Solution

Colligative Properties & dilute solution

This topic not only exist in your note books
It always exist in day to day life.
Salt is derived from mixture.

Solution :- It is a homogeneous mixture of two or more non reacting substances whose composition can be varied within certain limits.

A solution has two components (i) Solute (ii) Solvent.

Solvent :- The substance present in largest Proportion in the solution is called solvent.

Solute :- The substance which is present relatively in smaller Proportion in the solution is called solute.

Characteristics of solutions

(i) A solution is a single phase system.
(ii) A solution does not allow a beam of light to scatter.
(iii) The particle of solute in solution can't be seen with naked eye.
(iv) A solution is stable and solution from the solution can't be separated by filtration Process.
(v) The solute particle in a solution donot settle down.

Classification of solution

On the basis of solvent solution are classified into two types.

(i) **Aquesous solution** :-
The solution is said to be aquesous if its solute dissolved in water.
Ex: Ethanol in alcohol.

(ii) **Non-aquesous solution**:-
When solute dissolved in a solvent other than water, it's called non-aqous solution
Ex:- Iodine in alcohol.

On the basis of number of Components

On this basis solution can be classified into several types

(i) Binary solution (ii) Ternary solution.

Binary Solution :-

The solution which contain two components is called binary solution. Ex:- Salt solution.

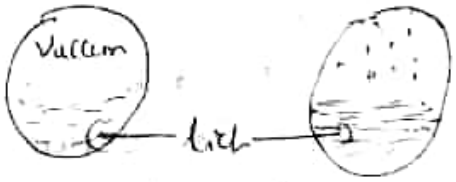
Ternary Solution :-

The solution which contains three component is called ternary solution.

(d) Either two solvent one solute (d) two solute one solvent etc. Ex:- Salt, sugar & water solution.

(Only binary solution for Std ⇒ XII).

Liquid-Gas Equilibrium :-



Not write anything for molecules

On vacuum there is no molecule. On giving heat the liq get evaporated. From beginning the rate of evaporation is more due to ~~(5)~~ at the top of the liq no. substance are present. When the particles are crowded, they will be attracted by each other & they will be pull down. ~~the~~ P & it is called condensation when the liq get pull down ~~d~~ the rate of condensation increases & finally a point ~~(5)~~ the rate of condensation to rate of evaporation

Atomic mass :

Present system of atomic mass is based on C-12 as the standard since 1961.

It is defined as the mass of an atom of an element is called atomic mass

Mass of a single atom is very small and it is not possible to determine such a small quantity on a balance. Thus mass of an atom is expressed relative to the mass of reference atom.

Relative atomic mass :

It is defined as the ratio of the mass of an atom of a substance to 1/12 th of the mass of a C-12 atom.

$$RAM = \frac{\text{mass of atom of a substance}}{1/12 \text{ mass of C-12.}}$$

Here C-12 or 12C is assigned a mass of exactly C-12 (atomic mass unit) & mass of all other atoms are given relative to this standard.

1 amu : $\frac{1}{12\text{th}}$ mass of one C-12 atom.

$= 1.66056 \times 10^{-24}$ gm

mass of H-atom = 1.008 amu.

O-atom = 15.995 amu

(*) Today amu has been replaced by 'u' which is known as unified mass

(*) Carbon is taken as the reference because it is react with most other elements

Average atomic mass

Many naturally occuring elements exist as more than one isotopes

Eg $C - C_6^{12}\ C_6^{13}\ C_6^{14}$

$Cl = Cl_{17}^{35}\ Cl^{37}$

$O = {}^{16}O_8\ {}^{18}O$.

Average atomic mass $= \frac{a_1x_1 + a_2x_2 + a_3x_3 + \cdots a_nx_n}{100}$.

a_1, a_2 = atomic mass of isotopes

x_1, x_2 = relative abundance of isotopes.

Q Naturally occuring Cl is 75% Cl^{35} which has an atomic mass 35 amu & 25% Cl^{37} which has mass of 37 amu. Calculate the average atomic mass of Cl.

Ans $\frac{35\times75 + 37\times25}{100} = \frac{2625 + 875}{100} = \frac{3500}{100} = 35.5$.

Molecular mass :

It is defined as sum of atomic mass of the element in a molecules.

RMM : $\frac{\text{mass of molecule of substance}}{\frac{1}{12}\text{ mass of C-12}}$.

Mole Concept :

A mole is the amount of substance that contains as many entities as there are in exactly 12 gm. of C^{-12} isotope.

Gram molecular mass :

The molecular mass expressed in grams is called GMM. GMM is not the mass of single molecule

Diff between Avogadro's number & Avogadro's const

Avogadro's no = 6.022×10^{23}. but Avogadro's const = 6.022×10^{23} Per mole

Calculating the no. of moles:

For Element, $n = \frac{\text{Given wt}}{\text{Atomic wt.}}$

For Compound $n = \frac{\text{Given weight}}{\text{Molecular wt.}}$

At S.T.P 1 mole of ideal gas occupies 22.4 ltr which is known as molare volume.

For gas: $n = \frac{\text{Given volume at STP}}{\text{molar volume (22.4 ltr)}}$

At N.T.P 1 mole of ideal gas occupies 22.7 ltr. which is known as

Q A Piece of Cu weighs 0.635gm. How many atoms of Cu does it Contain

Ans $\frac{0.635}{59} = 0.01 N_A$

Q why STP: if you measure in random state we just have not standardised.

Q Calculate the weight of 12.044×10^{23} atoms of Carbon.

1 mole = 6.022×10^{23} no. of atom

2 mole = $2 \times 6.022 \times 10^{23}$ no. of atom

$\Rightarrow 2 = \frac{\text{mass}}{12} = 24\text{gm}$

it is the mass of 6.022×10^{23} molecules.

Molare mass of a mole:

The mass of one mole of molecules of a substance is called molare mass.

Unit: g/mol or

1 mole = 6.022×10^{23} particles (atoms, ions, etc)

1 gm molecules = 1 mole molecules = 6.022×10^{23} molecules

1 gm atom = 1 mole atom = 6.022×10^{23} no. of atom.

To determine the no. of 6.022×10^{23}, the mass of C^{12} atom was determined using mass spectrometer & found to be equal to 1.9926×10^{-23} gm.

mass of one no. of hydrogen atom = 1.67×10^{-27} kg or 1.67×10^{-24} gm.

No. of 'H' atom in 1gm = $\frac{1}{1.67 \times 10^{-24}} = 6.022 \times 10^{23}$ atom

RAM of Na = 23 amu.

mass of one Sodium atom = $23 \times 1.67 \times 10^{-24}$ gm

No. of Na atom in 1gm = $\frac{1}{23 \times 1.67 \times 10^{-24}}$

No. of Sodium atom in 23gm = 6.022×10^{23} atom

This special no. is known as mole

Equivalent weight

wt. of an element which reacts or displaces. $\div$ 1.0089m H_2
8 gm O_2
35.5 am Cl.

Equivalent weight = $\frac{\text{Atomic/molecular weight}}{\text{n factor}}$

n-factor of.

⇒ Acids $\div$ n = basicity or H^+ replaced per molecule in a salt.

Bases $\div$ n = acidity or OH^- replaces per molecule.

Salt $\div$ n = Total cationic & anionic charge.

Redox $\div$ no. of $e^\ominus$ exchanged per molecule of the species.

HCl	H_2SO_4	H_3PO_4	H_3PO_4
1	2	3	2.

n = valency factor also

$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$ n = 2 for H_2SO_4

$NaOH + H_2SO_4 \longrightarrow NaHSO_4 + H_2O$ n = 1 for H_2SO_4.

Q Find the equivalent weight of H_3PO_4 in the rxn $Ca(OH)_2 + H_3PO_4 \longrightarrow CaHPO_4 + 2H_2O$.

Eq. wt = $\frac{98}{2} = 49$ n factor for H_3PO_4 is 2.

Molarity, M

It is defined as no. of moles of solute present in volume of sol^n in Litre.

$$\text{Molarity } M = \frac{\text{moles of solute}}{\text{Volume of sol}^n \text{ in L}}$$

Unit = mol/litre

(1) It is a temp. dependent.

Q What does 1.7 M for sol^n means?

Ans 1.7 moles of the solute present in 1 ltr of solution.

Q A solution of Glucose in water is labelled as 10% w/w. What would be the molality? If density of sol^n is 1.2 gm ml^-1

10% w/w = 10 gm of solute in 90 gm of sol^n

$$\text{molality of solute} = \frac{10}{180} = 0.18 \text{ mole.}$$

$$\text{Molality} = \frac{0.18}{\frac{90}{1000}} = \frac{0.18}{0.09} = \frac{10}{18} \times \frac{1000}{90} = \frac{100}{162}$$

$$= 0.61 \text{ m.}$$

Q A solution of is made by dissolving 2 moles of in 180 gm water. Find mole Fraction of both components.

$$x_{Ring} = \frac{2}{12} = \frac{1}{6} = 0.6.$$

$$x_{H_2O} = 1 - 0.6 = 0.4.$$

Molarity :- It is the no. of moles of solute dissolved per litre of solution

i.e. $M = \frac{\text{mole of solute}}{\text{Volm of soln}} = \frac{n}{V} \quad \frac{w/M}{V}$ mol. l^{-1}.

SI unit = mol Lt^{-1}.

(*) Concentration $\propto$ no. of solute

$$\propto \frac{1}{\text{Volume of solute}}$$

$$M = \frac{\text{wt. of Solute(g)/mol wt of solute(g)}}{\text{Volume of sol}^n \text{ (litre)}}.$$

$$M = \frac{\text{wt. of solute(g)} \times \text{density of sol}^n}{\text{mol. weight of Solute(g)} \times \text{mass of solution}} \times 1000$$

Q Calculate the molarity of NaOH in Solution Prepared by dissolving 4gm in enough water to form 250ml of the solution

Ans $M = \frac{0.1}{\frac{250}{1000}} \times 1000 = \frac{4a2}{\frac{25}{5}} = 0.4.M.$

Eq. wt of $AlCl_3$: $\frac{\text{mol wt}}{3}$

Normality : (N).

It is the no. of equivalent of solute present in the one litre of solution.

$$N = \frac{\text{Equivalent weight}}{\text{Volume of Sol}^n \text{ in litre}}$$

$$\text{no. of Equivalent} = \frac{\text{Given weight}}{\text{Eq. wt.}} = \frac{\text{Given weight}}{\text{At/mol wt}} \times \text{n factor}$$

No. of Eq = No. of mole × n factor.

$$N = \frac{\text{No. of Equivalent}}{\text{Vol}^m \text{ of solution in lit}}$$

N = Molarity × n factor.

Q Calculate molarity & normality of

(i) 0.74gm of $Ca(OH)_2$ in 500ml solution

(ii) 0.1 mole of H_2SO_4 in 500ml solution.

(iii) 34.2 gm of sucrose in 1250ml Sol^n

Ans (i) Molarity = $\frac{0.74}{} \sim \frac{2}{1000}$

pH SCALE :⇒

pH of a solution is negative logarithm of hydrogen ion or hydronium ion concentration in moles/litre.

$$pH = -\log[H_3O^+]$$

* In pure water (neutral); $[H_3O^+] = 1.0 \times 10^{-7}$

pH of water $= -\log 10^{-7}$

$= 7$

Thus pH value of neutral solution is 7.

