

Solid State**VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)****1. Define the term amorphous.**

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

Eg : glass, rubber, plastic.

2. What makes a glass different from quartz?

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

3. What is meant by the term coordination number?

Ans. The number of nearest oppositely charged ions surrounding a particular ion in an ionic crystal is called coordination number.

The number of nearest neighbours of a particle is called coordination number.

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

4. What is the coordination number of atoms in a cubic close pack structure?

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

5. What is the coordination number of atoms in a body-centered cubic structure?

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

6. 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.

7. 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

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

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

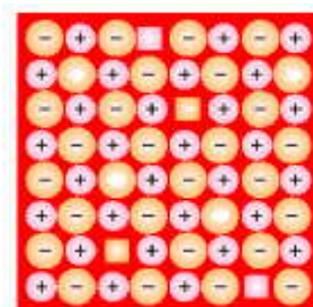
9. What is Schottky defect?

Ans. 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

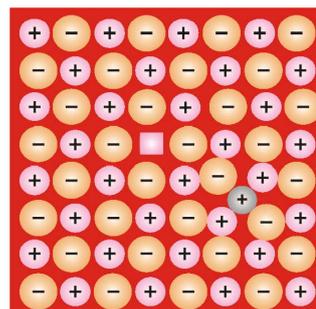
Schottky defect decreases the density.

**10. What is Frenkel defect?**

Ans. It is a point defect due to the cation is dislocated from its normal site into an interstitial site.

eg: AgBr, AgCl

Frenkel defect does not decrease the density.

**11. What is interstitial defect?**

Ans. When some constituent particles (atoms or molecules) occupy an interstitial site, the crystal is said to have interstitial defect.

12. What are F-centers?

Ans. The anionic sites occupied by unpaired electrons in a crystal are called F-centers.

SHORT ANSWER TYPE QUESTIONS (4 MARKS)**13. 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 |

14. Explain why ionic solids are hard and brittle.

Ans. Ionic solids are hard because of presence of strong electrostatic attraction forces between anions and cations.

They are brittle because of non-directional nature of ionic bonds.

15. Calculate the efficiency of packing in case of a metal of simple cubic crystal.

Ans. In a simple cubic lattice the atoms are located only on the corners of the cube. The particles touch each other along the edge.

Let the edge length or side of the cube a and the radius of each particle r .

They are related as $a = 2r$

The volume of the cubic unit cell $= a^3 = (2r)^3 = 8r^3$

Since a simple cubic unit cell contains only 1 atom, the volume of the occupied space $= \frac{4}{3}\pi r^3$

Packing efficiency $= \frac{\text{Volume of one atm}}{\text{Volume of cubic unit cell}} \times 100$

$$\begin{aligned} &= \frac{\frac{4}{3}\pi r^3}{8r^3} \times 100 = \frac{\pi}{6} \times 100\% \\ &= 52.4\% \end{aligned}$$

16. Derive Bragg's equation.

Ans.

- i) X-ray is diffracted from point A in the plane (1st layer)
- ii) X-ray is diffracted from point B in the plane (2nd layer)

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, i.e. $n\lambda$.

$$\therefore AB+BC = n\lambda \quad \text{_____ (1)}$$

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

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

$$AB = d \sin\theta$$

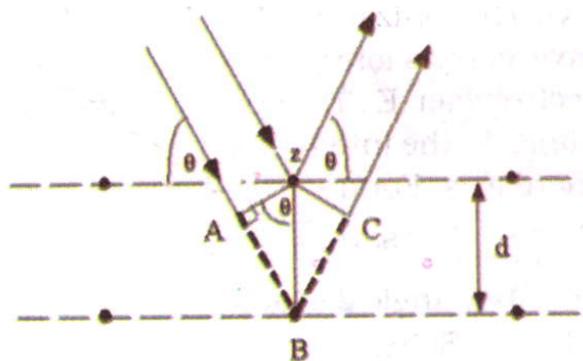
$$\text{as } AB = BC$$

$$\therefore AB + BC = 2d \sin\theta \quad \text{_____ (2)}$$

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. Define the term solution.

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

2. Define molarity.

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

$$\text{Molarity of a solution} = \frac{\text{number of moles of solute}}{\text{volume of solution (in L)}}$$

3. Define molality.

The number of moles of solute present in 1 kg solvent is called molality.

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

4. Define mole fraction.

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.

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

5. Define mass percentage of solution.

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

6. What is ppm of solution?

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

7. 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.

$$\frac{p_1^0 - p_1}{p_1^0} = x_2$$

OR

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

$$p_1 \propto x_1$$

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 component

8. State Henry's law.

Ans. The partial pressure of the gas in vapour phase (p) is directly 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

9. What are ideal solutions? Give examples.

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 is ebullioscopic constant (K_b)?

Ans. The elevation in boiling point of the one molal solution containing a non-volatile solute is called ebullioscopic constant.

11. 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.

12. Define osmotic pressure.

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

13. 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.

SHORT ANSWER TYPE QUESTIONS (4 MARKS)**14. Calculate the mole fraction of H_2SO_4 in a solution containing 98% H_2SO_4 by mass**

Ans. Assume that we have 100 g of solution.

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

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

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

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

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

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

Ans. Mass percentage of glucose in water solution = 10% w/w

This means 10g of glucose in 100g solution.

$$\text{Weight of water} = 100 - 10 = 90\text{g}$$

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

$$\text{Molarity of solution} = \frac{\text{weight of glucose}}{\text{G.M.wt. of Glucose}} \times \frac{1000}{\text{Vol. of solution}}$$

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

17. 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

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

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

$$\begin{aligned} \text{molefraction of sucrose} &= \frac{\text{no. of moles of sucrose}}{\text{total no. of moles in solution}} = \frac{0.058}{0.058 + 4.444} = \frac{0.058}{4.502} \\ &= 0.0129 \end{aligned}$$

$$\begin{aligned} \text{molefraction of water} &= 1 - \text{mole fraction of sucrose} \\ &= 1 - 0.0129 \\ &= 0.9871 \end{aligned}$$

18. How is molar mass related to the elevation in boiling point of a solution?

Ans. The elevation in boiling point of dilute solutions is directly proportional to the molality.

$$\Delta T_b \propto m$$

$$\Delta T_b = K_b m \quad \text{where } K_b = \text{Ebullioscopic constant}$$

$$\text{Molality } m = \frac{w_2}{M_2} \times \frac{1000}{w_1}$$

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

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

From this equation molar mass of solute is determined.

