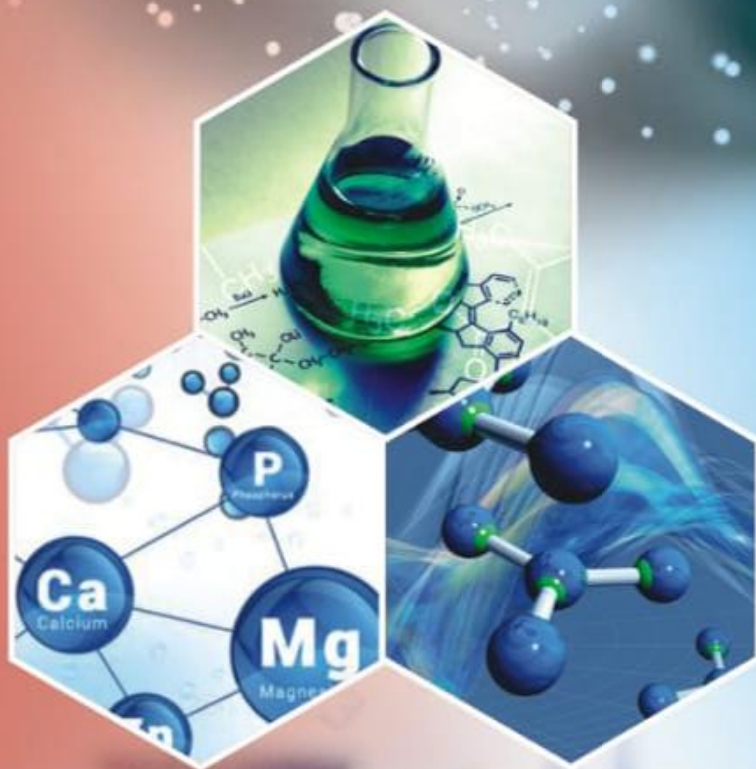Telangana State Board of
INTERMEDIATE Education

CHEMISTRY-II

BASIC LEARNING MATERIAL
For The Academic Year : 2020-2021

TELANGANA STATE BOARD OF INTERMEDIATE EDUCATION

CHEMISTRY-II
(ENGLISH MEDIUM)

BASIC LEARNING MATERIAL

ACADEMIC YEAR
2020-2021

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PREFACE

The ongoing Global Pandemic Covid-19 that has engulfed the entire world has changed every sphere of our life. Education, of course is not an exception. In the absence of Physical Classroom Teaching, Department of Intermediate Education Telangana has successfully engaged the students and imparted education through TV lessons. The actual class room teaching through physical classes was made possible only from 1st February 2021. In the back drop of the unprecedented situation due to the pandemic TSBIE has reduced the burden of curriculum load by considering only 70% syllabus for class room instruction as well as for the forthcoming Intermediate Public Examinations May 2021. It has also increased the choice of questions in the examination pattern for the convenience of the students.

To cope up with exam fear and stress and to prepare the students for annual exams in such a short span of time , TSBIE has prepared "Basic Learning Material" that serves as a primer for the students to face the examinations confidently. It must be noted here that, the Learning Material is not comprehensive and can never substitute the Textbook. At most it gives guidance as to how the students should include the essential steps in their answers and build upon them. I wish you to utilize the Basic Learning Material after you have thoroughly gone through the Text Book so that it may enable you to reinforce the concepts that you have learnt from the Textbook and Teachers. I appreciate ERTW Team, Subject Experts, who have involved day in and out to come out with the, Basic Learning Material in such a short span of time.

I would appreciate the feedback from all the stake holders for enriching the learning material and making it cent percent error free in all aspects.

The material can also be accessed through our website**www.tsbie.cgg.gov.in.**

Commissioner & Secretary
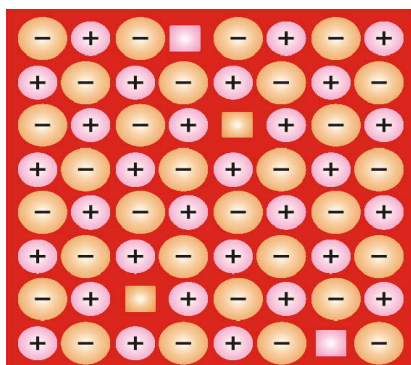Intermediate Education, Telangana.

CONTENTS

Solid State

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. **State Schottky and Frenkel Defects.**

Ans. **Schottky Defect:** It is basically a vacancy defect in ionic solids. To maintain electrical neutrality the number of missing cations and anions is equal.

Eg:AgBr, NaCl
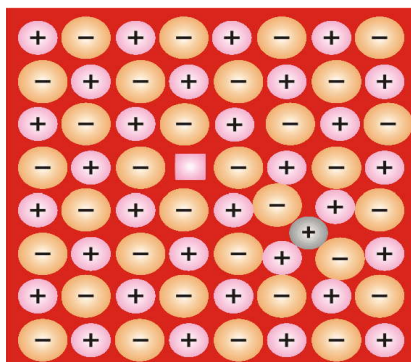
Schottky defect decreases the density.

Frenkel Defect: It is a point defect due to the smaller ion (usually cation) is dislocated from its normal site to an interstitial site.

eg:AgBr,AgCl

Frenkel defect does not decrease the density.

2.   What are amorphous substances? Give examples.

Ans.   The solid substances which have no orderly arrangement of particles are called as amorphous substances.

Eg : glass, rubber, plastic.

3.   What makes a glass different from quartz?

Ans.   Glass is amorphous in nature and quartz is crystalline in nature.

4.   What is meant by the term coordination number?

Ans.   The number of nearest oppositively charged ions surrounding a particular ion is called coordination number.

Eg : Coordination number of Na^+ in NaCl lattice is 6.

5.   What is the coordination number in cubic close pack structure?

Ans.   In cubic close-pack structure, coordination number is 12.

6.   What is coordination number in body-centered cubic structure.

Ans.   In body-centered cubic structure, coordination number is 8.

7.   How do you distinguish between crystal lattice and unit cell?

Ans.	**Crystal lattice**	**Unit cell**
i)	The three dimensional regular arrangement of constituent particles of a crystal is called crystal lattice.	i) The simple unit of crystal lattice which when repeated again and again gives the entire crystal lattice is called unit cell.

8.   How many lattice points are there in one unit cell of face centered cubic lattice?

Ans.   In one unit cell of face centered cubic lattice, no of lattice points = 14

9.   How many lattice points are there in one unit cell of body centered cubic lattice?

Ans.   In one unit cell of face body centered cubic lattice, no. of lattice points = 9

SHORT ANSWER TYPE QUESTIONS (4 MARKS)

1.   Explain the similarities and differences between metallic and ionic crystals.

Ans.   Similarities between metallic and ionic crystals :

i)   There are electrostatic forces of attractions

ii)   Bonds are non-directional.

Differences between metallic and ionic crystals :

Metallic crystals	**Ionic crystals**
i) Electrostatic forces of attraction are in between valence electrons	i) Electrostatic forces of attraction are between oppositely charged ions.
ii) Good conductors of electricity in solid state	ii) Good conductors of electricity in molten state
iii) Metallic bond may be weak or strong	iii) Ionic bond is strong

2. Derive Bragg's equation.

Ans. **Derivation of Bragg's equation :**

From the figure we can observe that 2nd ray travels more distance than the 1st ray i.e,AB+BC. According to Bragg's analysis the different rays striking the two layers of atoms are in phase initially. But they can be in phase after reflection, only if the extra distance AB + BC is equal to a whole number of wavelengths $n\lambda$.

$\therefore$ AB+BC = $n\lambda$ _____(1)

In the $\triangle ABZ$, $\sin\theta = \dfrac{AB}{BZ}$

BZ = d, $\sin\theta = \dfrac{AB}{d}$

AB = d $\sin\theta$
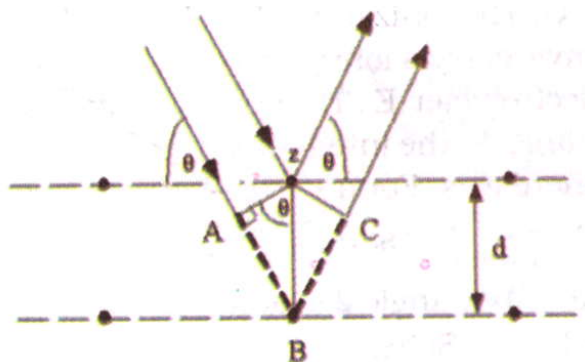
as AB = BC

$\therefore$ AB +BC = 2d $\sin\theta$_____(2)

From equation (1) and (2)

$n\lambda$ = 2d $\sin\theta$

This equation is called Bragg's equation.

Solutions

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1.   What is a solution?

Ans.   The homogeneous mixture of two or more components is called solution.

2.   Define the term Molality?

Molality : The number of moles of solute present in 1 kg solvent.

$$\text{Molality of a solution} = \frac{\text{number of moles of solute}}{\text{weight of solvent (in kg)}}$$

3.   What is pp`m of Solution?

Ans: **ppm (Parts per million) :**

$$\text{ppm} = \frac{\text{No. of parts of the component}}{\text{Total no. of parts of all components of the solution}} \times 10^6$$

4.   Define the term Mass percentage?

Ans. $\text{Mass percentage of a component} = \dfrac{\text{Mass of the component in the solution}}{\text{Total mass of the solution}} \times 100$

5.   What is Volume percentage ?

Ans. $\text{Volume percentage of a component} = \dfrac{\text{volume of the component}}{\text{Total volume of solution}} \times 100$

6.   State Raoult's Law.

Ans.   The relative lowering of vapour pressure of a dilute solution having non-volatile solute is equal to the mole fraction of the solute.