Acidic sol^n. –

* For acidic solution; $[H_3O^+]$ will be greater than 10^{-7} i.e. $10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}, 10^{-1}$.

Hence; the pH value will be 6, 5, 4, – –

Thus pH value for acidic sol^n will be always less ~~greater~~ than 7.

* BASIC SOL^n –

For basic solution; $[H_3O^+]$ will be less than 10^{-7} i.e. $10^{-8}, 10^{-9}, 10^{-10}$ – – 10^{-14} etc

Hence, the pH value will be 8, 9, 10, – –

Thus pH value for basic solution will be always greater than 7.

→ TYPES OF ACIDIC SOLUTION

Depending upon the pH value acidic sol^n. can be classified into three types.

(i) Strongly acidic –
If the pH value of sol^n lies bet^n. 0–2, the sol^n will be strongly acidic.

(ii) Moderately acidic –
If the pH value lies bet^n. 2–4 the sol^n will be moderately acidic.

(iii) Weakly acidic –
If the pH value lies bet^n. 4–7, the sol^n will be weakly acidic.

* Types of base –
Strongly basic → 12–14
Moderately basic → 10–12
Weakly basic → 7–10

Limitat^n –
i) pH values of solution donot give immediate idea of the relative strengths of solution.
eg – A sol^n of pH = 1 has $[H^+]$ 100 times more than that of a solution pH = 3.

ii) pH value of 1N sol^n of strong acid has pH value = 0. So the sol^n of conc. strong acid like 2N, 3N, 4N ... ; the pH value will be negative.

iii) The solution of an acid having very low concentrat^n say 10^{-8} N can't have pH = 8. In such cases, the H^+ or OH^- contributed from water is considered. So, the actual pH value ; $[H^+]_{total} = [10^{-8}]_{acid} + [10^{-7}]_{water} = 1.1 \times 10^{-7}$

HCl $\rightleftharpoons$ H^+ + Cl^-, $H_2O \rightleftharpoons H^+ + OH^-$
10^{-8} M ; 10^{-8} M ; 10^{-7} M

iv) pH may be greater than 14 (for concentrated) strong bases like 2N, 3N, 4N aq. sol^n. of NaOH or KOH etc. which are completely ionised.

Theories of ACIDS AND BASES

Three important theories have been proposed to explain the nature of acids & bases.

(*) ARRHENIUS THEORY -

(i) Acid - The substances which give H^+ ions in aqueous solution are called acids

ex - HCl, H_2SO_4, HNO_3, HClO etc. are strong acids.

H_2CO_3, H_3PO_4, HCN, H_2S, RCOOH etc. are weak acids

$$HCl + H_2O \rightleftharpoons H^+(aq) + Cl^-(aq)$$

$$H_2SO_4 + H_2O \rightleftharpoons 2H^+(aq) + SO_4^{2-}(aq)$$

$$CH_3COOH + H_2O \rightleftharpoons CH_3H^+(aq) + CH_3COO^-(aq)$$

(ii) Base - The substances which give OH^- ions in aqueous solution are called bases.

ex - → NaOH, KOH, $(CH_3)_4NOH$ are strong bases

→ NH_4OH, $Ca(OH)_2$, $Al(OH)_3$ etc. are weak bases.

$$NaOH + H_2O \rightleftharpoons Na^+(aq) + OH^-(aq)$$

(iii) Neutralisat° react°. ⇒ The react°. bet°. H^+ ions & OH^- ions in aqueous solution is called neutralisation react°

B BRONSTED - LOWRY ⇔ Theory
(PROTON - DONOR - ACCEPTOR (CONCEPT)

They (Bronsted & Lowry) proposed a broader concept of acids & bases

* ACIDS → (A substance which can donate Proton (H^+ ion) to some other substance is called an acid). Thus an acid is proton donor (protogenic)

eg - HCl, HNO_3, H_2SO_4, H_2CO_3, H_3PO_4, CH_3COOH, H_2O, HSO_4^-, H_2S, HCN

- $HCl \rightleftharpoons H^+ + Cl^-$
- $H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$
  $HSO_4^- \rightleftharpoons H^+ + SO_4^{2-}$
- $CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$

* BASE -
- (The substance which can accept a proton from acid is called a base.)
- Thus base is proton acceptor (protophile)

- ~~$NaOH \rightleftharpoons Na^+ + OH^-$~~
- ~~$Ca(OH)_2 \rightleftharpoons$~~
- $H_2O + H^+ \rightleftharpoons H_3O^+$
- $NH_3 + H^+ \rightleftharpoons NH_4^+$
- $Cl^- + H^+ \rightleftharpoons HCl$
- $CN^- + H^+ \rightleftharpoons HCN$

* Acid - Base reaction :→

(Acid reacts with a base to form another form of acid & base called acid-base reaction.)

Thus neutralisation reaction involves the transfer of proton between acid & base)

$CaO + CO_2 \longrightarrow CaCO_3$

3- The acidic nature of $AlCl_3$, BF_3, $FeCl_3$ can't be explained by this theory.

N.B. - Arrhenius acids are also bronsted acids but arrhenius bases are not bronsted acids

LEWIS THEORY :→

Acids -
The substance which can accept a pair of electron is called an acid, hence an acid is an electron-acceptor or electrophile.

The followings are lewis acids;

i) Molecules in which the central atom with incomplete octate
eg - BF_3, BCl_3, $AlCl_3$, $MgCl_2$, $BeCl_2$

ii) Simple $^{+ll}$ cations behave as lewis acid as they are electron deficient
eg - Na^+, K^+, Ca^{2+} etc have a very little tendency to accept electrons while H^+, Ag^+ have greater tendency to accept electron.

(iii) Molecules in which the central atom has empty d-orbital, such molecules have vacant d-orbitals & can accept electron pairs
eg- SiX_4, GeX_4, $TiCl_4$, SnX_4, PX_3 PF_3, PF_5, SF_4, SeF_4, $TeCl_4$ etc.

CONJUGATE ACID-BASE PAIRS

The pairs of acid & base which differ by a proton (H^+) are known as conjugate acid-base pairs.

Thus when an acid loses proton, its conjugate base is formed but when a base gains proton, its conjugate acid is formed.

Acid $\rightleftharpoons$ Conjugate base + H^+.

Base + H^+ $\rightleftharpoons$ conjugate acid.

- If an acid is strong, its conjugate base is weak & vice versa.

$H_3O^+(aq) + OH^-(aq) \rightleftharpoons 2H_2O$

limitations →

i) The acidic & basic properties of [redacted] can be explained in presence of water but dry HCl shall not act as an acid.

ii) This theory can't explain the acidic & basic nature of substances in non-aqueous solvent

(iii) The neutralisation process is limited to aqueous solutions only though reactions involving salt formation occure in absence of solvent. such

$CaO(s) + SO_2(g) \longrightarrow CaSO_3(s)$

$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$

(iv) It can't explain the acidic character of certain salts such as $AlCl_3$ in aqueous solution.

(v) Artificial explanation is required to explain the basic nature of ammonia & metallic oxides like Na_2O, acidic nature of non metallic oxides like SO_2, CO_2, N_2O_5.

$NH_3 + H_2O \longrightarrow NH_4OH \rightleftharpoons NH_4^+(aq.) + OH^-(aq.)$

$Na_2O + H_2O \longrightarrow 2NaOH \rightleftharpoons 2Na^+(aq.) + 2OH^-(aq.)$

$CO_2 + H_2O \longrightarrow H_2CO_3 \rightleftharpoons 2H^+(aq.) + CO_3^{2-}(aq.)$

$N_2O_5 + H_2O \longrightarrow 2HNO_3 \rightleftharpoons 2H^+(aq.) + 2NO_3^-(aq.)$

H^+ ion in aqueous medium does not exist free but it reacts with water to form hydronium ion, due to very small size & intense electric field of H^+ ion, further H_3O^+ ion is hydrated to give $H_5O_2^+$, $H_7O_3^+$ & $H_9O_4^+$.

Similarly OH^- ion is further hydrated to give $H_3O_2^-$, $H_5O_3^-$, $H_7O_4^-$

COORDINATION COMPOUND

Introduct^{n}.
These are the complex compounds (neu
ions or neutral molecules are linked
to the central metal atom or ion by
co-ordinate bonds through donation of
lone pair of electrons. In these com
the central metal atom or ion is surrounded
by number of ions or molecules beyond its normal
valency. These compounds are
widely present in minerals, plants
animals They have wide applicatio
in various fields in the form of metal
Proteins, metallo-enzymes, Vitamin B_{12},
haemoglobin (Fe complex), chlorophyll (Mg co
cis-platin in cancer chemo-therapy etc

Salts:→
The compounds which are formed by
replacing one or more replaceable H-a
from an acid by one or more metal
atoms from a base are called salts
(or) the compounds which are formed by
the neutralisation of an acid by a ba
are called salts.

Types of salts -
These are of 3 types
i.e. normal salts, acidic salts & basic
salt

(1) Normal salts → (Neutral salts)
The salts in which are formed by repla
all the replaceable H-atoms of an acid by

(i) Double salt –

The addition compound formed by crystallising solution of two simple salts in molecular proportion which exist in solid state but lose their identity in aqueous solution by completely dissociating into its ions is called double salt.

e.g- Mohr's salt → $FeSO_4 (NH_4)_2SO_4 \cdot 6H_2O$

Potash alum → $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$

Carnallite → $KCl \cdot MgCl_2 \cdot 6H_2O$

Double salt in aqueous solution give test for the constituent ions.

eg- Potash alum in aqueous solution gets dissociated into K^+, Al^{3+}, SO_4^{2-} ions.

$$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O \xrightarrow{H_2O} 2K^+_{(aq)} + 2Al^{3+}_{(aq)} + 4SO_4^{2-} + 24H_2O$$

(ii) Co-ordinate / complex compounds –

The addition compound formed by crystallising solution of two simple salts in molecular proportion which exist in only solid state but not completely lose their identity in aqueous solution is called complex compound. These are not completely dissociated into constituent ions hence don't give test for all the constituent ions.

eg- $[Cu(NH_3)_4]SO_4$, $K_4[Fe(CN)_6]$

In potassium ferrocyanide, the complex anion is ferrocyanide ion.

$$K_4[Fe(CN)_6] \xrightarrow{H_2O} 4K^+_{(aq)} + [Fe(CN)_6]^{4-}_{(aq)}$$

The anion does not give any test for Fe^{2+} ion in aq.

→ $[Cu(NH_3)_4]SO_4$ in aqueous solution is dissociated as

$$[Cu(NH_3)_4]SO_4 + H_2O \rightarrow [Cu(NH_3)_4]^{2+}_{(aq)} + SO_4^{2-}_{(aq)}$$

metal atoms are called normal salts.

(or) The salts which are formed by the complete neutralisation of strong acid & strong base are called normal salts.