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

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

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

p_1^0 = vapour pressure of pure solvent

p_1 = vapour pressure of solution

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

According to Raoult's law:

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

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

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

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{M_1}{M_2} \times \frac{w_2}{w_1}$$

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

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.

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

Ans. Given that,

Osmotic Pressure $\pi = 1.52 \text{ bar}$

Temperature $T = 300\text{K}$

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

Osmotic Pressure $\pi = CRT$.

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

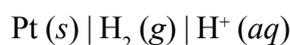
Electro Chemistry and Chemical Kinetics

Electro Chemistry

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

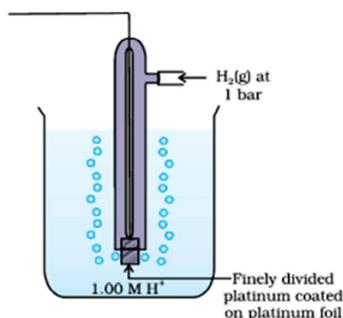
1. What is standard hydrogen electrode?

Ans. The reference electrode which is used to measure the potential difference between the two half-cell potentials is called standard hydrogen electrode.



2. Give a neat sketch of standard hydrogen electrode.

Ans.



3. What is Nernst equation?

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

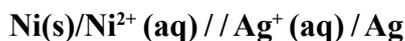
Ans. Nernst equation relates the reduction potential of an electrochemical reaction to the standard electrode potential, temperature and molar concentrations or activities of chemical species under going reduction and oxidation at any concentration.



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

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

4. Write the Nernst equation for the EMF of the cell.



Ans.
$$E_{cell} = E_{cell}^0 - \frac{RT}{2F} \ln \frac{[Ni^{2+}]}{[Ag^+]^2}$$

$$E_{cell} = E_{cell}^0 - \frac{0.059}{2} \log \frac{[Ni^{2+}]}{[Ag^+]^2}$$

5. How is E^0 cell related mathematically to the equilibrium constant K_C of the cell reaction?

Ans.
$$E_{cell}^0 = \frac{2.303RT}{nF} \log K_C$$

6. Define conductivity of a material. Give its SI units.

Ans. The inverse of resistivity or specific resistance is called conductivity or specific conductance.

$$\kappa = \frac{1}{\rho}$$

The SI unit of conductivity is Sm^{-1} .

7. Define molar conductivity Λ_m and how is it related to conductivity (κ).

Ans. The conductivity of an electrolytic solution divided by the molar concentration of the electrolyte.

$$\Lambda_m = \frac{\kappa}{C}$$

8. State Faraday's first law of electrolysis.

Ans. The amount of substance deposited or 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 (solution or melt).

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

9. State Faraday's second law of electrolysis.

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

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

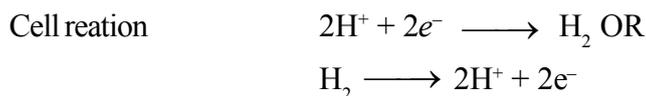
10. A solution of CuSO_4 is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode?

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

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

SHORT ANSWER TYPE QUESTIONS (4 MARKS)**11. What is standard hydrogen electrode?**

It is a standard electrode. By taking its electrode potential as 0.0 V, the electrode potential of another cell is determined. At 25°C, 1 atm pressure hydrogen gas is passed into 1 M HCl Solution it works as both anode and cathode.

**12. State and explain Kohlrausch law of independent migration of ions.**

Ans. 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, its limiting molar conductivity

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

Applications of Kohlrausch Law

- (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.

13. What is electrolysis? Give Faraday's first law of electrolysis.

Ans. The process of dissociation of an electrolyte into anions and cations by passing electricity is called electrolysis.

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.

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

ESSAY ANSWER TYPE QUESTIONS (8 MARKS)

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

Ans. 1. Determination of Λ_m^0 for any 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

$$\Lambda_{\text{CH}_3\text{COOH}}^0 = \lambda_{\text{CH}_3\text{COO}^-}^0 + \lambda_{\text{H}^+}^0$$

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

$$\begin{aligned}\Lambda_{\text{CH}_3\text{COOH}}^0 &= \Lambda_{(\text{CH}_3\text{COONa})}^0 + \Lambda_{(\text{HCl})}^0 - \Lambda_{(\text{NaCl})}^0 \\ &= \left[\lambda_{\text{CH}_3\text{COO}^-}^0 + \lambda_{\text{Na}^+}^0 \right] + \left[\lambda_{\text{H}^+}^0 + \lambda_{\text{Cl}^-}^0 \right] - \left[\lambda_{\text{Na}^+}^0 + \lambda_{\text{Cl}^-}^0 \right] \\ &= \lambda_{\text{CH}_3\text{COO}^-}^0 + \lambda_{\text{Na}^+}^0 + \lambda_{\text{H}^+}^0 + \lambda_{\text{Cl}^-}^0 - \lambda_{\text{Na}^+}^0 - \lambda_{\text{Cl}^-}^0 \\ &= \lambda_{\text{CH}_3\text{COO}^-}^0 + \lambda_{\text{H}^+}^0\end{aligned}$$

2. Calculation of dissociation constant of weak electrolytes.

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

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

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

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

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

Where, C = Concentration or molarity of the solution.

Chemical Kinetics

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. Define the speed or rate of a reaction.

- A. The change in the concentration of any one of the reactants or products per unit time called rate of reaction.



$$r_{qv} = \frac{-\Delta[R]}{\Delta t} = \frac{\Delta[P]}{\Delta t} \quad (\text{OR})$$

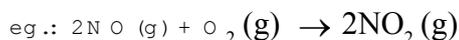
$$r_{inst} = \frac{-d[R]}{dt} = \frac{d[P]}{dt}$$

2. What are the units of rate of reaction?

- A. $\text{mol L}^{-1}\text{s}^{-1}$

3. What is rate law expression? Illustrate with an example.

- A. The equation which tells the relation between the rate of reaction and the concentration of reactants is called rate law expression or rate equation.



$$\text{Rate of reaction} = k [\text{NO}]^2 [\text{O}_2]$$

4. Give the units of rate constants of zero order, first order and second order reactions.

- A. Units of rate constant for zero order reactions: $\text{mol L}^{-1}\text{s}^{-1}$
 Units of rate constant for first order reactions : s^{-1} (Or) time^{-1}
 Units of rate constant for second order reactions: $\text{mol}^{-1} \text{L s}^{-1}$

5. Give two examples for zero order reactions.

- A. i) $2\text{NH}_3(\text{g}) \xrightarrow[\text{Pt catalyst}]{1130\text{k}} \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$
 ii) $2\text{HI}(\text{g}) \xrightarrow{\text{Au}} \text{H}_2(\text{g}) + \text{I}_2(\text{g})$

6. Give two examples for gaseous first order reactions.

- A. i) $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$
 ii) $\text{N}_2\text{O}_5(\text{g}) \longrightarrow \text{N}_2\text{O}_4(\text{g}) + \frac{1}{2}\text{O}_2(\text{g})$

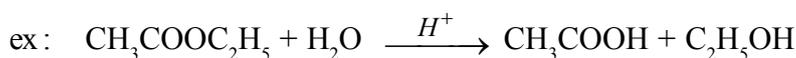
7. Write the equation useful to calculate half-life ($t_{1/2}$) values for zero and first order reactions.