(OR)

The partial vapour pressure of each component of the solution is directly proportional to its mole fraction present in solution.

$$\frac{p_1^{\ 0} - p_1}{p_1^{\ 0}} = x_2 \text{ or } p_1 \propto x_1$$

$p_1^{\ 0}$ = vapour pressure of pure solvent

p_1 = vapour pressure of solution

x_2 = mole fraction of solute

x_1 = mole fraction of solvent

7. State Henry's Law.

Ans. The partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution.

$$p = K_H x$$

p = partial pressure of the gas in vapour phase

K_H = Henry's law constant

x = mole fraction of the gas

8. What is Molarity?

Ans. The number of moles of solute present in 1 litre solution is called Molarity.

9. What are ideal solutions? Give example.

Ans. The solutions which obey Raoult's law over the entire range of concentration are known as ideal solutions.

    eg: n.hexane and n.heptane

       benzene and toluene

10. What are isotonic solutions?

Ans: Two solutions having same osmotic pressure at a given temperature are called isotonic solutions.

    eg: Normal Saline solution and blood.

11. What is osmotic pressure?

Ans. The excess pressure which is applied on the solution to prevent osmosis is called osmotic pressure. $\pi = CRT$

12. What is ebullioscopic constant (K_b)?

Ans. The elevation in boiling point of the one molal solution containing a non-volative solute is called ebullioscopic constant. It is denoted by K_b.

13. What is cryoscopic constant (K_f)?

Ans. The depression in freezing point of one molal solution containing a non-volatile solute is called cryoscopic constant. It is denoted by K_f.

SHORT ANSWER TYPE QUESTIONS (4 MARKS)

1. **How many types of solutions are formed? Give an example for each type of solution.**

Ans. There are three types of solutions. They are

(a) **Gaseous Solutions:** The solutions in which solvent is a gas and solute can be either solid, liquid or gas are known as gasesous solutions.

(b) **Liquid Solutions:** The solutions in which solvent is a liquid and solute can be either solid, liquid or gas are known as liquid solutions.

(c) **Solid Solutions:** The solutions in which solvent is a solid and solute can be either solid, liquid or gas are known as solid solutions.

Type of Solution	Solute	Solvent	Common Examples
Gaseous Solutions	Gas	Gas	Mixture of oxygen and nitrogen gases
	Liquid	Gas	Chloroform mixed with nitrogen gas
	Solid	Gas	Camphor in nitrogen gas
Liquid Solutions	Gas	Liquid	Oxygen dissolved in water
	Liquid	Liquid	Ethanol dissolved in water
	Solid	Liquid	Glucose dissolved in water
Solid Solutions	Gas	Solid	Solution of hydrogen in palladium
	Liquid	Solid	Amalgam of mercury with sodium
	Solid	Solid	Copper dissolved in gold

2. **If the osmotic pressure of glucose solution is 1.52 bar at 300K. What would be its concentration if R = 0.083 L bar mol^{-1} K^{-1}?**

Ans. Given that,

Osmotic Pressure, π = 1.52 bar

Tempereture,   T = 300K

R = 0.083 L bar mol^{-1} K^{-1}

Osmotic Pressure, π = CRT.

$$C = \frac{\pi}{RT} = \frac{1.52}{0.083 \times 300} = \frac{1.52}{24.9} = 0.061\,M$$

Concentration of Glucose solution is 0.061 M.

3. **What is mole fraction ? Calculate the mole fraction of H_2SO_4 in a solution contaning 98% H_2SO_4 by mass**

Ans. The ratio of number of moles of one component to the total number of moles of all the components present in the solution is called mole fraction of that particular component.

$$\text{Mole fraction of a component} = \frac{\text{Number of moles of the component}}{\text{Total number of moles of all the components in the solution}}$$

Assume that we have 100 g of solution.

No. of moles of water n_{H_2O} = 2/18 = 1/9 = 0.11

No. of Moles of H_2SO_4 $n_{H_2SO_4}$ = 98/98 = 1

Mole fraction of H_2SO_4 = $\dfrac{n_{H_2SO_4}}{n_{H_2O} + n_{H_2SO_4}}$ = $\dfrac{1}{0.11 + 1}$ = 0.9

4. **Calculate the mole fraction of ethylene glycol in a solution containing 20% of $C_2H_6O_2$ by mass.**

Ans. Assume that we have 100 g of solution.

Solution will contain 20 g of ethylene glycol and 80 g of water.

$Molar\ mass\ of\ C_2H_6O_2 = 2(12) + 6(1) + 2(16) = 62 g\ mol^{-1}$

$No.of\ moles\ of\ C_2H_6O_2 = \dfrac{20}{62} = 0.322\ mol$

$No.of\ moles\ of\ H_2O = \dfrac{80}{18} = 4.444\ mol.$

$Mole\ fraction\ of\ ethylene\ glycol = \dfrac{No.of\ moles\ of\ C_2H_6O_2}{No.of\ moles\ of\ C_2H_6O_2 + No.of\ moles\ of\ H_2O}$

$= \dfrac{0.322}{0.322 + 4.444} = 0.068$

5. **A solution of glucose in water is labeled as 10% w/w. What would be the molarity of solution?**

Ans. 10% w/w glucose solution : 10g of glucose in 100g solution weight of solvent (water) = 100 - 10 = 90g

Volume of solution = 90 mL ($\because$ density of water = 1 g / mL)

Molarity of solution = $\dfrac{\text{weight of glu} \cos e}{\text{G.M.wt. of Glu} \cos e} \times \dfrac{1000}{\text{Vol. of solution}}$

$= \dfrac{10}{180} \times \dfrac{1000}{90} = 0.617M$

6. **A solution of sucrose in water is labelled as 20% w/w. What would be the mole fraction of each component in the solution?**

Ans. Mass percentage of sucrose in water solution = 20% w/w.

This means 20g sucrose in 100g solution.

Weight of water = 100 - 20 = 80g

no. of moles of sucrose = $\dfrac{\text{wt.of sucrose}}{\text{G.M.W. of sucrose}} = \dfrac{20}{342} = 0.058$

$$\text{no. of moles of water} = \frac{\text{wt. of water}}{\text{G.M.W. of water}} = \frac{80}{18} = 4.444$$

$$\text{molefraction of sucrose} = \frac{\text{no. of moles of sucrose}}{\text{total no. of moles in solution}} = \frac{0.058}{0.058 + 4.444} = \frac{0.058}{4.502}$$

$$= 0.0129$$

molefraction of water $= 1 -$ mole fraction of sucrose

$$= 1 - 0.0129$$

$$= 0.9871$$

7. **What is relative lowering of vapour pressure? How is it useful to determine the molar mass of a solute?**

Ans. **Relative lowering of vapour pressure :** "The ratio of lowering of vapour pressure to the vapour pressure of pure solvent" is called relative lowering of vapour pressure.

$\dfrac{p_1^0 - p_1}{p_1^0}$ is relative lowering of vapour pressure.

$p_1^0 = $ vapour pressure of pure solvent

$p_1 = $ vapour pressure of solution

$p_1^0 - p = $ lowering of vapour pressure

According to Rault's law:

$$\frac{p_1^0 - p_1}{p_1^0} = x_2 \qquad \text{where } x_2 \text{ is the molefraction of solute.}$$

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1 + n_2} \qquad \text{For a dilute solution } n_2 <<< n_1, \quad n_2 \text{ can be ignored}$$

$$\therefore \frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1}$$

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{M_1}{M_2} \times \frac{w_2}{w_1} \qquad \therefore M_2 = \frac{p_1^0 \times M_1 \times w_2}{(p_1^0 - p_1) w_1}$$

where, $w_1 = $ weight of solvent

$w_2 = $ weight of solute

$M_1 = $ molar mass of solvent

$M_2 = $ molar mass of solute.

From this equation molar mass of solute is determined.

Electro Chemistry and Chemical Kinetics

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. **Define molar conductivity Λ_m and how is it related to conductivity (k) and the molarity (c) of the solution?**

Ans. Molar conductivity of a solution at a given concentration is the conductance of Vml of the solution containing one mole of electrolyte kept between two electrodes separated by unit length and area of cross section A.

Relation between molar conductivity $\left(\Lambda_m\right)$ and conductivity (k) :

$$\Lambda_m \; \alpha \; k$$

Relation between molar conductivity $\left(\Lambda_m\right)$ and molarity (c) :

$$\Lambda_m \; \alpha \; \frac{1}{c} \qquad\qquad \therefore \Lambda_m = \frac{k}{c}$$

2. **What is Nernst equation?**

Write the equation for an electrode with $M^{n+}_{(aq)} + ne^- \rightleftharpoons M(s)$

Ans. Nernst equation relates the reduction potential of an electro chemical reaction to the standard electrode potential, temperature and activities of chemical species under going reduction and oxidation at any concentration.

$$M^{n+}_{(aq)} + ne^{\ominus} \longrightarrow M(s)$$
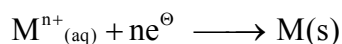
$$E_{M^{n+}/M} = E^0_{M^{n+}/M} - \frac{2.303RT}{nF} \; \log \left(\frac{[M]}{[M^{n+}]} \right)$$

$$E_{M^{n+}/M} = E^0_{M^{n+}/M} - \frac{0.059}{n} \; \log \left(\frac{1}{[M^{n+}]} \right)$$

3. **Calculate the E cell of the following reaction.**

    $Mg(s) + 2Ag^+(0.0001M) \rightarrow Mg^{+2}(0.130M) + 2Ag(s)$ ($E^0_{cell} = 3.17$ V)
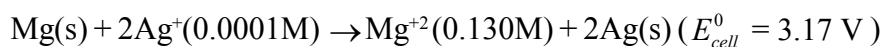
    $$E_{cell} = E^0_{cell} - \frac{0.059}{n} \log \frac{\left[Mg^{+2}\right]}{\left[Ag^+\right]^2}$$

    $$= 3.17 - \frac{0.059}{2} \log \frac{0.130}{(0.0001)^2} \quad = 3.17 - 0.21 = 2.96 \text{ V}.$$

4. **State Faraday's second law of electrolysis.**

    Faraday's Second Law:

    The amounts of different substances liberated, when the same quantity of current is passing through the electrolytic solution are proportional to their chemical equivalent weights.