Such salts don't contain any replaceable H-atom. The aqueous solution of such salts give neutral solution of pH 7.

e.g - $ZnCl_2$, $FeCl_3$, KCl, $ZnSO_4$, KNO_3, K_2SO_4, $KClO_4$

(ii) Acidic Salt -

The salts which contain replaceable H-atom & can give H^+ ion in aqueous solution are called acidic salt. (or)

The salt which is formed by the neutralisation of strong acid with weak base is called as acidic salt.

The aqueous solution of such salts give acidic solution having pH value less than 7.

ex - NaH_2PO_4, $NaHSO_4$, Na_2HPO_4, $NaHCO_3$, NH_4Cl, $Ca(NO_3)_2$, $CuSO_4$, $FeCl_3$ etc.

(iii) Basic Salt -

The salts which contain replaceable OH group & can give OH^- ion in aqueous solution is are called basic salts.

(or) The salt which is formed by the neutralisation of weak acid & strong base is called basic salt.

Sol^n. The aqueous solution of such salts give basic value of pH greater than 7.

e.g - $Mg(OH)Cl$, $Ca(OH)Cl$, Na_2CO_3, CH_3COONa, Na_3PO_4

Addition compounds / Molecular compounds -

The compounds formed by crystallising aqueous solution of two or more simple salts mixed in molecular proportions are called addition molecular compound. These are of two types,

General Principles & Processes of Isolation of Elements :→

Occurrence of Elements in nature :-

At present 118 elements are known out of these 92 elements from H - U are found in nature. The rest are synthesised by artificial means. These elements are called trans-uranic elements & most of them are radioactive in nature.

Out of 92 elements, only 10 elements are found about 99% mass of the earth's crust, Ocean & atmosphere;

1.	Oxygen	49.5%
2.	Silicon	25.7%
3.	Al	7.5%
4.	Fe	4.7%
5.	Ca	3.4%
6.	Na	2.6%
7.	K	2.4%
8.	Mg	1.9%
9.	H	0.87%
10.	Ti	0.58%

If the whole universe is considered, then 90% of the matter is Hydrogen, 9% is Helium & the rest elements is 1%

MODE OF OCCURRANCE OF ELEMENTS :⇒

Elements in nature occure in 2 state.

I) **Native state** :⇒ The elements which are least reactive & little affinity for oxygen, moister, CO_2 etc. occure in native / free state.

ex- Ag, Au, Pt, Noble gases, Nitrogen, C in diamond, Graphite & coal, Sulphur etc.

II) **Combined state** :⇒ The elements which are reactive & have affinity for oxygen, moisture, CO_2 etc. occure in a combined state in form of simple compounds or complex compound

These compounds are called minerals.

The minerals are the compounds in form of oxides carbonates, sulphides, silicate, halides

Combined State	Element	Name of minerals
1) Oxide	(i) Fe	Haematite (Fe_2O_3)
		Magnetite (Fe_3O_4)
		Limonite ($Fe_2O_3 \cdot 3H_2O$)
		Chromite ($Fe_3O_4 \cdot Cr_2O_3$)
	(ii) Al	Bauxite ($Al_2O_3 \cdot 2H_2O$)
		Corundum (Al_2O_3)
		Diaspore ($Al_2O_3 \cdot H_2O$)
	(iii) Mn	Pyrolusite (MnO_2)
	(iv) Si	Sand quartz / Flint (SiO_2)
	(v) Zn	Zincite (ZnO)
	(vi) Cr	Chrome ochre (Cr_2O_3)
	(vii) Sn	Cassiterite (SnO_2)
	(viii) Cu	Cuprite (Cu_2O)
2) Carbonate	(i) Ca	Dolomite ($CaCO_3 \cdot MgCO_3$)
		Calcite ($CaCO_3$)
		(iii) Limestone
	(ii) Mg	~~Siderite ($FeCO_3$)~~
		Magnesite ($MgCO_3$)
	(iii) Fe	Siderite ($FeCO_3$)
	(iv) Cu	Malachite ($Cu(OH)_2 \cdot CuCO_3$)
		Azurite ($2CuCO_3 \cdot Cu(OH)_2$)
	(v) Pb	Cerussite ($PbCO_3$)
	(vi) Zn	Calamine ($ZnCO_3$)
	(vii) Na	Trona $Na_2CO_3 \cdot 2NaHCO_3$
		Natron $Na_2CO_3 \cdot 3H_2O$

OCCURRANCE OF METALS IN NATURE :→

Metals occure in earth's crust in free & combined
In free state in form of minerals & ores.

(i) Minerals :→ The natural substance in which metals occure in native state or combined state in the earth are called minerals
It has a definite composition. It may be a simple compound or complex mixture associated with number of impurities.

(ii) Ore :→ The minerals from which metals can be easily & ~~mechanica~~ economically extracted are called ores.
All ores are minerals but all minerals are not ~~three~~ ores
ex:- ✓ Ore of Fe is Haematite & Magnetite
(Fe_2O_3) (Fe_3O_4).
✓ Bauxite is the ore of Al.
($Al_2O_3 \cdot 2H_2O$)
✓ Copper pyrite ($CuFeS_2$) is the ore of Cu.

Elements from earth :→
The elements are distributed in 3 parts of Earth, known as atmosphere, hydrosphere, lithosphere

(i) Atmosphere :→
It is the gaseous mixture which surrounds lithosphere, hydrosphere parts of the earth.
Of the total mass of atmosphere about 99% of is within 30 km of earth's surface.
N (78%), O (21%). Remaining 1%.

(ii) Hydrosphere :→ It covers about 80% of earth surface & constitutes lakes, streams, rivers & oceans.
Large number of elements in form of their dissolved salts are present

(iii) Lithosphere :→ It is the outermost solid part of the earth & consists of rocks
All naturally occuring elements are found in lithosphere

Elements in Living organism :→
Animals & plant organism consist of complex substances made up from both metals & nonmetals

(i) C, H, N & O in bodies of animals & plants
(ii) Fe in haemoglobin
(iii) Mg in chlorophyll
(iv) Zn is in the eyes of certain organisms
(v) Mg, Fe & Cu in chloroplast.
(vi) Ca & P in the bones & teeth of animals
(vii) I_2 in Seaweeds, Va in Cucumbers, K in Plants

METALLURGY [Extraction of Metals]

The process of removal of a pure metal from its ores is called as metallurgy or extraction of metals

It involves 4 steps as given below

(i) Crushing & Grinding of ore :→ pulverisation :→

The ores occure in nature in form of big lumps. These are broken into small pieces with the help of jaw crushers/ grinders. This process is called crushing. These pieces are converted into a fine powder with the help of ball mill/ Stamp mill.

This process is called pulverisation of ore

(ii) Concentration or dress

(A) Gravity Separation [Levigation] :→

This process is used to concentrate the ore in which the gangue particles are lighter while ore is heavier.

The powdered ore is agitated with running stream of water. The heavier ore particles settel down while the lighter gangue particles are washed away from this Wilfley table or hydraulic classifier is used Generally oxides & carbonates ores are concentrated by this one.

(B) Electromagnetic Separation :→

This process is used to concentrate such ores in which the ore & gangue differ in magnetic nature.

In this method a magnetic separator consisting of a belt moving on two rollers is used. One of the roller is strong magnet

When the powdered ore is dropped on the belt from end to other, the magnetic particles are attracted & fall nearer the roller while the non-magnetic particles fall away from the roller.

Ex - Ferro-magnetic ores having wolframite ($FeWO_4$) which is a magnetic one is separated from non magnetic ore tinstone (SnO_2) cassiterite by this method.

- Similarly chromite ore ($FeO \cdot Cr_2O_3$) which is magnetic is separated from siliceous impurities which is non-magnetic by this method.

(C) Froth Floation method :→

This method is used for concentrating sulphide ores.

It is based on the relative wetting properties with the frothing agent & water.

⇒ The sulphide ore particles are wetted by oil while the gangue particles are wetted by

The sol^n. containing $NaAlO_2$ & Na_2SiO_3 are diluted with water & seeded with $Al(OH)_3$, so that a white ppt. of $Al(OH)_3$ is formed while Na_2SiO_3 is left behind in sol^n.

$$NaAlO_{2(aq)} + H_2O \xrightarrow{Al(OH)_3} \underset{\text{White ppt}}{Al(OH)_3\downarrow} + NaOH$$

The sol^n. is filtered to separate ppt. of $Al(OH)_3$.

Then it is strongly heated at 1200°c to get Pure Alumina.

$$2\,Al(OH)_3 \xrightarrow{1200^\circ C} Al_2O_3 + 3H_2O.$$

The above process is known as Bayer's process

In serpeck's process, White Bauxite is heated with coke in presence of N_2 as a result AlN is produced. It is then treated with water to give ppt of $Al(OH)_3$ which on ignition gives Al_2O_3

$$Al_2O_3 + N_2 + 3C \xrightarrow{\Delta} 3CO + 2AlN$$

$$AlN + 3H_2O \longrightarrow NH_3 + Al(OH)_3$$

iii) Conversion of concentrated ore into Oxide :- [De electronation of ore]

The conversion of concentrated ore into metal oxide can be done by the following 2 methods.

Calcination :- It is a process heating the ore below its melting point in absence of air in a reverberatory furnace.

It is used to convert hydrated oxide, hydroxide & carbonate ores into their oxides.

- During calcination the following changes take place;

(i) moisture is driven out & the ore becomes dry

(ii) volatile impurities are expelled

(iii) Water is removed from the hydrated ores & hydroxide ores.

$$Al_2O_3 \cdot 2H_2O \xrightarrow{\Delta} Al_2O_3 + 2H_2O.$$

$$Fe_2O_3 \cdot 3H_2O \longrightarrow Fe_2O_3 + 3H_2O.$$

Limonite

3) Reduction (Electronation)

Metal oxide obtained above can be reduced to free metal by following methods.

(i) Reduction by carbon (Smelting) :→

It is a process of heating the metallic oxide strongly above its melting point of metal mixing with coal/coke in blast furnace.

Generally oxides of less electropositive metals like Zn, Sn, Pb, Fe etc. can be reduced to metal using C as reducing agent

$ZnO + C \longrightarrow Zn + CO$

$SnO_2 + 2C \longrightarrow Sn + 2CO$

$PbO + C \longrightarrow Pb + CO$

$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$

$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

If the ore contains some gangue after calcination or roasting, flux is added during smelting to remove gangue as fusible mass as slag.

Flux + Gangue $\longrightarrow$ Slag.

Slag being lighter than metal floats over the surface of metal & can be removed from time to time.

Types of Fluxes :⇒

Depending upon the nature of gangue present in the ore fluxes are of 2 types.

(i) Acidic flux :— If the gangue is basic like CaO, MnO, the flux is of acidic like SiO_2, P_2O_5, $Na_2B_4O_7 \cdot 10H_2O$.

$SiO_2 + CaO \xrightarrow{\Delta} CaSiO_3$ (Binary)

(flux) Calcium silicate

(ii) Basic flux :— If the gangue is acidic like SiO_2, P_4O_{10}, the flux is of basic like FeO, CaO, MgO

metals having low melting points like Bi, Sn, Pb, Hg than the impurities.
The impure metal is placed on the sloping hearth of a furnace & is heated in an inert atmosphere. The metal melts & flows down leaving behind the impurity on the hearth.