1. Half life for zero order reactions : $t_{1/2} = \frac{[R]_0}{2k}$ or $t_{1/2} = \frac{a}{2k}$

2. Half life for first order reactions : $t_{1/2} = \frac{0.693}{k}$

8. What are pseudo first order reactions? Give one example.

A second order reaction that is made to behave like a first order reaction is called pseudo first order reaction.



$$\text{Rate} = k' [\text{CH}_3\text{COOC}_2\text{H}_5] [\text{H}_2\text{O}]$$

As $[\text{H}_2\text{O}]$ is constant the above equation can be written as

$$\text{Rate} = k [\text{CH}_3\text{COOC}_2\text{H}_5]$$

The reaction behaves as first order reaction.

9. A reaction has a half-life of 10 minutes. Calculate the rate constant for the first order reaction

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

$$10 = \frac{0.693}{k}$$

$$k = \frac{0.693}{10} \\ = 0.0693 \text{ min}^{-1}$$

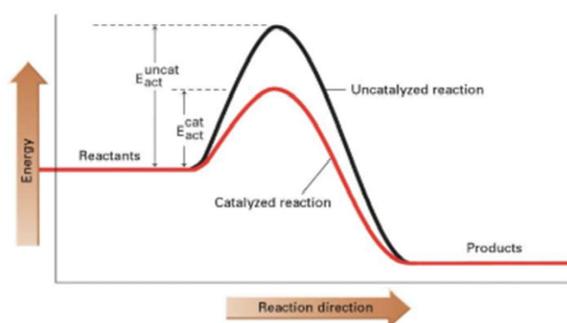
10. Calculate the half-life of first order reaction whose rate constant is 200 s^{-1} .

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{200} \\ = 0.00346 \text{ s or } 3.46 \times 10^{-3} \text{ s}$$

SHORT ANSWER TYPE QUESTIONS (4 MARKS)

11. Discuss the effect of catalyst on the kinetics of a chemical reaction with a suitable diagram.

The rate of reaction increases in presence of catalyst. Because in presence of catalyst the reaction proceeds in such a way where the energy of activation is less.



A catalyst is a substance which increases rate of reaction without itself undergoing any permanent chemical change.

12. What is half-life ($t_{1/2}$) of a reaction? Derive the equations for the half-life value of zero order and first order reactions.

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

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

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

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

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

First order reactions - Derivation of Half-life

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

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

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

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

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

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

13. What is molecularity of a reaction? How is molecularity 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 / reaction 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 reactions only.	3) It is applicable for both elementary and complex reactions.

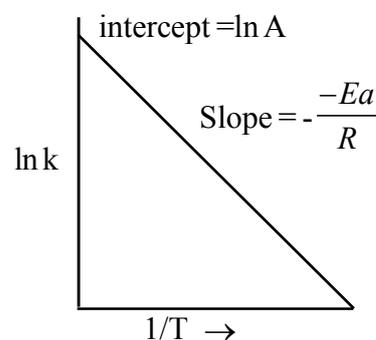
LONGANSWER TYPE QUESTIONS (8 MARKS)

14. What is Arrhenius equation ? Derive an equation which describes the effect of rise of temperature (T) on the rate constant (k) of a reaction.

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

$$k = Ae^{-E_a/RT} \quad \dots\dots\dots (1)$$

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

$$\ln k = \ln A - \frac{E_a}{RT} \quad \dots\dots\dots (2)$$

at temperature T_1 , equation is

$$\ln k_1 = \ln A - \frac{E_a}{RT_1} \quad \dots\dots\dots (3)$$

at temperature T_2 , equation is

$$\ln k_2 = \ln A - \frac{E_a}{RT_2} \quad \dots\dots\dots (4)$$

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

$$\ln k_2 - \ln k_1 = \ln A - \frac{E_a}{RT_2} - \left\{ \ln A - \frac{E_a}{RT_1} \right\}$$

$$\ln \frac{k_2}{k_1} = \ln A - \frac{E_a}{RT_2} - \ln A + \frac{E_a}{RT_1}$$

$$\ln \frac{k_2}{k_1} = \frac{E_a}{RT_1} - \frac{E_a}{RT_2}$$

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

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

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

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

15. 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 silver nitrate and sodium chloride.
- (c) **Order of a reaction :** The sum of the powers of the concentration terms of the reactants in the rate law expression is called as 'order of reaction'. It may be 0, 1, 2, 3 or a fraction. It is determined from experimentally.
- (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'. It is always a whole number (1 or 2 or 3). It is determined from reaction mechanism.
- (e) **Activation energy :** The difference between threshold 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 simultaneously. This phenomenon is called sorption.

3. What is desorption?

Ans. Removal of the adsorbed substance from the surface is known as desorption.

4. Give any two applications of the adsorption?

Ans. (i) Mixture of noble gases are separated by adsorption in Dewar's method.

(ii) A number of drugs kill germs by getting adsorbed on germs. Hence, forth curing the diseases.

5. Name the dispersed phase and dispersion medium in the following colloidal systems (i) fog (ii) smoke (iii) milk.

Ans.

S.No.	Colloidal System	Dispersed Phase	Dispersion medium
(i)	fog	Water droplets	air
(ii)	smoke	Carbon particles	air
(iii)	Milk	liquid fat droplets	water

6. 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).

7. 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.

8. 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.

9. 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 due to scattering of light by colloidal particles. This is called Tyndall effect.

10. What is Brownian movement.

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

11. 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.

12. 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.

13. What is electrophoresis?

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

14. What is Electro Osmosis?

Ans. The movement of the Colloidal particles is stopped but the dispersion medium moves in the opposite direction.

15. 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.

16. What is protective colloid?

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

17. Define the Flocculation Value?

Ans. The minimum concentration of an electrolyte in millimoles per litre required to cause coagulation of a sol in two hours is called flocculation value.