    $m_1 : m_2 : m_3 = E_1 : E_2 : E_3$

5. **Define rate of reaction. Give its units.**

    The change in the concentration of a reactant or product per unit time called rate of reaction.

    $R \rightarrow P$

    $$r = \frac{-d[R]}{dt} = \frac{d[P]}{dt}$$

    units : $mol\ L^{-1} S^{-1}$

6. **Mention the units of rate constants of zero and first order reactions.**

    Units of rate constant for zero order reactions: $mol\ L^{-1} s^{-1}$

    Units of rate constant for first order reactions : s^1 (Or) $time^{-1}$

    ## SHORT ANSWER TYPE QUESTIONS (4 MARKS)

1. **State Faraday's First law of electroylsis. A solution of $CuSO_4$ is electrolysed for 10 mintures with a current of 1.5 amperes. What is the mass of copper deposited at the cathode?**

    Faraday's First Law: The amount of substance deposited/liberated, at an electrode during electrolysis is directly proportional to the quantity of current (electricity) passing through the electrolyte.

    (OR)

    The amount of chemical reaction which occurs at any electrode during electrolysis is proportional to the quantity of current passing through the electrolyte.

    $$m = \frac{At.wt. \times C \times t}{valency \times 96500}$$

    $$m = \frac{63 \times 1.5 \times 600}{2 \times 96500} = 0.2938\ g$$

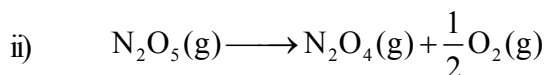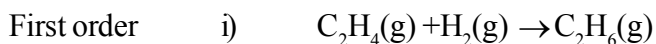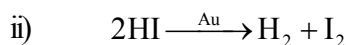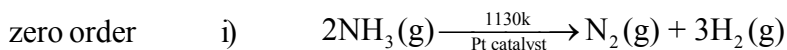2. **State Kohlrauch's Law and write its applications?**

Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and the cation of the electrolyte.

On dissociation if an electrolyte gives V_+ cations and V_- anions.

$$\Lambda_m^0 = v_+ \lambda_+^0 + v_- \lambda_-^0$$

(i) Λ_m^0 for any electrolyte from λ^0 of individual ions can be calculated.

(ii) Dissociation constants of weak electrolytes can be determined.

3. **Give two examples for zero and first order reactions?**

zero order   i) $2NH_3(g) \xrightarrow[\text{Pt catalyst}]{1130k} N_2(g) + 3H_2(g)$

                ii) $2HI \xrightarrow{Au} H_2 + I_2$

First order   i) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$

                ii) $N_2O_5(g) \longrightarrow N_2O_4(g) + \dfrac{1}{2}O_2(g)$

4. **What is half-life $\left(t\frac{1}{2}\right)$ of a reaction? Derive the equations for the half-life value of zero order and first order reactions.**

Half life $\left(t\frac{1}{2}\right)$ of a reaction : The time in which the concentration of a reactant is reduced to one half of its initial concentration is called half life of the reaction.

Zero order reactions:

Derivation of Half-life

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

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

$$k = \frac{[R]_0 - 1/2[R]_0}{t_{1/2}}$$

$$t_{1/2} = \frac{[R]_0}{2k} \quad \text{or} \quad t_{1/2} = \frac{a}{2k}$$

First order reactions:

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

Derivation of Half-life

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

so the above equation becomes

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

$$\text{Or } t_{1/2} = \frac{2.303}{k} \log 2$$

$$t_{1/2} = \frac{2.303}{k} \times 0.301$$

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

5. What is "molecularity" of a reaction? How is it different from the 'order' of a reaction?

Order of reaction: The sum of powers of the concentration terms of the reactants in the rate law expression or rate equation is called as order of reaction.

Molecularity of reaction: The No. of molecules or atoms or ions which participate in elementary step or rate determining step of reaction is called Molecularity.

Molecularity	Order
1) It is always a whole number. (1 or 2 or 3)	1) It may be 0, 1, 2, 3 or a fraction
2) It is determined from reaction mechanism.	2) It is determined from experimental results.
3) It is applicable for elementary rections only.	3) It is applicable for both elementary and complex reactions.

LONG ANSWER TYPE QUESTIONS (8 MARKS)

1. Give the applications of Kohlrausch's Law of independent migration of ions.

Ans. 1. Determination of Λ_m^0 for weak electrolyte.

Kohlrausch's law is applied in determining molar conductivity of weak electrolyte as it cannot be directly determined by extrapolation method. According to this law, the limiting molar conductivity is the sum of anion and cation of the electrolyte.

For acetic acid, the molar conductivity is given as

$$\Lambda_{CH_3COOH}^0 = \lambda_{CH_3COO^-}^0 + \lambda_{H^+}^0$$

This can calculated by the limiting molar conductivity of strong electrolytes like CH_3COONa, HCl and NaCl as shown below.

$$\Lambda_{CH_3COOH}^0 = \Lambda_{(CH_3COONa)}^0 + \Lambda_{(HCl)}^0 - \Lambda_{(NaCl)}^0$$

$$= \left[\lambda_{CH_3COO^-}^0 + \lambda_{Na^+}^0 \right] + \left[\lambda_{H^+}^0 + \lambda_{Cl^-}^0 \right] - \left[\lambda_{Na^+}^0 + \lambda_{Cl^-}^0 \right]$$

$$= \lambda^0_{CH_3COO^-} + \lambda^0_{Na^+} + \lambda^0_{H^+} + \lambda^0_{Cl^-} - \lambda^0_{Na^+} - \lambda^0_{Cl^-}$$

$$= \lambda^0_{CH_3COO^-} + \lambda^0_{H^+}$$

2. Calculation of dissociation of weak electrolytes.

The degree of dissociation (α) is the ratio of molar conductivity (Λ_m) to the limiting molar conductivity (Λ^0_m).

$$\alpha = \frac{\Lambda_m}{\Lambda^0_m}$$

Dissociation constant (K_a) is also calculated by taking degree of dissociation (α) as

$$K_a = \frac{C\alpha^2}{1-\alpha}$$

$$\therefore K_a = \frac{C\left[\dfrac{\Lambda_m}{\Lambda^0_m}\right]^2}{1 - \dfrac{\Lambda_m}{\Lambda^0_m}} = \frac{C\Lambda^2_m}{\Lambda^0_m\left(\Lambda^0_m - \Lambda_m\right)} \qquad \left(\because \alpha = \frac{\Lambda_m}{\Lambda^0_m}\right)$$

Where, C = Concentration or molarity of the solution.

2. Discuss the effect of temperature on the rate of a reaction. Derive necessary equations in this context.

Ans: The temperature dependence of the rate of a chemical reaction can be accurately explained by Arrhenius equation.

$$k = A \; e^{-Ea/RT} \qquad\qquad .... (1)$$

Where   k = rate constant

A = Arrhenius factor

E_a = activation energy

R = gas constant

T = absolute temperature

taking natural logarithm on both sides, we get

$$\ell n \; k = \frac{-Ea}{RT} + \ell nA \qquad\qquad .... (2)$$

at temperature T_1, equation is

$$\ell n \; k_1 = \frac{-E_a}{RT_1} + \ell n \; A \qquad\qquad .... (3)$$

at temperature T_2, equation is

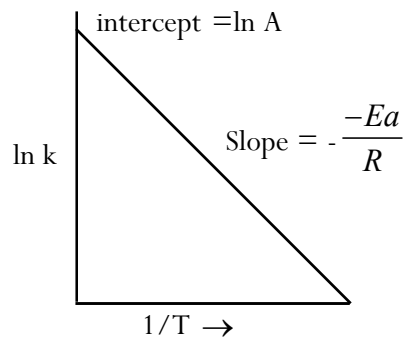$$\ell n\ k_2 = \frac{-E_a}{RT_2} + \ell n\ A \qquad \text{.................. (4)}$$

Subtracting eq (3) from eq (4) we get,

$$\ell n\ \frac{k_2}{k_1} = \frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right] \qquad \text{.................. (5)}$$

It has been found that for a chemical reaction with rise in temperature by 10^0C, the rate constant is nearly doubled.

3. **Explain the following terms.**
    (a) **Average rate of a reaction**
    (b) **Slow and fast reactions**
    (c) **Order of a reaction**
    (d) **Molecularity of a reaction**
    (e) **Activation energy of a reaction**

Ans. (a) **Average rate of a reaction:** The average rate is the change in concentration over of a selected period of time.

(b) **Slow reactions:** The reactions which proceed slowly are called slow reactions.
Example : Rusting of iron.
Fast reactions: The reactions which proceed fastly are called fast reactions.
Example : Reaction between sliver nitrate and sodium chloride.

(c) **Order of a reaction :** The sum of the powers of the concentration terms of the reaction in the rate law expression is called as 'order of reaction'.