(a) Distillation :- This method is used for volatile metals like Zn, Hg, Cd
- The impure metal is heated in an iron retort & the vapours are separately condensed in a receiver.
- The non-volatile impurities are left behind in retort.

(3) Pyrometallurgical oxidn process :→
This method is used when the impurities have great affinity for oxygen.
This method is usually employed for refining metals like Fe, Cu, Ag etc. the oxidn is done by various ways.

(i) Cupellation :→
- The impure metal is heated in a cupel or oval shaped crucible made of bone ash or cement.
- A blast of air is passed over the molten mass. The impurities get oxidised & are removed with blast of air.

ex- The impurity of Lead present in Ag is removed by forming Litharge (PbO) which is volatile.

(ii) Bessemerisation :-
The impure or crude metals is taken in a specially designed furnace called as Bessemer convertors.
A blast of air is passed through the molten mass the impurities get oxidised & blown away.

(v) Self reduction :⟹

The sulphide ores of less electropositive metals like Pb, Hg, Cu can be reduced to metal without using any external reducing agent.

- $HgS + 3O_2 \longrightarrow 2HgO + 2SO_2$
(cinnabar)

$HgS + 2HgO \longrightarrow 3Hg + SO_2$

- $PbS + 2O_2 \longrightarrow PbSO_4$

$PbS + PbSO_4 \longrightarrow 2Pb + 2SO_2$.

(vi) Electrolytic reduction :⟹

The oxides of highly electropositive metals like Na, K, Ca, Al etc. can't be reduced by any of the above method. In such cases molten salts of metals are reduced electrolytically.

ex - $NaCl(molten) \longrightarrow Na^+ + Cl^-$

Cathode $Na^+ + e^- \longrightarrow Na$

Anode $Cl^- \longrightarrow Cl + \bar{e}$, $Cl + Cl \longrightarrow Cl_2$ (i)

(v) Purification/Refining of the metals :⟹

The metals extracted by any one of the above process contain some impurity

- The impure metal is known as crude metal.
- The impurity present in metal may be
  (i) unchanged ore
  (ii) Other metals
  (iii) non metals like Si, C, P etc.
  (iv) Residual slag.
  (v) Residual flux etc.

- The process by which the impurity present in crude metal is removed is called refining/purification.

Important methods of refining :-

(i) Liquation :⟹ This method is used to purify such

(iv) Carbonate ores are converted into their oxides.

(a) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
(Limestone)

$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$.
(Calamine)

$CaCO_3 \cdot MgCO_3 \xrightarrow{\Delta} CaO + MgO + CO_2$.
(Dolomite)

$CuCO_3 \cdot Cu(OH)_2 \xrightarrow{\Delta} 2CuO + H_2O + CO_2$

(v) It makes the ore porous which can be easily reduced later on.

(iii) Roasting :-

It is a process of heating the ore below its melting in presence of excess air in a reverberatory furnace.

It is used for sulphide ores

The following changes takes place during roasting,

(i) moisture is removed

(ii) Organic matter is burnt.

(iii) Non metallic impurities like S, P, As etc. are removed as their volatile oxide

$S_8 + 8O_2 \rightarrow 8SO_2$.

$P_4 + 5O_2 \rightarrow P_4O_{10}$

$4As + 3O_2 \rightarrow 2As_2O_3$.
(Arsenious oxide)

(iv) Sulphide ores are converted into oxides

$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

$2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$

$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

(v) It makes the ore porous & can be easily ~~oxidised~~ reduced in later process

- In this method the powdered ore is added to water containg pine oil (frothing agent) & Sodium ethyl xanthate (collecting agent). Some cresols & aniline are added as froth stabelisen.
- When stream of air is passed, the mixture is agitated, as a result sulphide ore particles stick to oil drops and raise to the surface in form of froth while the gangue particles sticking to water sink to the bottom.
- The froth is skimmed off & is allowed to collapse & is dried to get the concentrated ore.

Sometimes depressants like ~~ZnS~~ or NaCN is used as depressant to prevent one type of sulphide ore particles ~~to~~ from forming the froth with air bubble.

ex:- In the concentration of galena ore NaCN is added as depressant for ZnS which forms a complex with ZnS i.e. $Na_2Zn(CN)_4$ on the surface of ZnS & thereby prevents it from the formation of froth while PbS forms froth.

(D) Leaching :- It is a process in which the powdered ore is treated with a suitable reagent which can selectively dissolve the ore but not the impurity. (Chemical separation)

- The impurities are separated by filtration & the ore is recovered by suitable chemical method

ex - (1) Bauxite ore having Fe_2O_3, TiO_2, Silica as impurities can be leached.

- The ore is dissolved in 45% NaOH sol^n. at 200°C under 36 bar pressure. As a result Sodium metaaluminate & Sodium Silicate are formed while Fe_2O_3 & TiO_2 remain as insoluble.

$$Al_2O_3 \cdot 2H_2O + 2NaOH + H_2O \longrightarrow 2NaAlO_2 + 3H_2O$$

(Sod. metaaluminate)

$$SiO_2 + 2NaOH \longrightarrow Na_2SiO_3$$

Alloys

The material obtained by melting together metals or metals with non-metals or metals with metalloids is called Alloy.

Feature of Alloy

(i) Alloy are homogeneous in molten state but they may be either homogeneous or heterogeneous in solid state.

(ii) Alloy containing mercury as one of the Constituent are called amalgams.

(iii) An alloy must contain a metal.

(iv) In alloys, chemical Properties of the Component element are retained, but certain physical Properties are improved.

Classification of Alloys

(A) Ferrous alloys The alloy Containing iron as the main Constituent is called ferrous alloy.

Ex: Stainless steel, Manganese steel etc.

(B) Non-ferrous alloy : The alloy which does not Contain iron as the main Constituent is called non-ferrous alloy.

Ex: Brass, Bronze, Solders, Bell metal etc.

Composition and uses of Brass, Bronze, ANILCO & DURALUMIN

① Brass : It Contains Cu : 60% - 90%.

Zn : 40% - 10%.

Uses : It is used in making utensils, hardwares, screws, jewellery etc.

(2) Bronze :- It Contains Cu :- 80% - 95%.
Sn :- 20% - 5%.

Uses :- (i) It is used in Making imitation Jewellery, water fitting, Statues, medals, heavy load Bearing, turbine blades etc

(3) Alnico :- It Contains Steel - 50%.
Ni :- 21%.
Al :- 20%.
Co :- 9%.

Uses :- It is used in making Permanent Magnet.

(4) Duralumin :- It Contains Al :- 95%.
Cu :- 4%.
Mn = 0.5%.
Mg = 0.5%.

(*) It is used in making air ships.

UNIT - 2

WATER POLLUTION AND Water Analysis

Water is one of the most abundant and important substance for all the living organisms. It is an important natural resource .. The hydrosphere includes all types of water resources like oceans, seas, lakes, rivers and ground water. It is estimated that oceans occupy nearly 70.8 percent of the total surface of the earth with total volume of 1376×10^6 cubic KMs and forms 97 percent of the hydrosphere

→ Sea water has a salinity of nearly 35 parts per thousand Because of high salt content in ocean water, it is of little use for human Consumption. About 2% of water resources are remaining in the form of polar ice caps and glaciers. only 1% of total water resources are available as fresh water for human Consuption.

→ Chemically Speaking water is a simple inorganic Covalent molecule. It is formed when hydrogen is burnt in oxygen and an electric spark is passed through a mixture of hydrogen and oxygen gas in the ratio 2:1

$$2H_2 + O_2 \xrightarrow[\text{spark}]{\text{electric}} 2H_2O$$

→ In physical State it exists in three different States.

water liquid (common water)
water Solid (Ice)
water gas (Vapour)

agriculture, power generation, ... processing, cleaning etc.

WATER POLLUTION:

Water is the most important Constituent of the Support system because on one hand it is vital for the maintenance of all forms of life.

→ Water is essential for power generation navigation, irrigation of crops, disposal of sewage etc. Only one percent of the total quantity of water of the hydrosphere is available to human beings and other biotic communities from various sources such as ground water, rivers coupled with population explanasion, rapid industrialisation and unplanned Urbanisation are releasing a lot of waste into water bodies thereby degrading the quality of water it exceed the tolerance level and self-purifying capacity of water, it gets polluted.

→ Water pollution may be defined as deterioration of physical, chemical and biological characterstics of water through natural and anthropogenic activities to such an extent that it becomes harmful to human-beings.

→ According to united States water pollution means presence of any toxic substance that degrates the quanlity to constitute a hazard or impair its usefulness.

→ Anyway water pollution is a global problem affecting both developed and developing Countries.

SOURCES OF WATER POLLUTION

Depending upon the specificity of waste discharge. The water pollution sources are categorised as.

point Sources : Point Sources are those which discharge pollutants from some specific Location such as pipeline, ditches and sewers) into water bodies. Common point sources include (i) Industries, (ii) Sewage treatment plants (iii) Land fills (iv) Hazardous waste sites. (v) Leakage from oil Storage tanks.

Pollutants from point sources are of definite identity with almost a fixed volume and composition. Pollution can be controlled by experimental modulation.

Non-point or diffused Sources: Non-point Sources of water pollution are widely Scattered and discharge pollutants over largen areas. Common non point Sources of water pollution are.

(i) run-off from agricultural fields.
(ii) Like-stock feed Lots
(iii) Storm run off from Urban streets
(iv) parking lots and streets into Surface water and Seepage into ground water.

Type of water Pollutants

HARDNESS

Hard water is that characteristics which prevents the lathering of soap.

→ Hardness of water is generally due to presence of carbonates, bicarbonates, chlorides, sulphates of calcium and magnesium. e.g $CaCO_3$, $Ca(HCO_3)_2$, $CaCl_2$, $CaSO_4$, $MgCO_3$, $Mg(HCO_3)_2$, $MgCl_2$, $MgSO_4$.

→ If carbonate and bicarbonates of calcium and magnesium are not present, then the hardness is called non-carbonates hardness.

Hardness may be divided into two class
① temporary hardness
② permanent hardness.

① Temporary Hardness

It is also known as carbonate hardness. It is due to the presence of dissolved bicarbonates of Ca and Mg in water. It is called as temporary hardness because it can be removed by simple boiling the water.

$$Mg(HCO_3)_2 \xrightarrow{\Delta} MgCO_3 + H_2O + CO_2$$

$$Ca(HCO_3)_2 \xrightarrow{\Delta} CaCO_3 + H_2O + CO_2$$

$Ca(HCO_3)_2$, $Mg(HCO_3)_2$ cause, alkalinity in water Hence temporary hardness can be calculated by estimating alkalinity of sample of hard water.

→ Drinking of hard water lead to the formation of kidney stone.
→ Wasteful Consumption of Soap so Laundary problem.
→ In the steam boiler, hardness in water produce boiler scale, which adhere to boiler tubes and reduce their heat transfer capacity and finally reduce the production rate.
→ Hardness also cause Corrosion of pipelines valve, joints etc.