18. Give the order of coagulating 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. $PO_4^{-3} > SO_4^{-2} > Cl^-$

19. 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, $Na^+ < Ba^{+2} < Al^{+3}$.

20. How is artificial 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 artificial rains.

21. Name any two applications of colloidal solutions?

Ans. (i) Rubber is obtained from latex by coagulation.
(ii) Water is purified by adding alum which removes the impurities in water by coagulation.

SHORT ANSWER QUESTIONS (4 MARKS)

1. What do you understand by the term given below:

(A) Absorption (b) Adsorption (c) Adsorbent and Adsorbate

Ans. (a) **Absorption** : Absorption is a bulk phenomenon. Hence it occurs throughout the body of the material.

(b) **Adsorption** : Adsorption is a surface phenomenon. Hence it occurs only at the surface of the adsorbent.

(c) The molecular Species which accumulates on the surface is called adsorbate.
The material on the surface of which adsorption takes place is called adsorbent.

2. What are different types of adsorption ? Give any four differences between characteristics 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.

3. 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.

4. Describe Bredig's Arc method of preparation of colloids with a neat diagram?

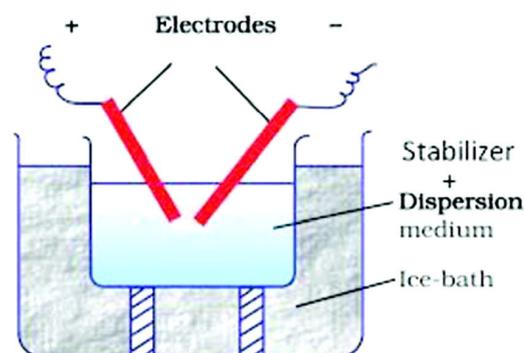
Ans: **Bredig's Arc Method:** (i) This process involves dispersion as well as condensation.

(ii) Colloidal sols of metals such as gold, Silver, Platinum etc are prepared by this method.

(iii) In this method, electric arc is struck between electrodes of the metal immersed in the dispersion medium.

(iv) The intense heat produced vapourises the metal, which then condenses to form particles of colloidal size.

(v) Diagram of Bredig's Arc Method.



5. Describe Cottrell smoke Precipitator with a neat diagram.

Ans: (i) Smoke is a colloidal solution of solid particles such as carbon, arsenic compounds, dust etc, in air.

(ii) The smoke before coming out of chimney is passed through cottrel precipitator.

(iii) The precipitator has plates having a charge opposite to that carried by smoke particles.

(iv) On contact with the plates the particle lose their charge and get precipitated and there by settle down.

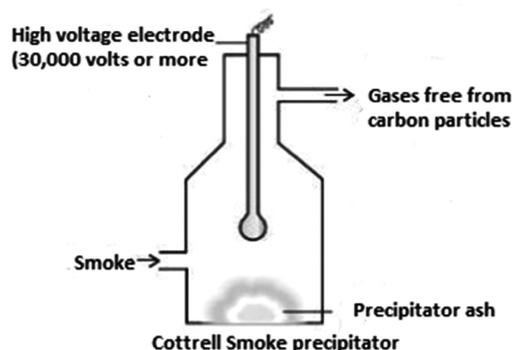
(v) Aerial pollution by smoke is prevented by cottrell precipitator.

(vi) Diagram:

6. Define the Gold Number?

Ans: The Mass of protective colloid in milligrams which protects the coagulation of 10 ml of a gold sol on

adding 1 ml of 10% NaCl solution is known as Gold Number. The Gold Number of few positive colloids are - Gelatine: 0.005-0.01; Haemoglobin: 0.03; Gumarabic: 0.15-0.25, Potato Starch: 25.



p-Block Elements**VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)**

1. Nitrogen exists as diatomic molecule and phosphorus as P₄- 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.

2. 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.

3. 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.

4. What is inert pair effect?

- Ans. The reluctance of ns electrons towards bond formation is known as inert pair effect.

5. Write the oxidation states of phosphorovs in solid PCl₅.

- Ans. It exists as an ionic solid i.e., $[PCl_4]^+ [PCl_6]^-$ in solid state

$[PCl_4]^+$ 'P' oxidation state is +5

$[PCl_6]^-$ 'P' oxidation state is +5

\therefore Oxidation state of 'P' in solid PCl_5 is '+5'

6. 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.

7. NH₃ forms hydrogen bonds but PH₃ 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.

8. NO is paramagnetic in gaseous state but diamagnetic in liquid and solid states.

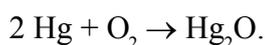
Ans. In gaseous state NO exists as a monomer and contains one unpaired electron but in liquid and solid states it dimerises to N_2O_4 so it does not contain unpaired electron.

9. Why is H_2O a liquid While H_2S is a gas ?

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

10. 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'.



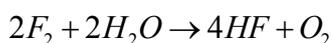
It is removed by shaking it with water.

11. How is Ozone detected?

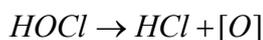
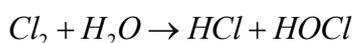
- Ans:
1. Pure ozone is a pale blue gas, dark blue liquid and violet black solid.
 2. It gives blue colour with starch iodide paper.
 3. It can show tailing of mercury with mercury (Hg)

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

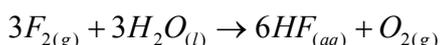
Ans: Fluorine reacts with water gives oxygen.



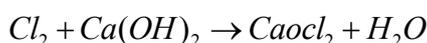
Chlorine reacts with water gives hypochlorous acid.



Fluorine gives oxygen and ozone with H_2O .

**13. What happens when Cl_2 reacts with dry slaked lime?**

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

**14. What is major source of helium?**

Ans. The main commercial source of helium is natural gas

15. List out the uses of neon

- Ans.
- (i) Neon bulbs are used in botanical gardens and in green houses.
 - (ii) 'Ne' is used in discharge tubes and fluorescent bulbs for advertisement display purposes.

16. Write any two uses of Argon.

- Ans.
1. It provides inert atmosphere in high temperature metallurgical processes.
 2. Used for filling electric bulbs.

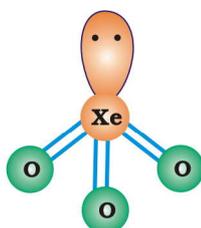
17. How is XeO₃ prepared?