(d) **Molecularity of a reaction :** The number of molecules or atoms or ions which participate in elementary step or rate determining step of a reaction is called 'molecularity of a reaction'.

(e) **Activation energy :** The difference between threohold energy and average energy possessed by reactants is activation energy.

Surface Chemistry

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. **Distinguish between adsorption and absorption. Give one example of each.**

Ans. **Adsorption:** The accumulation (or) concentration of a substance on the surface rather than in the bulk of solid (or) liquid is known as adsorption.

Eg: O_2, H_2 on charcoal.

Absorption: The uniform distribution of a substance through out the bulk of the solid substance is known as absorption.

Eg: Chalk stick dipped in ink.

2. **What is sorption?**

Ans. In case of some substances both adsorption and absorption takes place. This phenomenon is called sorption.

3. **What are micelles? Give one example.**

Ans. Some substances which at low concentrations behave as normal strong electrolytes, but at high concentrations exhibit colloidal behaviour due to formation of aggregates. The aggregated particles thus formed are called micelles.

Eg: Stearate ions (associate together in high concentration, in a solution of soap in water and forms a micelle).

4. **What is Peptization?**

Ans. The process of converting a precipitate into colloidal sol by shaking it with the dispersion medium in the presence of a small amount of electrolyte is called Peptization.

5. **What is dialysis ? How is dialysis can be made fast?**

Ans. The process of removing a dissolved substances from a colloidal solution using a suitable membrane is called dialysis.

Dialysis is made faster by applying an Emf. This is known as Electrodialysis.

6. **What is Tyndall effect ?**

Ans. When light passes through a colloidal solution we will be able to see the path of the light as a luminous beam. This is called Tyndall effect.

7.   What is Brownian movement.

Ans. Zig-zag motion of colloidal particles is called Brownian movement.

8.   State Hardy – Schulze rule.

Ans: Greater the valence of the coagulating ion added, the greater is its power to cause coagulation. This is known as Hardy – Schulze rule.

9.   Sky appears blue in colour. Explain.

Ans: The light gets scattered by the colloidal dust particles in air. Hence, due to tyndall effect, sky appears blue in colour.

10.   What is electrophoresis?

Ans: The movement of colloidal partciles under the influence of electric potential is known as electrophoresis.

11.   What is Coagulation?

Ans: The process of settling down of colloidal particles is called coagulation or precipitation or flocculation of the sol. (or)

       The process of forming aggregates of colloidal particles is known as coagulation. It is also Known as Flocculation or precipitation of sol.

12.   What is protective colloid?

Ans: Lyophilic colloid which is added to lyophobic colloid to prevent it from coagulation is known as protective colloid.

13.   Give the order of cogulating power of $Cl^-, SO_4^{-2}, PO_4^{-3}$ in the cogulaton of positive sols.

Ans: The order of coagulating power for the given anions in the coagulation of the positive sols is as follows. $PO_4^{-3} > SO_4^{-2} > Cl^-$

6.   Amongst Na⁺, Ba⁺², Al⁺³, which coagulates negative sol readily and why?

Ans: Al+3 coagulates amongst Na⁺, Ba⁺², Al⁺³, negative sol readily as it has highest charge. The Orders of coagulating powers can be given as follows, Na⁺< Ba⁺²< Al⁺³.

7.   How is artifical rain produced?

Ans: When oppositely charged sol like colloidal dust or sand particles are sprayed over the clouds by aeroplane the colloidal water particles of the clouds get neutralised and coagulate to bigger droplets. Hence, produces artifical rains.

SHORT ANSWER QUESTIONS (4 MARKS)

1.   What are different types of adsorption ? Give any four differences between character- istics of these different types.

Ans.

Physisorption	Chemisorption
1. It arises because of van der Waals' forces.	1. It is caused by Chemical bond formation.
2. It is not specific in nature.	2. It is highly specific in nature.
3. It is reversible in nature.	3. It is irreversible in nature.

4. It depends on the nature of gas. Easily liquefiable gases are adsorbed readily.	4. It also depends on the nature of gas. Gases which can react with the adsorbent shows chemisorption.
5. Enthalpy of adsorption is low (20-40KJ/mole)	5. Enthalpy of adsorption is high. (80-240KJ/mole)
6. Low temperature is favourable for adsorption. It decreases with increase of temperature.	6. High temperature is favourable for adsorption. It increases with the increase of temperature.
7. No appreciable activation energy is needed.	7. High activation energy is sometimes needed.
8. It results into multi molecular layers on adsorbent surface under high pressure.	8. It results into unimolecular layer only.

2. What are lyophilic and lyophobic sols? Compare the two terms interms of stability and reversibility.

Ans: Lyophilic sols - There is more attraction between dispersed phase and dispersed medium

Lyophobic sols - There is less attraction between dispersed phase and dispersed medium.

Lyophilic sols are stable and not easily coagulated. They are reversible sols. Lyophobic sols are unstable and they are easily coagulated. They are irreversible sols.

p-Block Elements

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. **Nitrogen molecule is highly stable-Why?**

Ans: Nitrogen molecule is highly stable. This is due to the presence of triple bond between the nitrogen atoms ($N \equiv N$) Which has high bond dissociation energy.

2. **NH_3 forms hydrogen bonds but PH_3 does not Why?**

Ans: NH_3 forms hydrogen bonds because the electro negativity difference between nitrogen and hydrogen is high. But in PH_3 the electro negativity of phosphorous is nearly equal to hydrogen. Therefore PH_3 does not form hydrogen bonds.

3. **Give an example of**
   (a) acidic oxide of phosphorus (b) Neutral oxide of nitrogen.

Ans: (a) Phosphorus Pentoxide P_2O_5 Or P_4O_{10} is acidic oxide of phosphorus.

   (b) Nitrous oxide (N_2O) is the neutral oxide of nitrogen.

4. **What is Allotropy? Give the Allotropes of phosphorous.**

Ans: An element exists in different physical forms with same chemical properties is known as allotropy. Allotropic forms of phosphorous are white, red and black.

5. **Nitrogen exists as diatomic molecule and phosphorus as P_4- Why ?**

Ans: 1) Due to smaller atomic size Nitrogen forms one σ - bond and two π-bonds i.e. triple bonds with other nitrogen atom and exist as di atomic molecule.

   2) Due to large atomic size P is unable to form π-bonds with another P atom and so it is tetra atomic in which each atom is linked with three P atoms by three σ -bonds.

6. **Why is H_2O a liquid While H_2S is a gas ?**

Ans: Due to intermolecular hydrogen bonding, water exists as a liquid.

7. **What is tailing of mercury? How is it removed?**

Ans: Ozone reacts with mercury and gives Hg_2O. Due to the dissolution of Hg_2O in Hg, mercury loses its meniscus and starts sticking to the sides of the glass (container) called 'tailing of mercury'.

   $2\,Hg + O_2 \rightarrow Hg_2O.$
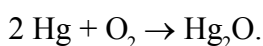
It is removed by shaking it with water.

8. How is Ozone detected.

Ans: 1. Pure ozone is a pale blue gas, dark blue liquid and violet black solid.

2. It gives blue colour with starch iodide paper.

3. It can show tailing of mercury with mercury (Hg)

9. What happens when Cl_2 reacts with dry slaked lime?

Ans: Cl_2 reacts with dry slaked lime to form bleaching powder.

$$Cl_2 + Ca(OH)_2 \rightarrow Caocl_2 + H_2O$$
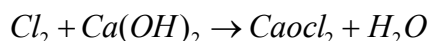
10. Write any two uses of Argon.

Ans. 1. It provides inert atmosphere in high temperature metallurgical processes.

2. Used for filling electric bulbs.

11. Explain structure of XeO_3?

Ans: Structure of XeO_3

1. In XeO_3, Xenon atom undergoes Sp^3 Hybridisation.

2. XeO_3 molecule is having pyramidal shape due to the presence of one lone pair and three bond pairs on central atoms
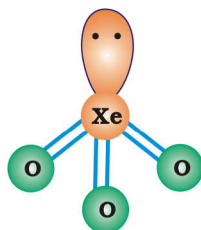
12. How $XeOF_4$ is prepared? Write its structure.

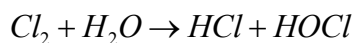Ans: On partial hydrolysis of XeF_6 gives $XeOF_4$

$$XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$$
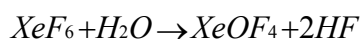
Square pyramidal shape.

13. Write the reaction between fluorine and chlorine with water.

Ans: Fluorine reacts with water gives oxygen.

$$2F_2 + 2H_2O \rightarrow 4HF + O_2$$
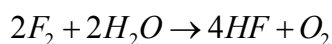
Chlorine reacts with water gives hypochlorous acid.

$$Cl_2 + H_2O \rightarrow HCl + HOCl$$

$$HOCl \rightarrow HCl + [O]$$
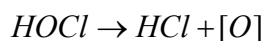
14.   Noble gases are inert – explain.

Ans: Noble gases are inert because they have completely filled ns^2np^6 electronic configuration in their valence shell.

<div align="center">

SHORT ANSWER QUESTIONS (4 MARKS)

</div>

1.   Explain the anamalous nature of nitrogen in Group-15.

Ans: Nitrogen exhibits anamalous behaviour and differs from other elements of group-15 due to the following reasons.

1.   Small size

2.   High electro negativity

3.   High ionization enthalpy.

Anamalous nature of Nitrogen:

(i)   Nitrogen exists as diatomic molecule and other elements form tetratomic molecules.

(ii)   Nitrogen is a gas while all other elements are solids.

(iii)   It has a tendency to form $p\pi$ - $p\pi$ multiple bonds.