(Bathing, cooking, drinking, Textile, Dye, paper and other industry)

Hardness is usually expressed in ppm or mg/L of $CaCO_3$ in water.

$$1 \text{ ppm} = \frac{1 \text{ parts of hardness}}{10^6 \text{ parts of water}}$$

The Scale of hardness from the consumer point of view may be as follows.

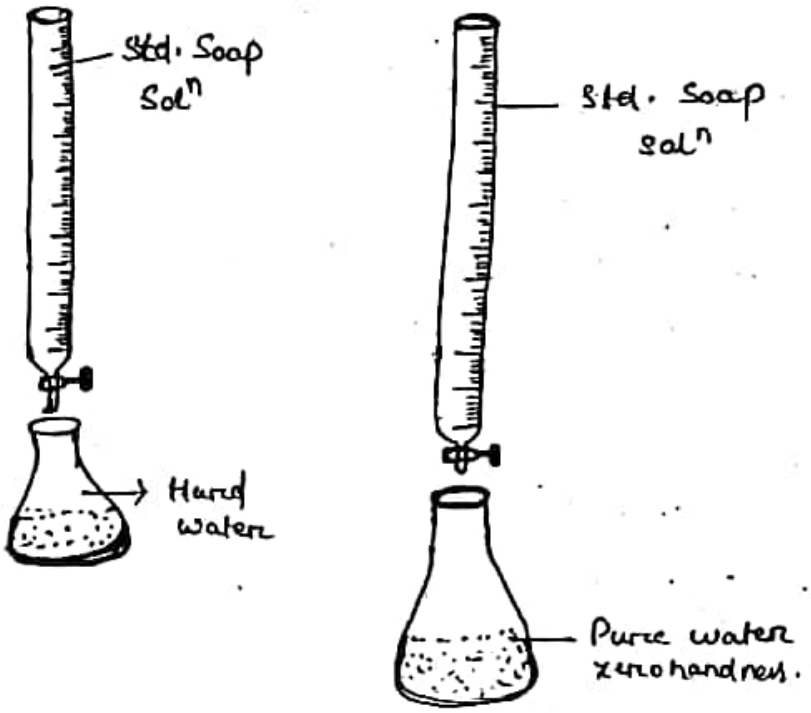
0 - 50 mg/L → Soft
50 - 100 mg/L → Moderately Soft
100 - 150 mg/L → Slightly hard
150 - 250 mg/L → Moderately hard
Over 250 mg/L → hard

Hardness of water may be determined either by the soap test or EDTA method. The EDTA method is considered to be most accurate method.

SOAP TEST

→ Add standard soap solution to the hard water sample and shake the mixture solution vigorously for 5 min and then see lather form.

→ The hardness is then determined from the difference between the total amount of soap solution and the lather factor.



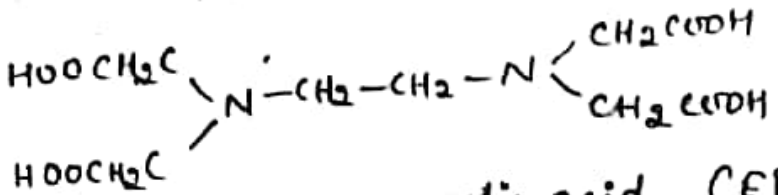
Burette reading gives lather factor

EDTA METHOD

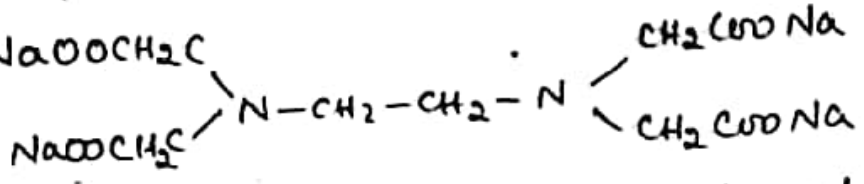
In EDTA method, the total hardness is measured by titrating hard water sample against ethylene diamine tetraacetic acid (EDTA) or its sodium salts. The Ca^{+2} and Mg^{+2} form stable complex with EDTA as per the following eq^n.

$Ca^{+2}/Mg^{+2} + EDTA \leftarrow [Mg^{+2} - EDTA]$

(12)

→ 

Ethylene diamine tetra acetic acid (EDTA)

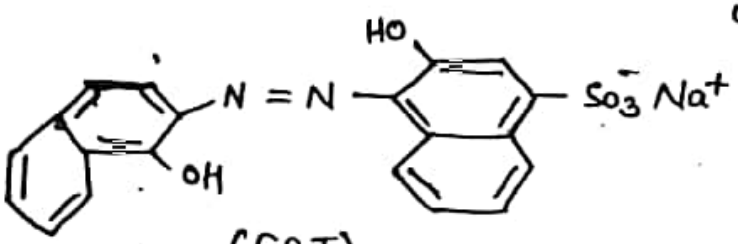
→ 

(Disodium ethylene · diamine tetra · acetic acid
Sod^n salt of EDTA)

The titration involves the use of Erichrome black-T (alcoholic solution of blue dye) EBT as indicator to show when all the ions causing hardness have been complexed. The indicator when added in a small amount to a sample of hard water buffered to a pH value of about 10 — with few Ca^{+2} and Mg^{+2} ion to form weak complex wine red colour according to the following equations.

$$Ca^{+2} - EDTA + EBT \rightleftharpoons \left[\begin{matrix} Ca^{+2} - EBT \\ Mg^{+2} - EBT \end{matrix}\right] + EDTA$$
$$Mg^{+2} - EDTA$$

wine red.



(EBT)

As the Ca^{+2} – EBT and Mg^{+2} – EBT complex is unstable upon further titration with EDTA, EDTA replaced · EBT forming Ca^{+2} – EDTA and Mg^{+2} – EDTA complex. Thus the wine red colour change to blue making the end point of titration.

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Different industrial pollutants include chlorides, sulphides, carbonates, nitrites, nitrates of heavy metals such as mercury, lead, zinc, arsenic etc, Organic Compounds synthesized for industrial purposes, radioactive wastes etc.

(b) Agricultural Pollutants

These are chemical fertilisers pesticides insecticides and herbicides, synthetic chemical compounds, weeds and plant remains.

(c) Urban Pollutants

These contain chemicals from automobiles exhaust, chemicals from lime and chemical fertilizers used in the lawns and gardens within city, chemicals from Urban sewage household sewage etc.

(d) Natural pollutants

Natural pollutants include volcanic dusts, sediments due to weathering and erosion, debris caused by Landslide, decayed and decomposed Organic matter.

2. On the basis of physical and chemical characteristics

(a) Physical Pollutants: Pollutants changing the physical characteristic such as colour, taste, turbidity, sediments, oil and grease content, dissolved and suspended solid etc.

(b) Chemical Pollutants: These are Chlorides, Sulphites,

GROUND WATER :

water present under the surface of the earth, is known as ground water.. The average magnitude of the total ground water content is about 210 billion m^3 including recharge through infiltration, seepage and evapo-transpiration.

→ There are some intermolecular spaces bet^n the soil particles which allow rain water molecules to pass through them. These molecules get collected at different zones giving subsurface or ground water. Spaces are called voids.

→ The ground water is usually of good quality & free from ex-traneous pollutions. So it can be used for drinking and for our day-to-day use. It can be withdrawn for human consumption by following ways bore-well, infiltration galleries.

SURFACE WATER:

Water present over the surface of earth in riverss, lakes, ponds, seas and oceans is known as surface water for day to day uses. The surface water contains a lots of pollutants micro-organisms and mineral nutrients for the feeding of bacteria and virus. The surface water gets polluted by the run of water from agricultural fields containing pesticides and fertilisers, soil particles. However the surface water can be purified and reused.

→ Water can be used for different purposes. i.e domestic use for drinking, cooking and cleaning irrigation for

IMPORTANCE OF WATER:

water is indispensible for substance of all living organisms because of several unique properties.

Universal solvent:

water is capable of solubilising varieties of substances. By such a process a number of nutrients and ions can be transported into plant body.

High Viscosity:

Because of its higher viscosity it protects the aquatic organisms against mechanical disturbances and helps the swimming and floating of living aquatic animals.

Transperiancy:

Since water is transparent, it allows the effective penetration of light where by the submerged aquatic plants are able to photo-synthesize.

Pressure:

Pressure exerted by water at a particular depth modifies the shape and size of aquatic Organism.

Buoyancy:

Water has this unique property which helps the aquatic organisms to float over its surface.

SOURCES OF WATER

Fresh water required by man is obtained from two natural sources.

① Ground Water ② Surface water.

LUBRICANTS

The substance applied in between two moving or sliding surfaces with a view to reduce the frictional resistance between them is called Lubricant.

Function of Lubricants :

(i) It reduces wearing and tearing of machinery parts.

(ii) It reduces the frictional resistance between the sliding surface.

(iii) It reduces lose in energy.

(iv) It increases the efficiency of engine.

Types of Lubricant

① Depending on the physical state Lubricant are classified into several types.

Solid Lubricants

A solid Lubricants are materials that despite being in the solid phase, are able to reduce friction between two surfaces sliding against each other without the need for a liquid oil medium.

Examples :- Graphite, mica, molybdenum, disulphide etc.

Uses :- (i) Dry lubricants are often used in application such as locks are dry lubricated bearing.

(ii) It is used where the working temp is very high.

* Liquid Lubricants

The lubricant which exist in liquid form and are used to reduce friction by providing a uniform film between them.

Examples :- oils, Mobiles, petroleum oil etc.

Function of liquid Lubricants

(i) It acts as a cooling medium.

(ii) It reduces the chance of rusting of metals.

(iii) It Prevents Corrosion of machinery Parts.

Uses :- (i) The opperating temp. is very high.

(ii) The speed of the rollers is very high.

(iii) The sealing arrangement is perfect to prevent the loss of oil.

Semi-Solid Lubricants

Semi-Solid lubricants are a gel-like substance which reduced friction between two moving surface.

Ex:- Greases, Vaseline, waxes etc.

Uses of Graphite as Lubricants

(a) ~~Graphite is best suited for Lubrication in air.~~

The ad

Graphite is used as Lubricant due to its slippery nature. Graphite is best suited for lubrication in air. The adsorption of water reduces the bonding energy between the hexagonal planes of the graphite to a lower level than the adhesion energy between a substrate and Graphite.

Uses of Lubricating oil :

(a) Lubricating oil, sometimes simply called Lubricants is used to reduce the friction, heat and wear between mechanical components that are in contact with each other.

(b) Lubricating oil is used in motorized vehicles where it is known specifically as motor oil and transmission fluid.

~~Uses of Grease~~

~~Major Component of~~

Grease : It is a type of semi solid lubricant.

The major components of grease are

(i) Oil Component : mineral oil, waxes, Petroleum oil

(ii) Thickening Components : Na, K, Ca Al Soaps.

(i) The consistency of grease depends on the percentage of thickner in the grease.

Modifiers :- Anti oxidant, anti rust etc.

Uses :- (i) It is used where lubricating oil would not stay in position.

(ii) It also acts as sealants to prevent ingress of water and in compressible materials.

(iii) Grease - lubricated bearing have greater frictional characteristics de to its high viscosity.