Ans. Hydrolysis of XeF₄ and XeF₆ gives XeO₃

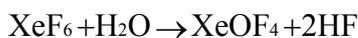
**18. Explain structure of XeO₃?**

Ans: Structure of XeO₃

1. In XeO₃, Xenon atom undergoes Sp³ Hybridisation.
2. XeO₃ molecule is having pyramidal shape due to the presence of one lone pair and three bond pairs on central atoms

**19. How XeOF₄ is prepared? Write its structure.**

Ans: On partial hydrolysis of XeF₆ gives XeOF₄



Square pyramidal shape.

20. In modern diving apparatus, a mixture of He and O₂ is used why?

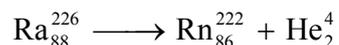
Ans. A mixture of O₂ and He is used in diving apparatus by deep sea divers, because of low solubility of He compared to N₂ in blood.

22. Noble gases are inert – explain.

Ans: Noble gases are inert because they have completely filled ns²np⁶ electronic configuration in their valence shell.

21. Which noble gas is radio active? How is it formed?

Ans. Radon is a radio active element. It is obtained as a decay product of Ra²²⁶

**SHORT ANSWER QUESTIONS (4 MARKS)****1. Explain the anomalous nature of nitrogen in Group-15.**

Ans: Nitrogen exhibits anomalous 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.

Anomalous 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 3 because it does not have vacant d-orbitals in its valency shell.
- (v) It is chemically inert because of high bond dissociation energy of nitrogen molecule.

2. Why conc H_2SO_4 , P_4O_{10} and anhydrous $CaCl_2$ cannot be used to dry ammonia?

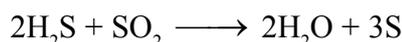
Ans. Ammonia reacts with them forming $(NH_4)_2SO_4$, $(NH_4)_3PO_4$ and $CaCl_2 \cdot 8NH_3$, hence they cannot be used as drying agents.

3. Which oxide of sulphur can act as both oxidising and reducing agent? Give one example each

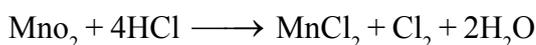
Ans. SO_2 act as a good reducing agent in the presence of moisture.



SO_2 acts as mild oxidising agent also

**4. How can you prepare Cl_2 from HCl and HCl from Cl_2 ? write the reactions.**

Ans. Chlorine can be formed by heating manganese dioxide with the concentrated hydrochloric acid.



Hydrogen chloride can be obtained by the direct combination of Cl_2 and H_2

**5. What are inter halogen compounds ? Give some examples 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

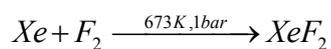
The oxidation state of halogen atom X is +1, +3, +5, +7 while for atom X' is always -1.

Classification:-

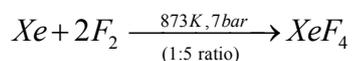
Type	XX'	XX'_3	XX'_5	XX'_7
Example	ClF, BrF	ClF_3, BrF_3	ClF_5, BrF_5	IF_7
Shape	Linear	T-Shaped	Square pyramidal	Pentagonal bipyramidal
Hybridisation	-	Sp^3d	Sp^3d^2	Sp^3d^3

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

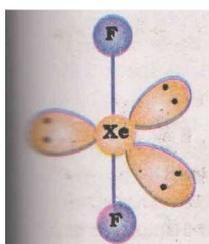
Ans. a) Excess xenon reacts with fluorine and forms XeF_2



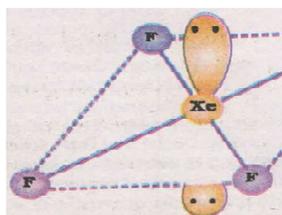
In 1:5 ratio xenon and fluorine react each other to form XeF_4



Linear
(OR)



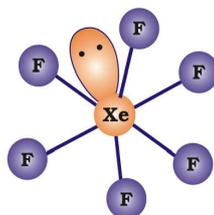
Square Planar
(OR)



7. Explain the structure of (a) XeF_6 (b) XeOF_4

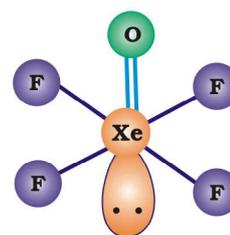
Ans: (a) XeF_6 Structure:

- (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.

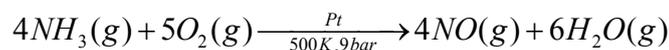


LONGANSWER TYPE QUESTIONS (8 MARKS)

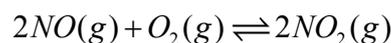
1. How is nitric acid manufactured by Ostwald's process? How does it react with the following?

(a) Copper (b) Zn (c) S₈ (d) P₄

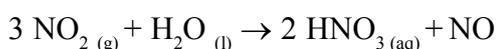
Ans: Catalytic oxidation of NH₃ by atmospheric oxygen gives NO.



Nitric oxide combines with oxygen and gives NO₂

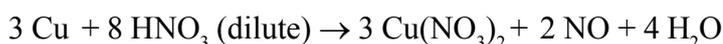


Nitrogen dioxide dissolves in water to give HNO₃.



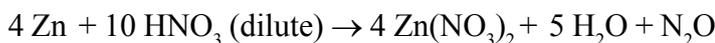
(a) Copper :

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



(b) Zn :

Zinc reacts with dilute nitric acid to give N₂O and with concentrated acid to give NO₂.



(c) S₈ :

Concentrated nitric acid oxidises sulphur to sulphuric acid.



(d) P₄ :

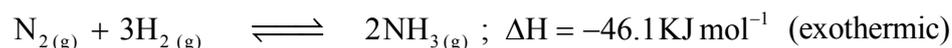
Concentrated nitric acid oxidises phosphorus to phosphoric acid.



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.



According to Lechatelier's principle, the optimum conditions are

Pressure: about 200 atm

Temperature: nearly 700k

Catalyst: Iron oxide + small amount of K₂O and Al₂O₃

Promoter : Molybdenum

Reactions of ammonia :



Uses of NH₃ :

- i) To produce various nitrogenous fertilizers
- ii) To prepare many inorganic nitrogen compounds
- iii) As a refrigerant.

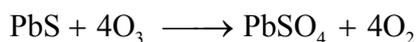
3. How is ozone prepared? How does it react with the following ?

(a) PbS (b) KI (c) NO (d) Ag (e) C₂H₄

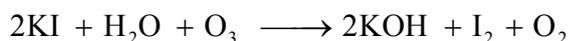
Ans: **Ozone preparation :** Oxygen when passed through a silent electrical discharge conversion of oxygen to ozone (10%) occurs. The product is called ozonised oxygen.