(iv)   The maximum covalency of nitrogen is 4 because it does not have vacant d-orbitals in its valency shell.

(v)   It is chemically inert because of high bond dissocation energy of nitrogen molecule.

2.   What are inter halogen compounds ? Give some exmaples to illustrate the definition. How are they classified.

Ans: **Interhalogen Compounds:** The compounds formed when one halogen reacts with another halogen are known as Inter halogen compounds.

Ex: ClF, ClF_3, BrF_3 etc.

The general Compositions are XX', XX'_3, XX'_5 and XX'_7

Where,

X - Halogen atoms of large size.

X' Halogen atoms of smaller size

The oxidation state of halogen atom X is +1, +3, +5, +7 while for atom X' is always -1.

Classification:-

Type	XX'	XX'_3	XX'_5	XX'_7
Example	ClF, BrF	ClF_3, BrF_3	ClF_5, BrF_5	IF_7
Shape	Linear	T-Shaped	Square pyramidal	Pentagonal bi pyramidal
Hybridisation	-	Sp^3d	Sp^3d^2	Sp^3d^3

3.   How are XeF_2 and XeF_4 prepared? Give their structures.

Ans.   a)   Excess xenon reacts with flourine and forms XeF_2

$$Xe + F_2 \xrightarrow{673K, 1bar} XeF_2$$
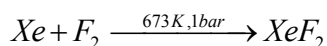
In 1:5 ratio xenon and fluorine react each other to form XeF_4

$$Xe + 2F_2 \xrightarrow[\text{(1:5 ratio)}]{873K, 7bar} XeF_4$$
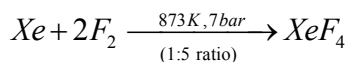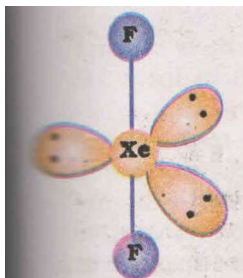
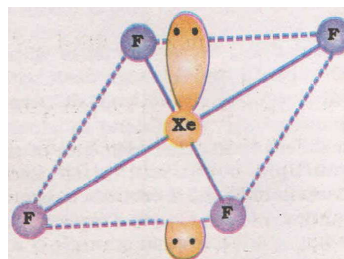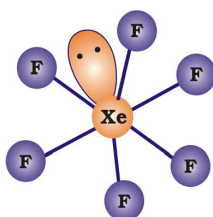Linear   Square Planar
(OR)   (OR)

**4.   Explain the structure of (a) XeF_6 (b) $XeOF_4$**

Ans: (a) XeF_6 Structure:

(1)   In XeF_6 ,Xenon undergoes Sp^3d^3 hybridisation.

(2)   In XeF_6 around Xe atom one lone pair and six bond pairs are present.

(3)   According to VSEPR theory, XeF_6 has a distorted octahedral shape.

(b) $XeOF_4$ Structure:

(1)   In $XeOF_4$ Xenon undergoes Sp^3d^2 hybridisation.

(2)   In $XeOF_4$ around Xe atom lone pair and five bond pairs are present.

(3)   According to VSEPR theory, $XeOF_4$ has a Square Pyramidal shape.
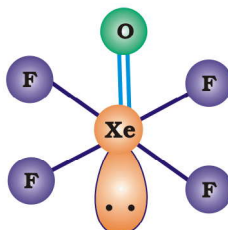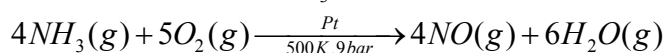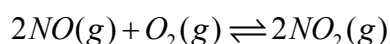
LONG ANSWER TYPE QUESTIONS (8 MARKS)

1. **How is nitric acid manufactured by Ostwald's process? How does it react with the following.**
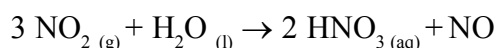
   (a) Copper (b) Zn (c) S_8 (d) P_4

Ans: Catalytic oxidation of NH_3 by atmospheric oxygen gives NO.

$$4NH_3(g)+5O_2(g)\xrightarrow[500K,9bar]{Pt}4NO(g)+6H_2O(g)$$

Nitric oxide combines with oxygen and gives NO_2

$$2NO(g)+O_2(g)\rightleftharpoons 2NO_2(g)$$

Nitrogen dioxide dissolves in water to give HNO_3.

$$3\ NO_{2\ (g)}+H_2O_{\ (l)}\rightarrow 2\ HNO_{3\ (aq)}+NO$$
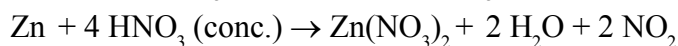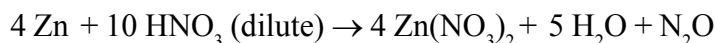
(a) Copper :

Copper reacts with dilute nitric acid gives nitric oxide with concentrated acid gives nitrogen dioxide.

$$3\ Cu+8\ HNO_3\ (dilute)\rightarrow 3\ Cu(NO_3)_2+2\ NO+4\ H_2O$$
$$Cu+4\ HNO_3\ (conc.)\rightarrow Cu(NO_3)_2+2\ NO_2+2\ H_2O$$
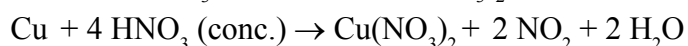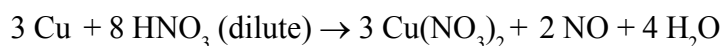
(b) Zn :

Zinc reacts with dilute nitric acid to give N_2O and with concentrated acid to give NO_2.

$$4\ Zn+10\ HNO_3\ (dilute)\rightarrow 4\ Zn(NO_3)_2+5\ H_2O+N_2O$$
$$Zn+4\ HNO_3\ (conc.)\rightarrow Zn(NO_3)_2+2\ H_2O+2\ NO_2$$

(c) S_8 :

Concentrated nitric acid oxidises sulphur to sulphuric acid.

$$S_8+4\ HNO_3\rightarrow 8\ H_2SO_4+48\ NO_2+16\ H_2O$$

(d) P_4 :

Concentrated nitric acid oxidises phosphorus to phosphoric acid.

$$P_4+20\ HNO_3\rightarrow 8\ H_3PO_4+20\ NO_2+4\ H_2O$$

2. **How is ammonia manufactured by Haber's process? Explain the reactions of ammonia with**

   a) $ZnSO_{4\ (aq)}$ b) $CuSO_{4\ (aq)}$ c) $AgCl_{\ (s)}$

Ans. Ammonia is manufactured by Haber's process based on Lechatelier's principle.

$$N_{2\ (g)}+3H_{2\ (g)}\rightleftharpoons 2NH_{3\ (g)}\ ;\ \Delta H=-92KJ\ \ (exothermic)$$
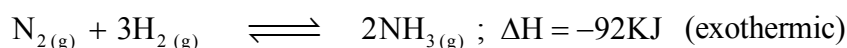
According to Lechatelier's principle, the optimum conditions are

Pressure: about 200 atm

Temperature: nearly 700k

Catalyst: Iron oxide + small amount of K_2O and Al_2O_3

Promoter : Molybdenum

Reactions of ammonia :

a) $Zn\,SO_{4(aq)}$: $Zn\,SO_4 + 2\,NH_4\,OH \rightarrow Zn(OH)_2 + (NH_4)_2\,SO_4$

b) $CuSO_{4(aq)}$: $CuSO_4 + 4\,NH_{3(aq)} \rightleftharpoons \left[Cu(NH_3)_4\right]SO_4$

c) $AgCl_{(S)}$: $AgCl + 2\,NH_{3(aq)} \rightarrow \left[Ag(NH_3)_2\right]Cl_{(aq)}$

Uses of NH_3 :

i) To produce various nitrogenous fertilizers

ii) To prepare many inorganic nitrogen compounds

iii) As a refrigerant.

3. **How is ozone prepared? How does it react with the following ?**

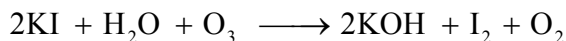   **(a) PbS**   **(b) KI**   **(c) NO**   **(d) Ag**   **(e) C_2H_4**

Ans: **Ozone preparation :** Oxygen when passed through a silent electrical discharge conversion of oxygen to ozone (10%) occurs. The product is called ozonised oxygen.
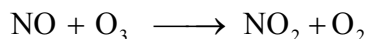
$3O_2 \rightleftharpoons 2O_3$; $\Delta H = 142KJ/mole^{-1}$

a) **PbS :** Ozone reacts with lead sulphide and gives lead sulphate.

   $PbS + 4O_3 \longrightarrow PbSO_4 + 4O_2$
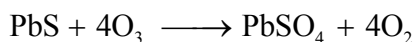
b) **KI :** Ozone reacts with moist KI to give iodine.

   $2KI + H_2O + O_3 \longrightarrow 2KOH + I_2 + O_2$

c) **NO :** Ozone oxidises nitric oxide to nitrogen dioxide.

   $NO + O_3 \longrightarrow NO_2 + O_2$

d) **Ag :** Ozone reacts with silver and forms silver oxide.