Purpose of Lubrication

Lubrication is highly important in industrial fields. The purposes of lubrication are

(i) It helps to reduce frictional resistance between the moving, rolling or sliding surface.

(ii) It reduces wearing and tearing of machinery parts.

(iii) It reduces noise pollution.

(iv) It increases the efficiency of engines.

(v) It reduces expansion of metals.

Viscosity :- The property of a liquid by virtue of which it opposes the relative motion between different layers.

FUEL

Fuel is a combustible matter which on burning with air produces a huge quantity of heat energy along with a low quantity of other by products.

Fuel + O_2 → Product(s) + Heat.

Characteristics of good fuel

(i) It's calorific value should be high.
(ii) It should be cheap and readily available.
(iii) It should be stored for a long period i.e., it should be non-volatile and stable.
(iv) It should not produce more ash.
(v) Transportation should be easy.
(vi) It should not produce any poisonous gas.
(vii) It should not produce much smoke.
(viii) It should have low ignitation temperature.
(ix) It should not be explosive in nature.
(x) It should not contain high percentage of moisture.

Calorific value :-

It is defined as the net amount of heat energy produced by the complete combustion of a unit mass or unit volume of fuel in air.

Units of calorific value are

(i) Cal/gm.
(ii) kCal/kg
(iii) kJ/kg

Classification of fuel

Depending on the physical state fuel may be classified into three categories.

1) Solid fuel :- (Coal, wood, sawdust, rice, bran,)
2) Liquid fuel :- (kerosene, Petrol, Diesel, Spirit, LPG)
3) Gaseous fuel :- (Methane, butane, water gas, Producer gas, bio-gas, Coal gas, etc).

Wood.

(*) A fresh wood contains about 50% moisture.

(*) On air drying the moisture ~~Carbon~~ contents reduces about 15%.

(*) The average composition of a dry wood is C=50%. H=6% O=43% Ash=1%.

(*) The Calorific value = 3500 to 4500 K Cal/kg. It is largely used as a domestic fuel and seldom used for industrial purpose.

Coal :- It is a combustible solid. It is usually stratified. That means, formed by the burial of partially decomposed vegetation in post geological ages. During natural calamities big trees are uprooted from the ground and get buried under the surface of earth. After thousand ~~E~~ thousands of years under high temperature and pressure and in absence of oxygen, by the action of bacteria wood is decomposed into coal.

Anthracite :-

(i) It has dark brown or black surface
(ii) It has higher density than other form of Coal.
(iii) It is lustrous in appearance.
(iv) It contains very low % of moisture and volatile matter.
(v) It's Calorific value is 8650 to 8700 kcal/kg.

Uses :- It is used in metallurgical operation as a reducing agent and as a fuel.

Petroleum :-

The word Petroleum is coined from two greek words 'Petra' means rock and oleum means oil. It is also known as rock oil and mineral oil.

Origin of Petroleum :-

It is obtained deep in the earth crust and at the bottom of sea. Petroleum is formed by the partial decomposition of aquatic creatures deep in the sea. The decomposition occurs as a result of high pressure and in the absence of air Petroleum oil contains various constituents such as Petrol, diesel, kerosene, fuel oil, Paraffin, etc. Also it contains water and sulphur as impurities.

Purification of crude Petroleum oil :

Removal of water (Cottrell's Process).

The crude petroleum oil is passed through two highly charged electrodes when water gets separated as emulsion.

Removal of Sulphur

The crude petroleum oil free from water is then passed through copper oxide solution; so that Sulphur present in the petroleum react with the solution giving insoluble CuS, which can be filter off.

Separation of different Constituents from Petroleum.

Different Constituent of crude Petroleum oil are separated by fractional distillation method. The Crude Petroleum oil is passed through a furnance where it is heated to about 400°C. So that all the fraction are converted into their gaseous form. the vapour then passed ~~over~~ through a fractional distillation unit. when the vapours move in upward direction, the temperature gradually falls & different fractions are collected from their respective outlets.

Petrol or Gasoline :

(★) The fraction obtained between 40°-120°C chiefly Contains Petrol.

(★) It Consist of hydrocarbon between Pentane to Octane.

(★) It is volatile and flammable.

Average Composition C = 84%. H = 15%. O+S+N = 1%.

Calorific value = 11,250 K Cal/kg.

Producer gas

(☆) It is a mixture of combustible gases, CO & H_2 with large quantities of non-combustible gases CO_2 & N_2.

(☆) The average composition of Producer gas is
CO = 22% - 30%. H_2 = 8-12%. CO_2 = 3%. N_2 = 52-55%.

(☆) It's Calorific value is 1300 kcal/m^3.

Uses :- (i) In heating furnace in metallurgical operation.
(ii) As a reducing agent.

Light diesel oil & High speed diesel.

LDO-light diesel oil and high speed oil are produced from crude petroleum oil. The fraction obtained between 150° - 400°C contains LDO & HSD. These contain hydro carbon having C_{12} - C_{18}.

Uses :- LDO is normally used for the generation of electricity, in marine engines etc.

Uses :- It is used as a fuel in the petrol engine.
(ii) It is used as a dry cleaning agent.

Kerosene
(i) It is obtained in between 180°-250°C.
(ii) It Consist of hydrocarbon between decane to hexadecane.
(iii) Average Composition C=84%. H=16%. S<0.1%.
(iv) Calorific value = 11,100 kCal/kg.

Uses :- It is used as a fuel in the kitchen for domestic.
(ii) It is used as making oil gas.
(iii) It is used as a fuel in jet planes.

Diesel :- (i) It is obtained between 250°-320°C.
(ii) It Contains a mixture of hydrocarbon between pentadecane to octadecane.
(iii) Average Composition C=85%. H=12% rest=3%.
(iv) Calorific value :- 11000, kCal/kg.

Uses :- It is used as a fuel in diesel engine.

water gas :- (i) It is mixture of CO + H_2 with a little quantity of non-combustible gases CO_2 & N_2.
(ii) Average Composition :- H_2 = 51%. CO = 14%. CO_2 = 4%. N_2 = 4
(iii) It's Calorific value is 2800 kCal/m^3.

Uses :- It is used as.
(i) an illuminating gas
(ii) a fuel (iii) a source of H_2 gas.

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The Progressive conversion of wood into Coal is Called Coalification.

Wood → Peat → Lignite → Bituminous → Anthracite.

Peat :-

(i) It is either brown or black in Colour.

(ii) It is the first stage in the Coalification of wood.

(iii) Average Composition C = 57%. H = 6%. O = 35%. Ash 2.5%.

(iv) Calorific value is low.

Uses :- It is seldom used as fuel as it contains a high % age of moisture.

Lignite :-

(i) It is brown in colour & soft in nature.

(ii) It contains about 20 to 60% moisture.

(iii) Average Composition C = 60 to 70%. O = 20%. H & N = 10 to 20%.

(iv) Calorific value - 6500 to 7100 Kcal/kg.

Uses :- It is used in small scale industries and for domestic purposes.

Bituminous :- (i) It contains about 10% to 40% moisture

(ii) Average Composition C = 78 to 90%. O = 7 to 10%.

(iii) Calorific value :- 8000 to 8500 kcal/kg.

(iv) It contains about 45% volatile matter.

Uses :- It is used as fuel in small scale industries.

industries.

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In Greek word poly means many and meros means Parts.

Polymers are the high molecular weight compounds whose str. are made up of a large no. of simple repeating units.

Monomers :- The repeating units which are obtained from low molecular mass of simple compands as known as monomers.

Polymerization

The rean by which monomers are converted to Polymer is known as Polymerization.

Ex:-

$CH_2 = CH_2 \xrightarrow{\text{Polymerization}} -CH_2-CH_2-CH_2-CH_2-$

Ethylene
Cmonomer

Polythene
(Polymer).

Types

Classification of Polymer:

Polymer are classified in a no. of ways depending upon their source, structure Physical properties and type of Polymerization rean.

i) On the basis of source :-

On the basis of source Polymer are classified in to two types

(i) Natural Polymer.
(ii) Synthetic Polymer.

Natural Polymers :- The polymers which are obtained from natural resources are called natural polymers.

Ex:- Proteins, Cellulose, Starch, rubber etc.

Synthetic Polymers :-

The polymers which are synthesized by chemical reaⁿ are called synthetic polymers.

Ex:- Polyethylene, teflon, nylon etc.

On the basis of structure :-

On the basis of str., polymers are of two types.

i) The composition of basic polymer unit

ii) The arrangement of polymer chain.

On depending upon the composition of basic polymer unit, polymers are classified into two types

Homo Polymers :- The polymers which are made from only one type of monomer unit are called homopolymers.

Ex:- $n\,CH_2 = CH_2 \xrightarrow{\text{Polymerisation}} \left(-CH_2-CH_2-\right)_n$

Polythene.

Co Polymers :-

The polymers are obtained from diffs. monomers. are called Co-polymers.

Ex:- Nylon 6,6.

$$n\,H_2N-(CH_2)_6-NH_2 + n\,HO-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-OH$$

hexa methylene diamine — adipic acid

$$-HN-(CH_2)_6-NH-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-OH$$

Nylon 66.

(iii) Depending upon their molecular force :-

Depending upon the magnitude of intermolecular forces, Polymers are classified into four types.

Elastomers :-

The Polymers in which very weakest intermolecular forces exists bet^n the polymer chain are called elastomers.

These can be easily stretched and can be regain their original positions due to removal of stretching force.

Vulcanised rubber, fibers :- (i) The Polymers in which the strongest inter-molecular forces of attraction exist bet^n the polymer chain are called fibres.

(ii) They have high strain strength and elasticity. These have close packed str. and exist in crystalline state.
They have sharp M.P.
Ex:- Nylon, Polyacrene.

Thermo plastics :-

The Polymers in which the inter molecular force exist bet^n elastomers and fibres are called thermo-plastics.

These are linear Polymer which are

and become hard on cooling. Hence these can be easily moulded to any shape.

Ex:- PVC (Polyvinyl chloride), polystyrene, nylon-cellulose etc.

Thermo setting :-

The polymers in which the monomers are three dimensionally arranged are called thermosetting polymer.

These are insoluble in organic solvent. These can't be moulded to any shape.

Ex:- Bakelite, melamar, silicones.