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



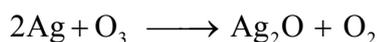
b) KI : Ozone reacts with moist KI to give iodine.



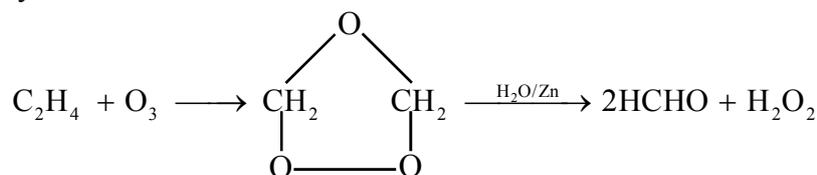
c) NO : Ozone oxidises nitric oxide to nitrogen dioxide.



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



e) C₂H₄ : Ozone reacts with C₂H₄ 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 NH₃ and excess Cl₂ with NH₃
c) Na₂S₂O₃ d) Ca(OH)₂ e) Fe f) H₂S

Ans: Preparation of chlorine by laboratory method :

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



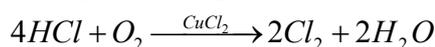
- b) Chlorine is prepared by heating manganese dioxide with mixture of common salt and concentrated H_2SO_4 .



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



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



Reactions:

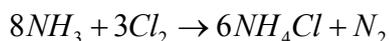
- a) Chlorine reacts with hot and conc. sodium hydroxide and gives sodium chloride and sodium chlorate.



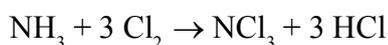
Chlorine reacts with cold and dilute sodium hydroxide and gives sodium chloride and sodium hypo chlorite.



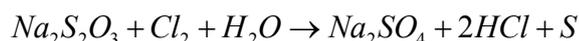
- b) Chlorine reacts with excess of ammonia and gives ammonium chloride and nitrogen.



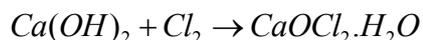
Excess chlorine reacts with ammonia and gives nitrogen trichloride and hydrochloric acid.



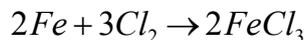
- c) Chlorine reacts with sodium thiosulphate and gives sodium sulphate, hydrochloric acid and sulphur.



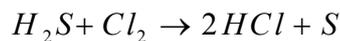
- d) When chlorine reacts with dry slaked lime bleaching powder is formed.



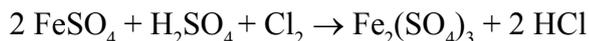
- e) Chlorine reacts with iron and gives ferric chloride.



- f) Chlorine reacts with H_2S and gives HCl and sulphur.



- g) Chlorine reacts with acidic Ferrrous sulphate and gives Ferric sulphate and gives HCl.



d and f Block Elements and Coordination Compounds**VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)**

1. **What are transition elements give example**

Ans. Elements having incompletely filled $(n-1)d$ orbitals in their atomic or Ionic state are called transition elements.

Ex : Fe, Co

2. **Why are d - block elements called transition elements**

Ans. d-block elements are called transition elements because they have incompletely filled $(n-1)d$ sub shell and they possess properties that are transitional between the S and P block elements.

3. **Write the general electronic configuration of transition elements?**

Ans: $(n-1)d^{1-9}ns^{1 \text{ or } 2}$

4. **Why do transition elements exhibit characteristic properties?**

Ans. Due to the presence of lone electrons and incomplete filled $(n-1)d$ transition elements exhibit characteristic properties.

5. **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.

6. **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.

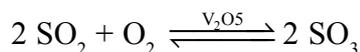
7. **Calculate the 'spin only' magnetic moment of $Fe^{2+}_{(aq)}$ ion.**

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

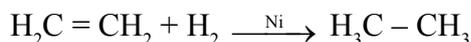
as $n = 4$, $\mu = \sqrt{4(4+2)} = \sqrt{4(6)} = \sqrt{24} = 4.9 \text{ BM}$

8. Give two reactions in which transition metals or their compounds acts as catalysts.

Ans. (1) V_2O_5 : In contact process for preparation of H_2SO_4



(2) Ni : In catalytic Hydrogenation

**9. What is an alloy? Give example**

Ans. A homogeneous mixture of a metal with other metals or metalloids or non - metals having physical and chemical properties similar to that of the metal is called as an alloy.

Ex: Brass - (copper + zinc)

Bronze - (copper + tin)

10. $CuSO_4 \cdot 5H_2O$ is blue in colour whereas anhydrous $CuSO_4$ is colourless. Why?

In $CuSO_4 \cdot 5H_2O$, 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.

11. What are coordination compounds? Give example.

Ans. Transition metal atoms or ions bound with other ions or groups through coordinate covalent bonds such compounds are called coordination compounds or complex compounds.

Ex : $[Pt(NH_3)_2Cl_2]$; $[Co(NH_3)_6]Cl_3$

12. 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^-

13. What is double salt? Give example?

Ans. Double salts are the compounds which dissociate into constituent ions when dissolved in water or any other solvent and properties of constituent ions are not lost.

Ex: Carnallite $KCl \cdot MgCl_2 \cdot 6H_2O$

Mohr's salt $FeSO_4 \cdot (NH_4)_2 SO_4 \cdot 6H_2O$

14. What is the oxidation state of cobalt in

a) $K[Co(CO)_4]$

b) $[Co(NH_3)_6]_3SO_4 \cdot 6H_2O$

Ans. a) cobalt o.No : (-1)

b) cobalt o.No in : (+3)

15. What is Chelating Ligand?

Ans. Ligands having more than one donor atom in the coordinating group and are capable of forming two or more coordinate bonds with the same central atom simultaneously. This type of ligands are called chelating ligands.

Ex: (1) EDTA

(2) NTA

16. What is Ambidentate Ligand?

Ans. A unidentate ligand containing two possible donor atoms, can thereby coordinate through either of donor atoms. Such ligand is called ambidentate ligand.

Ex: (1) $-\text{CN}$, $-\text{NC}$ (2) $-\text{NO}_2$, $-\text{ONO}$

SHORT ANSWER TYPE QUESTIONS (4 MARKS)**1. Write the characteristic properties of transition elements**

- Ans. (1) Show variable oxidation numbers
 (2) Form coloured ions
 (3) They exhibit paramagnetic character
 (4) They form complex compounds
 (5) They form interstitial compounds
 (6) They form alloys
 (7) They show catalytic activity
 (8) They have High B.P & M.P

2. 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 valences 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 $\text{CoCl}_3 \cdot 6\text{NH}_3$ Primary valence is 3; Second valence is 6

2. In $\text{CoCl}_3 \cdot 5\text{NH}_3$ Primary valence is 3; Second valence is 6

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.