   $2Ag + O_3 \longrightarrow Ag_2O + O_2$
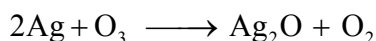
e) **C_2H_4 :** Ozone reacts with C_2H_4 to form ethylene ozonide which on hydrolysis gives formaldehyde.
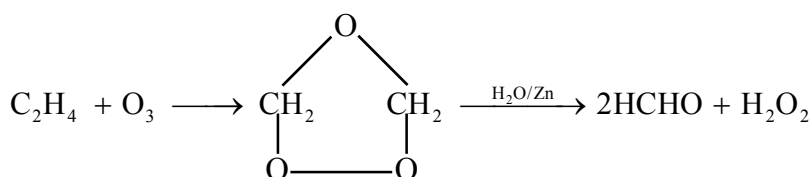
4. **How is chlorine prepared in laboratory and by Deacon's method? Explain its reaction with**

   a) hot, conc. NaOH and cold, dil. NaOH   **b) Excess NH_3 and excess Cl_2 with NH_3**

   c) $Na_2S_2O_3$ **d) $Ca(OH)_2$**   **e) Fe**   **f) H_2S**

Ans: Preparation of chlorine by laboratory method :

a) Chlorine is prepared by heating manganesedioxide with concentrated hydrochloric acid.

   $MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$

b) Chlorine is prepared by heating manganesedioxide with mixture of common salt and concentrated H_2SO_4.

$$4NaCl + MnO_2 + 4H_2SO_4 \rightarrow MnCl_2 + 4NaHSO_4 + 2H_2O + Cl_2$$

c) Chlorine is prepared by the action of HCl on $KMnO_4$.

$$2\ KMnO_4 + 16\ HCl \rightarrow 2\ KCl + 2\ MnCl_2 + 8\ H_2O + 5\ Cl_2$$

Deacon's Process: Chlorine is prepared by oxidation of hydrogen chloride gas by atmospheric oxygen in the presence of $CuCl_2$ at 723 K.

$$4HCl + O_2 \xrightarrow{\ CuCl_2\ } 2Cl_2 + 2H_2O$$
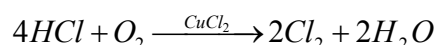
Reactions:

a) Chlorine reacts with hot and conc. sodium hydroxide and gives sodium chloride and sodium chlorate.

$$6NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$$
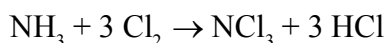
Chlorine reacts with cold and dilute sodium hydroxide and gives sodium chloride and sodium hypo chlorite.

$$2\ NaOH + Cl_2 \rightarrow NaCl + NaOCl + H_2O$$

b) Chlorine reacts with excess of ammonia and gives ammonium chloride and nitrogen.

$$8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$$
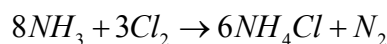
Excess chlorine reacts with ammonia and gives nitrogentrichloride and hydrochloricacid.

$$NH_3 + 3\ Cl_2 \rightarrow NCl_3 + 3\ HCl$$

c) Chlorine reacts with sodium thiosulphate and gives sodium sulphate, hydrochloric acid and sulphur.

$$Na_2S_2O_3 + Cl_2 + H_2O \rightarrow Na_2SO_4 + 2HCl + S$$
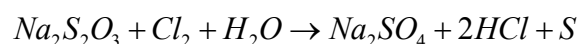
d) When chlorine reacts with dry slaked lime bleaching powder is formed.

$$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2.H_2O$$
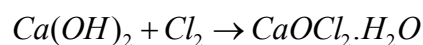
e) Chlorine reacts with iron and gives ferric chloride.

$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$
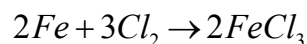
f) Chlorine reacts with H_2S and gives HCl and sulphur.

$$H_2S + Cl_2 \rightarrow 2HCl + S$$
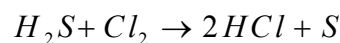
g) Chlorine reacts with acidic Ferrsous sulphate and gives Ferric sulphate and gives HCl.

$$2\ FeSO_4 + H_2SO_4 + Cl_2 \rightarrow Fe_2(SO_4)_3 + 2\ HCl$$
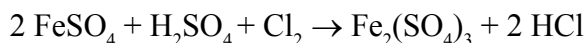
d and f Block Elements and Coordination Compounds

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1.   Calculate the 'spin only' magnetic moment of $Fe^{2+}_{(aq)}$ ion.

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

as $n = 4, \mu = \sqrt{4(4+2)} = \sqrt{4(6)} = \sqrt{24} = 4.9\,BM$

2.   Write electronic configuration of Co^{2+} and Mn^{2+}.

Ans: Electronic configuration of Co^{2+} is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$ (OR) $[Ar]3d^7$ and it has only (three) unpaired electrons.

Electronic configuration of Mn^{2+} is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$ (OR) $[Ar]3d^5$ and it has (five) unpaired electrons.

3.   Why Zn^{2+} is diamagnetic whereas Mn^{2+} is paramagnetic?

Ans: In Mn^{+2} ions unpaired electrons are present in d orbitals. In Zn^{+2} ions unpaired electrons are not present in d orbitals.

4.   What is ligand?

Ans: Coordinating entity (ion or molecule) that is bound to the central atom by donating electron pairs.

eg: $Cl^-, Br^-, I^-, SCN^-, CN^-, NO_3^-$

5. $CuSO_4.5H_2O$ is blue in colour where as anhydrous $CuSO_4$ is colourless. Why?

In $CuSO_4.5H_2O$, water acts as ligand, as a result it causes crystal field splitting. Hence it exhibits blue colour.

In anhydrous $CuSO_4$ due to absence of H_2O crystal field splitting is not possible. So it exhibits no colour.

SHORT ANSWER TYPE QUESTIONS (4 MARKS)

1.   Explain Werner's theory of coordination compounds with suitable example.

Ans: 1.   In co-ordination compounds metal ions show two types of valences – primary and secondary.

2.   The primary valences are satisfied by negative ions. Whereas secondary valances are satisfied by neutral molecules as well as negative ions.

3. Every metal ion has a fixed number of secondary valences called coordination number.

4. The ions / neutral molecules bound by the secondary valences have characteristic spatial arrangements corresponding to different coordination numbers, such spatial arrangements are now called coordination polyhedra.

Eg: 1. In $CoCl_3.6NH_3$ Primary valence is 3; Second valence is 6

2. In $CoCl_3.5NH_3$ Primary valence is 3; Second valence is 6

2. Using IUPAC norms write the systematic names of the following

   (i) $[Co(NH_3)_6]Cl_3$ **(ii) $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$**

   (iii) $[Ti(H_2O)_6]^{3+}$ **(iv) $[NiCl_4]^{2-}$**

Ans. (i) Hexa ammine Cobalt(III) chloride

   (ii) Dia ammine chloro methanamine Platinum(II) chloride

   (iii) Hexa aqua Titanium(III) ion

   (iv) Tetrachloro Nickelate(II) ion

3. Explain the following

   (a) Ambidentate Ligand   **(b) Co-ordination number**

   (c) Co-ordination entity   **(d) Central metal atom/ion**

Ans. a) **Ambidentate Ligand:** The ligand which contains two possible donor atoms is called Ambidentate Ligand.
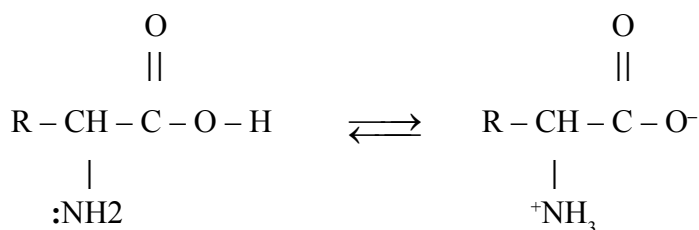
   Eg. NO_2, CN^-

   b) **Co-ordination number :** The number of coordination bonds with which the ligands are bound to central ion.

   c) **Co-ordination entity:** One in which a central metal atom or ion is bound by a fixed number of ions or molecules.

   d) **Central metal atom/ion:** The atom/ion to which a fixed number of ions/groups are bound in a definite geometrical arrangement around it.

Biomolecules

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. **What is Zwitter ion? Give an example.**

   In aqueous solution amino acids lose proton from carboxyl group and amino group can accept a proton giving rise to a dipolar ion known as zwitter ion. Eg. Glycine

$$
\underset{\underset{:NH_2}{|}}{R-CH}-\overset{\overset{O}{||}}{C}-O-H \quad \rightleftharpoons \quad \underset{\underset{^+NH_3}{|}}{R-CH}-\overset{\overset{O}{||}}{C}-O^-
$$

2. **Why are sugars called reducing and non-reducing sugars?**

Ans: Sugars having free aldehyde or ketone group can reduce Fehling solution and Tollen's reagent, hence called reducing sugars. Ex : Glucose, maltose, lactose.

   Sugars having no free aldehyde or ketone group cannot reduce Fehling's solution and Tollen's reagent, hence called non reducing sugars. Ex : Sucrose

3. **What are amino acids? Give two examples.**

Ans: **Amino acids :** Organic compounds having amino ($-NH_2$) group and carboxyl ($-COOH$) group are called amino acids.

   Ex :   Alanine, Aspartic acid

4. **What do you mean by essential and non essential amino acids?**

Ans: **Essential amino acids :** Amino acids not synthesized in the body and should be taken in diet are called essential amino acids.

   Ex : Phenylalanine, Lysine.

   Non essential amino acids : Amino acids synthesized in the body are called non essential amino acids.

   Ex : Alanine, Aspartic acid.

5.   What are nuclei acids? Mention their two important functions?

Ans: Nucleic acids are the biomolecules present in the nuclei of living organisms in the form of chromosomes or nucleoproteins.

Functions :

1.   DNA is responsible for the transmission of heredity characteristics from one generation to another due to its replication property.

2.   RNA and DNA help in protein synthesis in the cell.

6.   Write the biological functions of nucleic acids.

Ans: The biological functions of nucleic acids are,

1.   DNA is responsible for the transmission of heredity characteristics from one generation to another due to its replication property.