~~Depending upon the structure :-~~

Classification of Polymers :-

There are two main type of Polymers (i) Addition Polymer

~~(ii) Chain Growth Polymers.~~

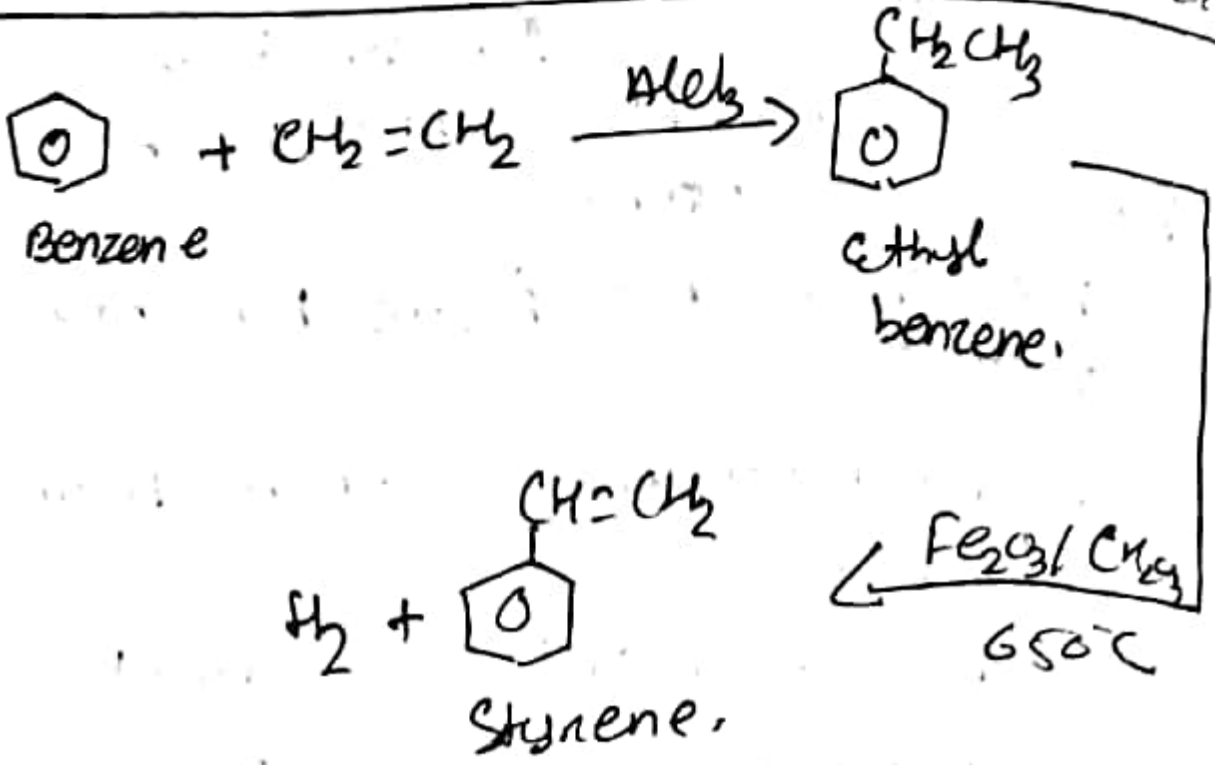
(ii) Condensation Polymers.

Addition Polymerization :-

The polymers which are formed by combination of alkene monomers to produce a single huge molecule only, are called addition Polymers.

These are catalyzed by peroxides or acids.

The rxn require pressures of 1000 atm at 200°C.



Polyisoprene (rubber) :-

When isoprene undergoes Polymerization polyisoprene results.

$$n CH_2=\underset{\underset{CH_3}{|}}{C}-CH=CH_2 \xrightarrow{\text{Polymerization}} \left[CH_2-\underset{\underset{CH_3}{|}}{C}=CH-CH_2 \right]_n$$

~~Low~~ Pressure Polyethylene :-

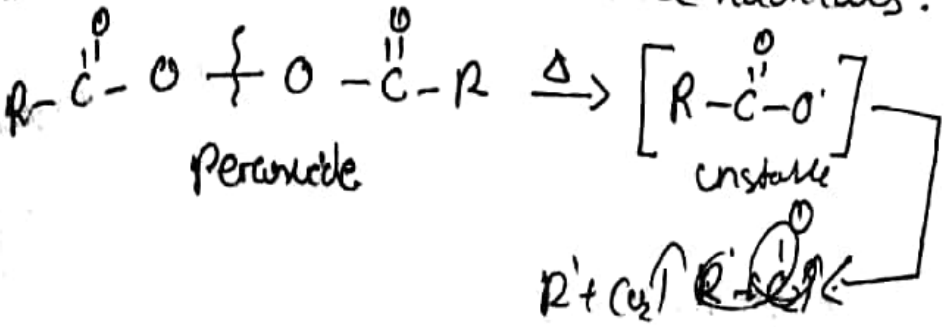
Mechanism of addition Polymerization

Addition Polymerization take place by one of the following three mechanism.

① Free-radical Polymerization :-

i) chain initiation :-

when organic peroxide undergoes homolytic fission to form free radicals.



ii) chain Propagation :-

Free radical Produced in the above step adds to an alkene molecule to form a new free radical.

$$R^{\cdot} + CH_2=CH_2 \longrightarrow R-CH_2-\dot{C}H_2$$

This free radical can attack another alkene molecule and so on.

$$RCH_2\dot{C}H_2 + CH_2=CH_2 \longrightarrow RCH_2CH_2CH_2\dot{C}H_2$$

$$RCH_2\dot{C}H_2 + nCH_2=CH_2 \longrightarrow R(CH_2CH_2)_n\dot{C}H_2$$

This process is repeated over and over. Hundreds and even thousand of alkene monomers can add one at a time to the growing chain.

Chain termination :-

~~Two chains can combine and~~
This can come to a half in two ways

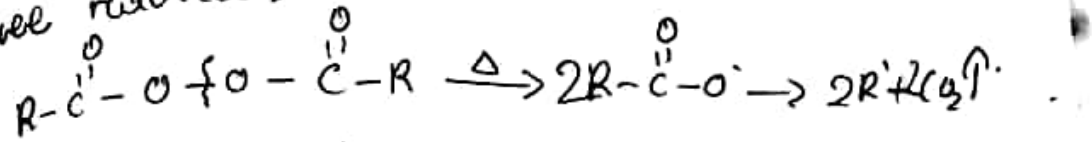
a) chain Combination :-

Two chains can combine at their Propagates sites.

Mechanism :-

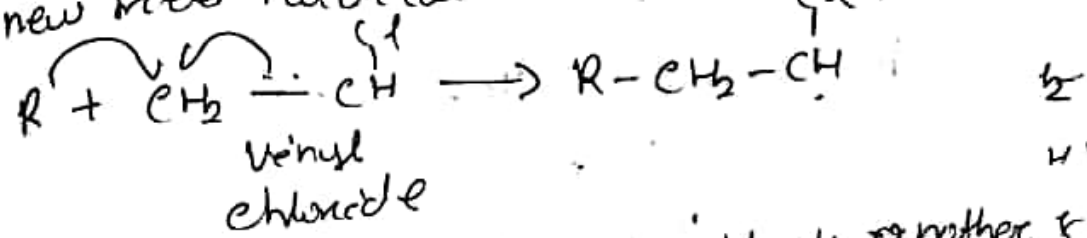
i) Chain initiation :-

Organic peroxides decompose to form free radicals.



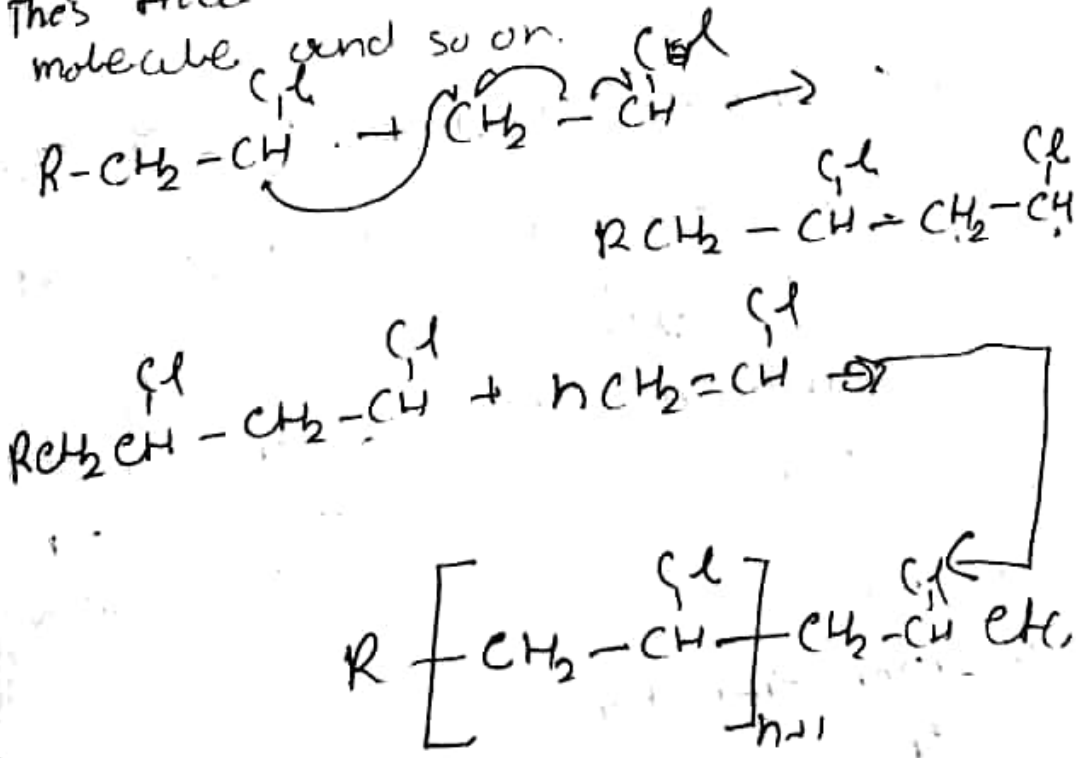
Chain propagation :-

Free-radical produced in the above step adds to vinyl chloride to form a new free radical.

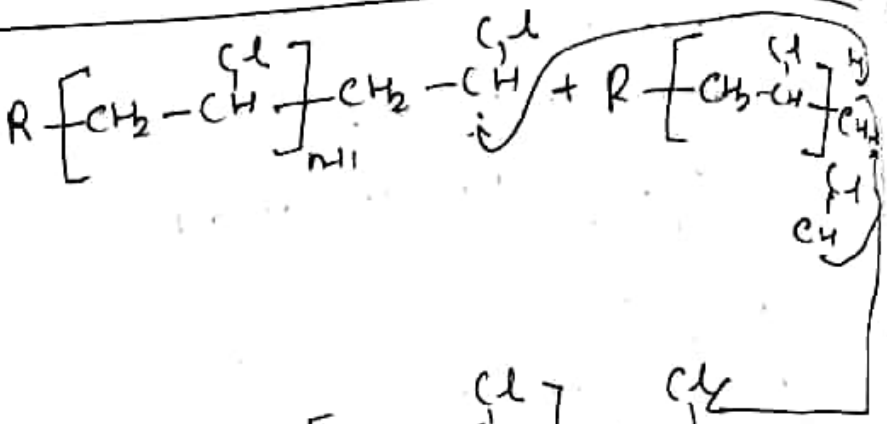


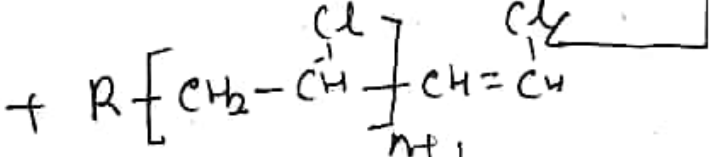
Vinyl chloride

This free radical can attack another molecule and so on.