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

- (i) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ (ii) $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NH}_2\text{CH}_3)]\text{Cl}$
 (iii) $[\text{T i}(\text{H}_2\text{O})_6]^{3+}$ (iv) $[\text{NiCl}_4]^{2-}$

- 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

5. Give the oxidation numbers of the central metal atoms in the following complex entities.

- a) $[\text{Ni}(\text{Co})_4]$ b) $[\text{CO}(\text{NH}_3)_6]^{+3}$
 c) $(\text{Fe}(\text{CN})_6)^{4-}$ d) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{+3}$

- Ans. a) $[\text{Ni}(\text{CN})_4]$ in this Ni o. No is "0"
 b) $[\text{CO}(\text{NH}_3)_6]^{+3}$ in this CO o. No is + 3
 c) $[\text{Fe}(\text{CN})_6]^{4-}$ in this Fe o. No. + 2
 d) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ in this Fe o. No is + 3

6. Using IUPAC norms write the formulas for the following

- a) Tetra hydroxo zincate (II) ion

Ans: $[\text{Zn}(\text{OH})_4]^{-2}$

- b) Hexaamine cobalt (III) sulphate

Ans: $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_3$

- c) Potassium tetrachloro palladate (II)

Ans: $\text{K}_2[\text{PdCl}_4]$

- d) Potassium trioxalate chromate (III)

Ans: $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$

7. What are Homoleptic and heteroleptic complexes give one example for each?

Ans. Homoleptic complexes in which metal is bound by only one kind of ligands

Ex : $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ (or) $\text{K}_4[\text{Fe}(\text{CN})_6]$

Heteroleptic complexes : Complexes in which metal is bound by more than one kind of ligands

Ex : $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$

Biomolecules

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. 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

2. What are amino acids? Give two examples.

Ans: **Amino acids** : Organic compounds having amino (-NH₂) group and carboxyl (-COOH) group are called amino acids.

Ex : Alanine, Aspartic acid

3. 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.

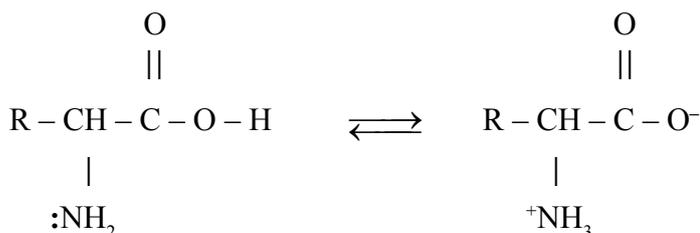
Ex : Phenylalanine, Lysine.

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

Ex : Alanine, Aspartic acid.

4. 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



5. What are proteins? Give an example

Ans. Proteins are polymers of α -amino acids. A polypeptide chain with more than 100 amino acids having a molecular mass higher than 10,000 u is called a protein

Ex : Egg Yolk, Haemoglobin

6. Differentiate between globular and fibrous proteins

Globular proteins	Fibrous Proteins
1. polypeptide chains are arranged as coils	1. polypeptide chains are parallel to each other
2. they have spherical shape	2. they have thread like structure
3. they are soluble in water	3. they are insoluble in water
4. Ex : Insulin	4. Ex : Keratin

7. 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.

8. 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).

9. 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.

10. 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)

11. What is the difference between a nucleoside and a nucleotide?

Ans. Nucleo side : Base + Sugar

Ex : Adenosine

Nucleotide : Nucleoside + phosphoric acid
Ex : Adenylic acid

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) Oligosaccharides iii) Polysaccharides

i) **Monosaccharides** : Carbohydrates that cannot be hydrolysed further 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.

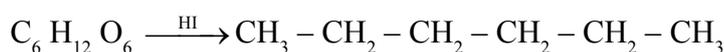
Ex : Glucose, Ribose

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

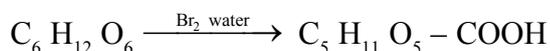
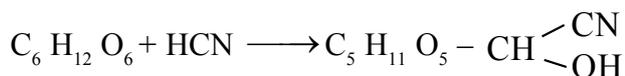
2. Write a brief note on the structure of glucose

Ans. **Structure of Glucose :**

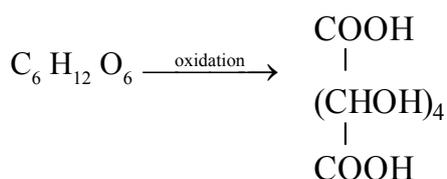
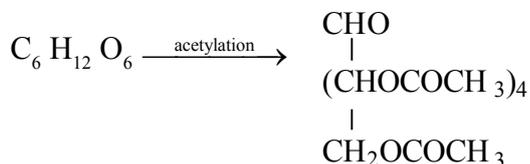
1. MF $C_6H_{12}O_6$. It react with HI gives n - Hexane indicates all carbons are in straight chain.



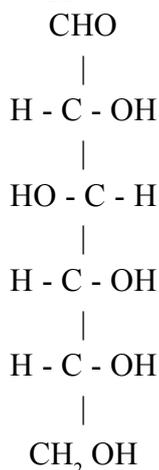
2. It reacts with HCN gives cyanohydrin ; react with Br_2 water gives gluconic acid indicates presence of carbonyl group that is aldehyde.



3. On acetylation with acetic anhydride gives penta acetate, oxidation with HNO_3 gives saccharic acid indicates presence of five ($-\text{OH}$) groups on five different carbons atoms, and in this one ($-\text{OH}$) group is primary.



4. From all above reactions Fischer suggest following structure to glucose

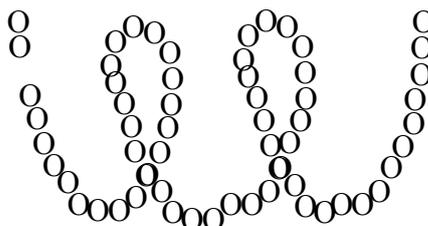


3. **Explain the classification of proteins as primary, secondary, tertiary, quaternary proteins with respect to their structure.**

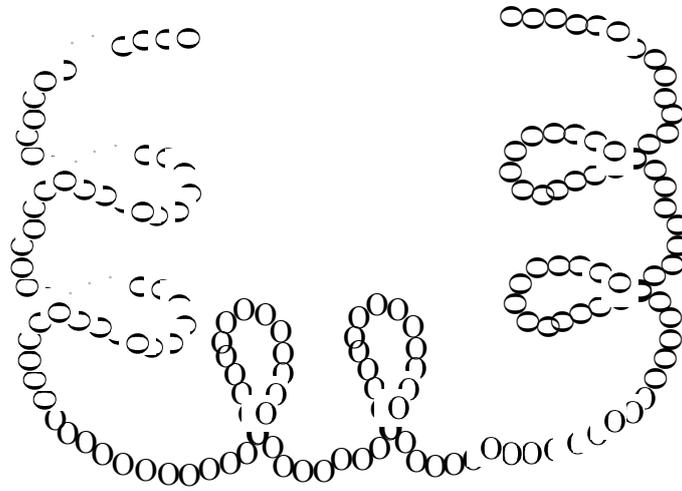
Ans: **Primary structure of proteins** : Sequence of amino acids in a peptide chain is called primary structure of proteins. It represent its constitution.