2.   RNA and DNA help in protein synthesis in the cell.

3.   RNA synthesis the proteins and DNA holds the message of protein synthesis.

7.   What are the components of a nucleic acid?

Ans: The components of a nucleic acid are Pentose sugar, phosphoric acid and nitrogen containing hetero cyclic bases (purine or pyrimidinc).

8.   Write the names of three types of RNA.

Ans: The three types of RNA are

(i)   Messenger RNA (m-RNA)

(ii)   Ribose RNA (r-RNA)

(iii)   Transfer RNA (t-RNA)

SHORT ANSWER TYPE QUESTIONS (4 MARKS)

1.   Define carbohydrates. How are the carbohydrates classified on the basis of their

(a) Taste   (b) Hydrolysis   (c) Functional groups

Ans: Optically active polyhydroxy carbonyl compounds are called carbohydrates. Ex: Glucose, Sucrose, Cellulose.

(a)   Classification based on taste into   i)   Sugars   ii) Non-sugars

   i)   **Sugars :** Sweet carbohydrates are called sugars. Ex : Glucose, Lactose, Sucrose

   ii)   **Non-sugars :** Carbohydrates which are not sweet are called non sugars. Ex : Cellulose, Starch, Glycogen

(b)   Classification based on hydrolysis into

   i) Monosaccharides   ii) Oligosacchrides   iii) Polysaccharides

   i)   **Monosaccharides :** Carbohydrates that cannot be hydrolysed are called monosaccharides. Ex : Glucose, Fructose, ribose.

   ii)   **Oligosaccharides :** Carbohydrates which can give two to ten monosaccharide units on

hydrolysis are called oligosaccharides. Ex : Sucrose, maltose, lactose.

    iii) Polysaccharides : Carbohydrates which can give large number of monosaccharide units on hydrolysis are called polysaccharides. Ex : Cellulose, starch, glycogen

(c)   Classification based on functional groups into   i)   Aldoses   ii) Ketoses

    i) Aldoses : Carbohydrates having aldehyde group are called aldoses.

      Ex : Glucose, Ribose

    ii) Ketoses : Carbohydrates having keto group are called ketoses. Ex : Fructose.

2.   **What are proteins? Give their classification into fibrous and globular proteins with examples.**

Ans: **Proteins :** Polymers of α – amino acids with peptide bonds are called proteins.

    Ex : Albumin (in white egg), Casein (in milk), keratin (hair).

    Proteins are classified into fibrous and globular based on their shape.

    Fibrous proteins : Fibre - like proteins present parallel to one another are called fibrous proteins. Insoluble in water.

    Ex :   Keratin (hair, wool)

          Myosin (muscles)

    Globular proteins : Spherical shaped proteins present like a coil are called globular proteins. Soluble in water.

    Ex : Insulin, albumin

3.   **Explain the classification of proteins as primary, secondary, tertiary, quaternary proteins with respect to their structure.**

Ans: **Primary structure of proteins :** Sequence of amino acids in a peptide chain is called primary structure of proteins. It represent its constitution.

    Secondary structure of proteins : Shape in which a long polypeptide chain can exist is the secondary structure of proteins.

    Ex : α – Helix.
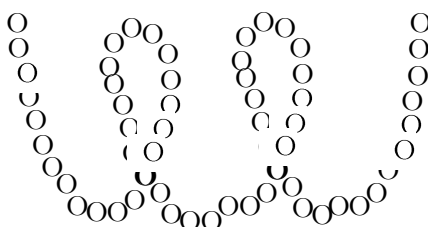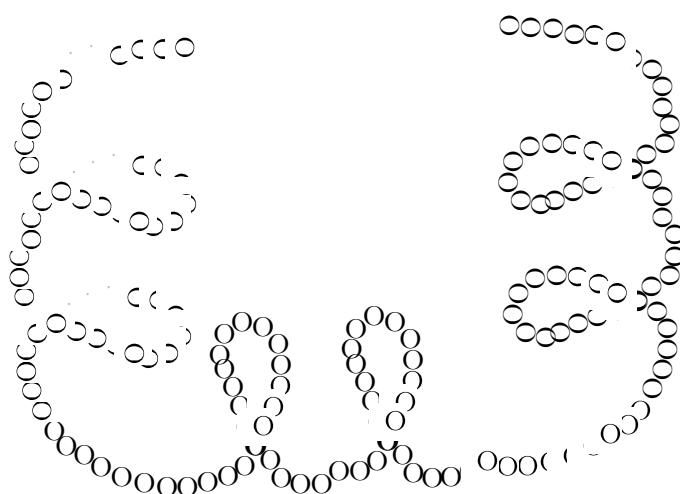
Tertiary structure of proteins : Further folding of secondary structure is called tertiary structure of proteins. Ex : Fibrous proteins, Globular proteins.

Quaternary structure of proteins : Spatial arrangement of two or more polypeptide chains with respect to each other is called quaternary structure of proteins.

4.   **Explain the denaturation of proteins.**

Ans: **Denaturation of proteins :** Destruction of 2^0 and 3^0 structures of proteins and disturbance of hydrogen bonds when they are subjected to a change in temperature or change in pH is called denaturation of proteins.

Ex :   Coagulation of egg white on boiling, curdling of milk.

Organic Chemistry

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. **What are ambident nucleophiles? Give examples**

Ans. The nucleophiles which possess two nucleophilic centres are called ambident nucleophiles.

eg: Cyanide, nitrite groups

2. **What is Racemic mixture?**

Ans. Mixture containing two enantiomers in equal proportions is known as racemic mixture. The optical rotation due to one isomer is cancelled by the optical rotation due to other isomer.

3. **What are Enantiomers?**

The stereo isomers which are non super imposable mirror images to each other are called Enantiomers

4. **What is the stereochemical result of S_N^1 and S_N^2 reactions.**

Ans: (1) In case of optically active alkyl halide S_N^1 reactions are accompanied by racemisation.

(2) In case of optically active alkyl halide S_N^2 reactions are accompanied by inversion of configuration.

5. **Compare the acidic strength of acetic acid, chloroacetic acid, benzoic acid and Phenol .**

Ans: Carboxylic acids are stronger acids than alcohols and Phenols. Phenols are more acidic than alcohols. Hence the acidic strength order is

Chloroacetic acid > benzoic acid > acetic acid > Phenol

6. **Arrange the following bases in decreasing order of pk_b Values.**
   $C_2H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2 NH$ and $C_6H_5NH_2$.

Ans: As the basic strength increases, the pk_b value decreases.

Therefore the decreasing order of the pkb values is,

$$C_6H_5NH_2 > C_6H_5NHCH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$$

| pk_b values | 9.38 | 9.3 | 3.29 | 3.00 |

7.   Explain the acidic nature of Phenols and compare with that of alcohols?

Ans: (1)   The reaction of phenol with aqueous NaoH indicates phenols are more acidic than alcohols.

(2)   The ionisation of an alcohol and phenol takes place as follows.

$$R - \ddot{\text{O}} -H \Longleftrightarrow R - \ddot{\text{O}}\text{:}^- + H^+$$
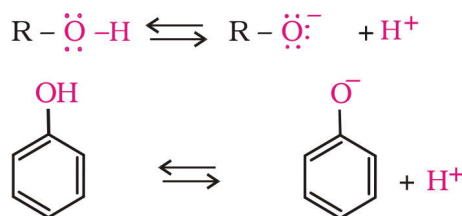
(3)   Due to high electro negativity of sp^2 hybridised carbon of phenol to which OH is attached, electron density decreases on oxygen.

(4)   This increases the polarity of O-H bond and results in an increase in ionisation of phenols than that of alcohols.

(5)   The delocalisation of negative charge makes phenoxide ion more stable and favour ionisation of phenol but not ethoxide ion.
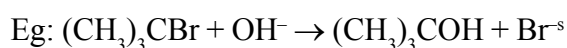

I   II   III   IV   V
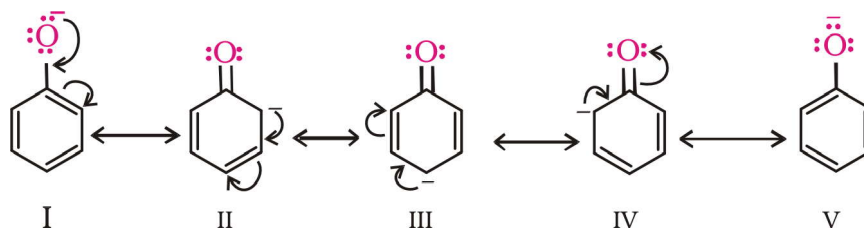
(6)   Hence phenols are more acidic than alcohols

SHORT ANSWER TYPE QUESTIONS (4 MARKS)

1.   Explain S_N^1 and S_N^2 Reactions with example.

Ans: **S_N^1 Reaction** – The nucleophilic substitution reactions in which rate of reaction depends upon the concentration of only one reactant are known as S_N^1 reactions.

Eg: $(CH_3)_3CBr + OH^- \rightarrow (CH_3)_3COH + Br^{-s}$

S_N^2 Reaction – The nucleophilic substitution reaction in which rate of reaction depends upon concentration of both the reactants is known as S_N^2 reaction.

Eg: $CH_3Br + OH^- \rightarrow CH_3OH + Br^-$
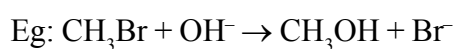
2. **Give the equations for the preparation of phenol from Cumene?**

Ans: Phenol is prepared by oxidising cumene (Isopropyl Benzene) is oxidised in the presence of air to cumene hydroperoxide. It is converted to phenol and acetone by treating it with dilute acid.