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^o and 3^o 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

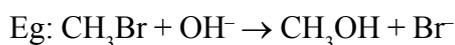
Chloroacetic acid > benzoic acid > acetic acid > Phenol

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.

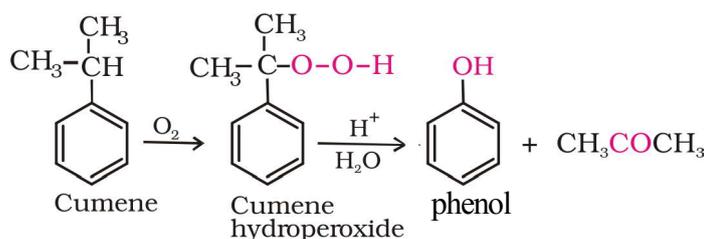
Eg: $(CH_3)_3CBr + OH^- \rightarrow (CH_3)_3COH + Br^-$

S_N² Reaction – The nucleophilic substitution reaction in which rate of reaction depends upon concentration of both the reactants is known as S_N² reaction.



2. Give the equations for the preparation of phenol from Cumene?

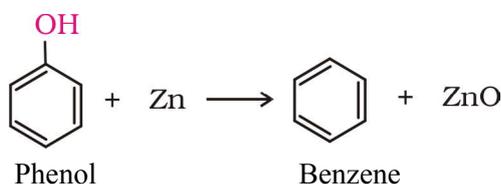
Ans: Phenol is prepared by oxidising cumene (Isopropyl Benzene) is oxidised in the presence of air to cumene hydroperoxide. It is converted to phenol and acetone by treating it with dilute acid.



3. Write the products formed by the reduction and oxidation of phenol?

Ans: (1) Reduction of phenol with Zinc dust.

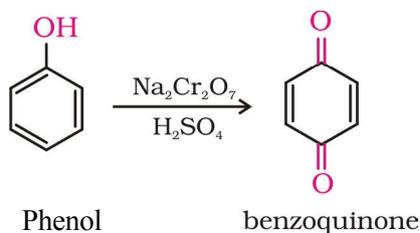
Phenol is converted to benzene on heating with Zinc dust.



(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.



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 (-OCH₃) decreases while that of electron withdrawing group (-NO₂) increases.

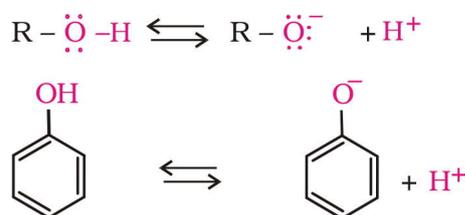
Therefore, the acidic strengths of different acids in increasing order is,

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

5. 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.

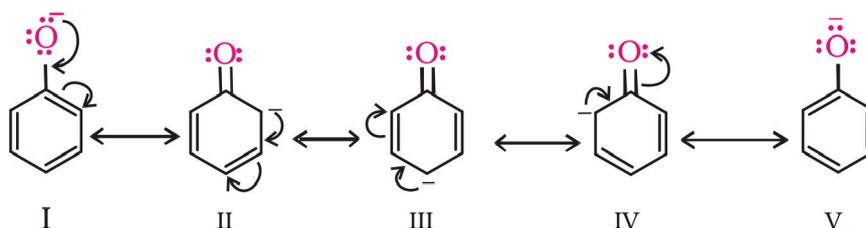
(2) The ionisation of an alcohol and phenol takes place as follows.



(3) Due to high electro negativity of sp² 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.



(6) Hence phenols are more acidic than alcohols

LONG ANSWER TYPE QUESTIONS (8 MARKS)

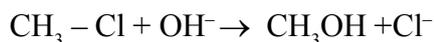
1. Explain the mechanism of Nucleophilic bi-molecular substitution (SN²) reaction with one example.

Ans. 1. The nucleophilic substitution reaction in which rate depends upon concentration of both reactants is called SN² reaction

2. It follows 2nd order kinetics. So it is called bi - molecular reaction.

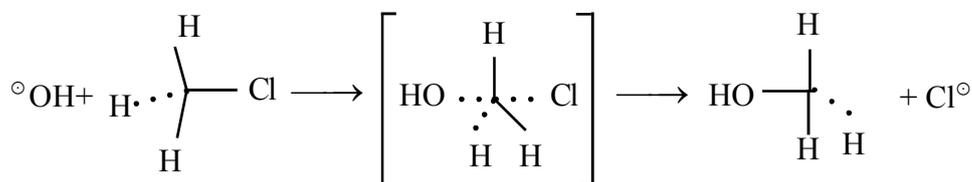
Ex : Methyl chloride reacts with hydroxide ion & forms methanol and chloride ion.

3. The rate of reaction depends upon the concentration of two reactants.



$$\text{rate} \propto [\text{CH}_3\text{Cl}] [\text{OH}^-]$$

4. **Mechanism :**



Transition state

5. In this reaction there is inversion of configuration.
6. The transition state is highly unstable as it is bonded to both incoming nucleophile and outgoing group.
7. The order of reactivity for SN^2 reactions follows :
 1° - alkyl halides > 2° - alkylhalides > 3° - alkylhalides

2. Define the following

(i) Racemix mixture (ii) Retention of configuration (iii) Enantiomers.

Ans. (i) **Racemix mixture** : Mixture containing two enantiomers in equal proportions is known as racemic mixture. It is optically inactive as the rotation due to one isomer will be exactly cancelled by the rotation due to the other isomer.

Ex : (\pm)butan-2-ol

(ii) **Retention of configuration** : The preservation of the spatial arrangement of bonds around an asymmetric centre during a chemical reaction is called retention of configuration.