Cumene

Cumene hydroperoxide
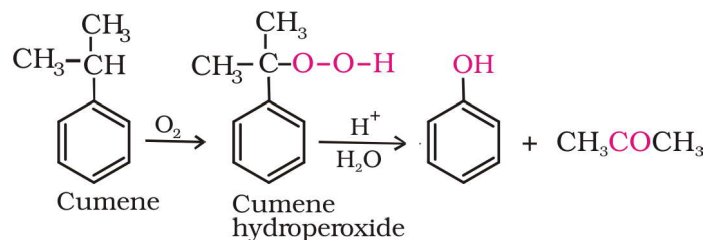
3. **Write the products formed by the reduction and oxidation of phenol?**
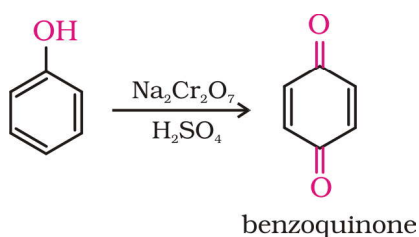
Ans: (1) Reduction of phenol with Zinc dust.

Phenol is converted to benzene on heating with Zinc dust.
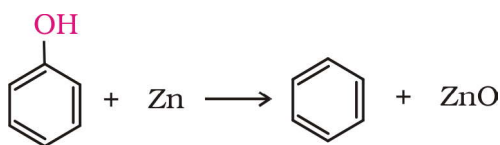
(2) Oxidation of Phenol with Chromic acid.

Oxidation of Phenol with chromic acid producing a conjugated diketone known as benzoquinone.

In presence of air, Phenols are slowly oxidised to dark coloured mixtures containing quinones.

benzoquinone

4. **Arrange the following in the increasing order of their acidic strength.**

Benzoic acid, 4- Methoxy benzoic acid, 4- Nitrobenzoic acid and 4-Methyl benzoic acid.

Ans: The acidic strength of electron donating group ($-OCH_3$) decreases while that of electron with drawing group ($-NO_2$) increases.
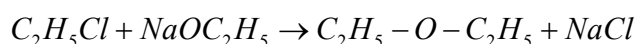
Therefore, the acidic strenths of different acids in increasing order is,

4- Methoxy benzoic acid < 4-Methyl benzoic acid < Benzoic acid < 4- Nitrobenzoic acid.

LONG ANSWER TYPE QUESTIONS (8 MARKS)

1. **Explain following reactions**

    1. **Williamson's Synthesis** : Ethyl chloride reacts with sodium ethoxide and forms di-ethyl ether.

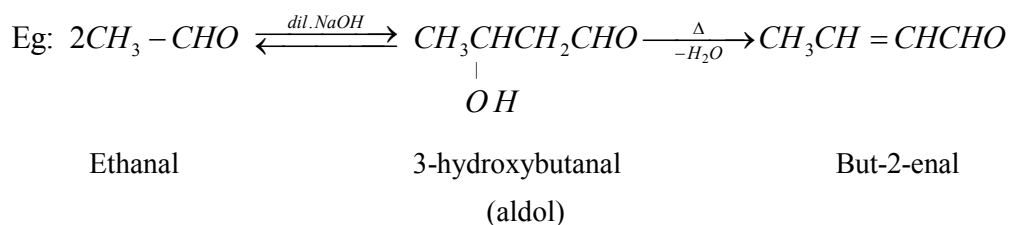 $$C_2H_5Cl + NaOC_2H_5 \rightarrow C_2H_5 - O - C_2H_5 + NaCl$$

    2   **Kolbe's Reaction:** Phenol reacts with sodium hydroxide and carbondioxide and forms salicylic acid.
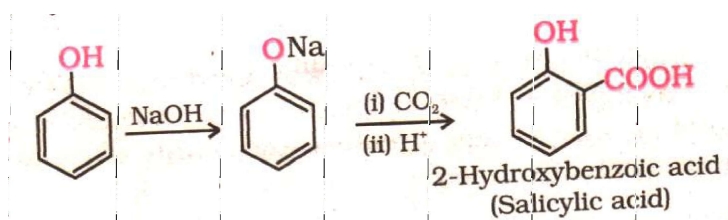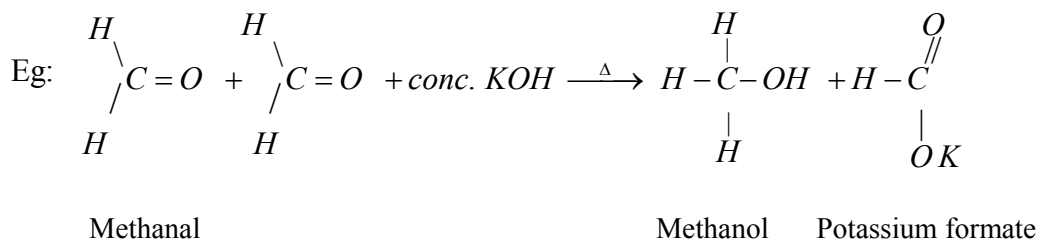

    3. **Reimer –Tiemann Reaction** : On treating phenol with chloroform in presence of sodium hydroxide salicyl aldehyde is formed.
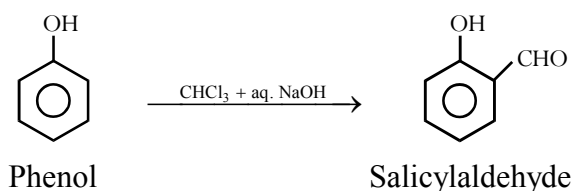

    4.   **Aldol Condensation :** Aldehydes and ketones (carbonyl compounds) which have atleast one α- hydrogen undergo condensation reaction in presence of dilute alkali and gives β-hydroxy aldehydes (aldol) or β-hydroxy ketones (ketols). They lose water to give α,β-unsaturated carbonyl compound.

        Eg: $2CH_3 - CHO \xrightarrow[\quad]{dil.NaOH} CH_3CHCH_2CHO \xrightarrow[-H_2O]{\Delta} CH_3CH = CHCHO$
        $$\underset{OH}{|}$$

        Ethanal   3-hydroxybutanal   But-2-enal
                                              (aldol)

    5. **Cannizzaro Reaction:** Aldehydes which do not have α-hydrogen undergo self oxidation and reduction (disproportionation) reaction on heating with conc. alkali and give alcohol and salt of carboxylic acid.

Eg: $$\underset{\substack{\text{Methanal}}}{\underset{H}{\overset{H}{\diagup}}C=O \;\; + \;\; \underset{H}{\overset{H}{\diagup}}C=O} \;\; + conc.\ KOH \xrightarrow{\;\Delta\;} \underset{\substack{\text{Methanol}}}{H-\underset{H}{\overset{H}{\underset{|}{\overset{|}{C}}}}-OH} \;\; + \underset{\substack{\text{Potassium formate}}}{H-\overset{O}{\underset{OK}{\underset{|}{\overset{/\!/}{C}}}}}$$

6. **Esterification :** Alcohols / phenols react with carboxylic acids / acid chlorides / acid anhydrides to form esters.

Eg: $R' / ArOH + RCOOH \underset{}{\overset{H^+}{\rightleftharpoons}} RCOOR' / Ar + H_2O$
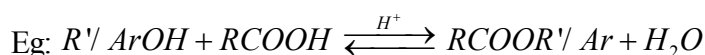
7. **De-carboxylation:** Carboxylic acids lose carbondioxide to form hydrocarbons when their sodium salts are heated with soda lime (NaOH and CaO in the ratio of 3:1).

Eg: $R\text{-COONa} \xrightarrow[\text{Heat}]{\text{NaOH \& CaO}} R\text{-H} + Na_2Co_3$
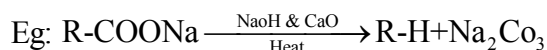
8. **Carbylamine reaction:** Aliphatic or aromatic primary amines on heating with chloroform and Alcoholic potassium hydroxide form isocyanides (carbylamines) which are foul smelling substances. This is called carbylamine reaction.

Eg: $R\text{-NH}_2 + CHCl_3 + 3KOH \xrightarrow{\text{Heat}} R\text{-NC} + 3KCl + 3H_2O$
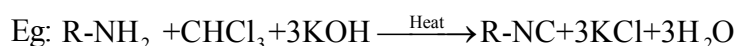
9. **Wurtz Reaction:** Alkyl halides react with sodium in dry ether to give hydrocarbons containing double the number of carbon atoms present in the halide. This is called Wurtz Reaction.

$2\,RX + 2\,Na \xrightarrow{\text{dry ether}} R\text{-}R + 2\,NaX$
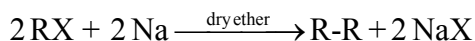
10. **HVZ (Hell-Volhard-Zelinsky) Reaction:** Carboxylic acids with one α- hydrogen react with halogens in presence of red phosphorous to give α-halo carboxylic acid.

$$CH_3COOH + Cl_2 \xrightarrow[H_2O]{Red\ Phosporus} ClCH_2COOH$$
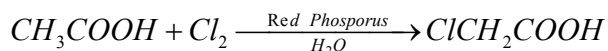
11. **Cross-Aldol condensation:** When Aldol condensation is carried out between two different aldehydes and / or ketones, it is called Cross-Aldol condensation

$C_6H_5CHO + C_6H_5COCH_3 \xrightarrow[293K]{OH^-} C_6H_5CH=CHCOC_6H_5$
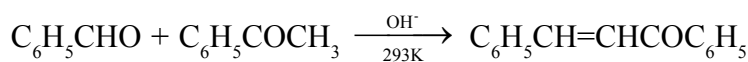
Benzaldehyde Acetophenone   Benzalacetophenone