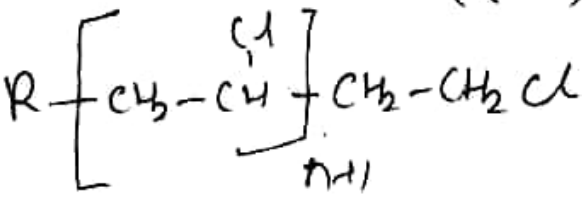


Chain termination :- The chain reaction can be interrupted when the free radicals combine one by disproportion





(PVC)



PVC

Free radical Polymerization of Styrene

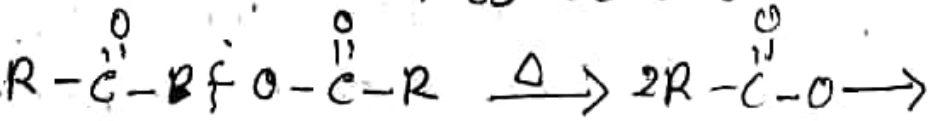
When styrene on polymerization Polystyrene results.

Styrene. Polystyrene.

Mechanism :-

i) Chain initiation :-

Organic Peroxide decompose to form free radicals.



Property :-

1) It is a transparent having moderate tensile strength and high toughness, chemically inert, slightly flexible and poor conductor of electricity. Uses :-

It is used as packing material, insulating wires & cables and manufacture of pipe, bottle etc.

2. High density polyethene :-

It is obtained by heating ethene at 333 - 343K under 6-7 atm Pressure in Presence of ziegler Natta Catalyst.

$$n CH_2=CH_2 \xrightarrow[\text{6-7 atm}]{\text{333-343K}} \underset{\text{ziegler natta catalyst}}{} \underset{\text{Polyethene.}}{+CH_2-CH_2+_n}$$

Property :-

It is well packed polymer having high density inert, harder, tougher & greater tensile strength

Uses :- It is used for making buckets, tubes, house wire articles, pipes, bottles, toys, insulator, anti corrosive & Packing materials.

Cis 1,4 Poly buta di'ene.

Vi'nyl Polymeri'sation :-

The Polymeri'sation ei'n which two no. of vi'nyl monomers combi'ne i'n a lineare manneri to formi Polyvi'nyl ci's Called vi'nyl Polymeri'sati'on.

Ex:- Polyethene, Polystyrene, neoprene, Buna-s.

i) Polyethene :-

It i's obtai'ned by the Polymeri'sati'on of ethene. ~~There two~~ Polyethene are of two types.

a) low densi'ty polyethene (LDP)

b) hi'gh densi'ty polyethene (HDP).

a) low densi'ty polyethene :-

~~It i's obtained by the Polymeri'sation of ethene.~~

It i's obtai'ned by heati'ng ethylene to 473'K under a pressure of 1500-2000 atm i'n presence of li'ttle amt of O_2.

$$n CH_2=CH_2 \xrightarrow[1500\text{-}2000\text{ atm}]{473\text{ K}} \left(CH_2-CH_2\right)_n$$

Polyethene.

t.v. bodies, electrical insulator, tiles etc.

polydiene :-

The polymer which are obtained from diene monomers are called polydiene.

(1) **Neoprene :-** (synthetic rubber).

It is obtained by polymerisation of chloroprene in presence of peroxide.

$$n(CH_2=\underset{Cl}{\underset{|}{C}}-CH=CH_2) \xrightarrow{\text{Peroxide}} \left[CH_2-\underset{Cl}{\underset{|}{C}}=CH-CH_2\right]_n$$

neoprene.

Properties :-

* It is superior to natural rubber in resistance to oil, gasoline & other organic solvent.
* It is used before making container for storing petrol, oil & other solvents, shoe heel, houses, bells etc.

ii) **Natural rubber :-** (Isoprene).

It is obtained by the polymerization of Isoprene (2-methyl, 1,3-butadiene).

$$n(CH_2=\underset{CH_3}{\underset{|}{C}}-CH=CH_2) \xrightarrow{\text{Polymerisation}} \left[CH_2-\underset{CH_3}{\underset{|}{C}}=CH-CH_2\right]_n$$

isoprene

natural rubber

$$2R(CH_2CH_2)_nCH_2\dot{C}H_2 \longrightarrow 2R(CH_2CH_2)_nCH=CH_2$$

$$\oplus$$

$$CH_2CH_2(CH_2CH_2)_n$$

Polyethylene.

Disproportionation -

Two chains undergoes disproportionation with one chain being oxidized to alkane and other being reduced to an alkane as a result of hydrogen atom transfer.

$$2R(CH_2CH_2)_nCH_2\dot{C}H_2 \longrightarrow 2R(CH_2CH_2)_nCH=CH_2$$

Polyethylene

$$+ \quad R(CH_2CH_2)_nCH_2CH_3$$

Polyethylene

(Polymer)

Free radical Polymerization of Vinyl

(iii) Buna-S- rubber :-

It is obtained by polymerisation of 1,3-butadiene and styrene in presence of acid & heat.

$$n CH_2=CH-CH=CH_2 + n C_6H_5-CH=CH_2 \xrightarrow{Na/\Delta} \left(-CH_2-CH=CH-CH_2-CH(C_6H_5)-CH_2-\right)_n$$

1,3 Butadiene. Styrene. Buna-S-rubber.

Characteristics :-

* It has improved heat and abrasion resistance than synthetic rubber.
* It is used for making tyres, water proof shoe, rubber shoe etc.

(iv) Buna-N- rubber

It is obtained by the polymerisation of 1,3 butadiene and acrylonitrile. It is also known as Perbunan.

$$n CH_2=CH-CH=CH_2 + n CH_2=CH(CN) \longrightarrow \left(-CH_2-CH=CH-CH_2-CH_2-CH(CN)-\right)_n$$

BNS.

(c) Addition Polymer have the same empirical formula as their monomers.

i) Polyethylene :-

Ethelene Polymerises to form Polyethylene Commonly called Polythene.

$$n CH_2 = CH_2 \xrightarrow{\text{Polymerisation}} \left[CH_2 - CH_2 \right]_n$$

Ethelene — Polythelene.

Uses :- i) It is used to manufacture of house ware such as buckets and dustbins Carpet backing, Packaging materials and Cable insulation.

Poly Propelene :- Propene Polymerises to from Poly Propene.

$$n CH_3 - CH = CH_2 \xrightarrow{\text{Polymerisation}} \left[\begin{matrix} CH_3 \\ | \\ CH - CH_2 \end{matrix} \right]_n$$

Propelene — Poly Propene.

Uses :- It is used in manufacture of insulation leather, floor Covering, Corrugated roofing, & Gramphone records.

Uses :- It is used in the manufacture of housewares, medical equipment, toys, electronic Components, tube etc.

Polyvinyl Chloride :-

Characteristics

i) It is quite rigid, heat resistance and resistant to swelling action of petrol, lubricating oil and other organic solvent.

ii) It is used for making oil seals, fuel tank linings.

c) Polyacrylates :-

The polymers which are obtained from acrylic monomers are called

a) Polyacrylates.

i) Polyacrylonitrile (PAN or Acrilon)

It is obtained by polymerisation of acrylonitrile (vinyl cyanide)

$$n CH_2 = \underset{CN}{CH} \xrightarrow{\text{Polymerisation}} \left(CH_2 - \underset{CN}{CH} \right)_n$$

Acrylonitrile. Pan.

Characteristics :-

i) It is hard and horny material with high m.p.

ii) It is used for making acrilan & orlon fibres which are used to making carpet, blanket, suiting.

ii) Polymethyl methacrylate (PMMA)

Uses :-

Butyl rubber is used for making tubes, for tires, motor & for other vibration-dampening application.

Acrylonitrile-butadiene rubber

(Buna-N, NBR)

It is a copolymer made from acrylonitrile and 1,3-butadiene.

$$n CH_2=\underset{\text{Acrylonitrile}}{\underset{|}{CH}-CN} + n CH_2=CH-CH=CH_2 \quad \text{1,3 butadiene}$$

$$\left[CH_2-\underset{|}{CH}-CN-CH_2-CH=CH-CH_2 \right]_n$$

Acrylonitrile-butadiene rubber (NBR)

Uses :- Buna-N is valuable for use requiring resistance to action of oils & abrasion.

Neoprene :-

It is a polymer of chloroprene, i.e. 2-chloro, 1,3-butadiene. The polymerization proceeds by free radical addition mechanism.

$$n CH_2=\underset{\displaystyle CH_3}{\overset{|}{C}}-CH=CH_2 \xrightarrow{Li} \left[CH_2-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH-CH_2\right]_n$$

Some important synthetic rubber are.

Methyl rubber

When Pinacol on dehydration 2,3-dimethyl butadiene results which on polymerizes in presence peroxide, methyl rubber results.

$$n CH_2 \rightarrow CH_3-\underset{\displaystyle H_3C}{\overset{|}{C}}-\underset{\displaystyle CH_3}{\overset{|}{C}}-CH_3 \xrightarrow{-2H_2O} CH_2=\underset{\displaystyle H_3C}{\overset{|}{C}}-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH_2$$

(OH, OH)

2,3 dimethyl butadiene

$$\left[CH_2-\underset{\displaystyle H_3C}{\overset{|}{C}}=\underset{\displaystyle CH_3}{\overset{|}{C}}-CH_2\right]_n \leftarrow \text{Peroxide}$$

methyl rubber

Butyl rubber :- It is a Co polymer made from isobutelene & isoprene. The polymerization is carried out at -80 to 100°C in methyl chloride as solvent with anhydrous $AlCl_3$ as catalyst.

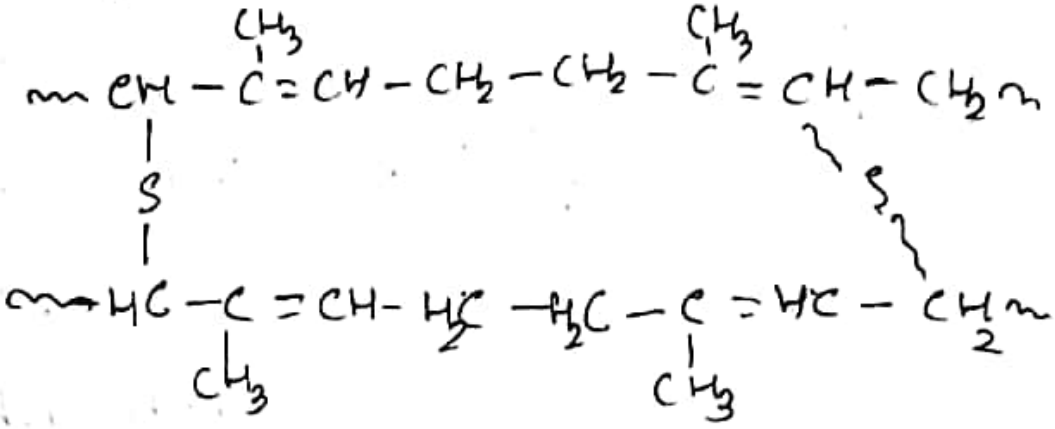
$$CH_3-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH_2 + CH_2=\underset{\displaystyle CH_3}{\overset{|}{C}}-CH=CH_2$$

isobutylene. isoprene.

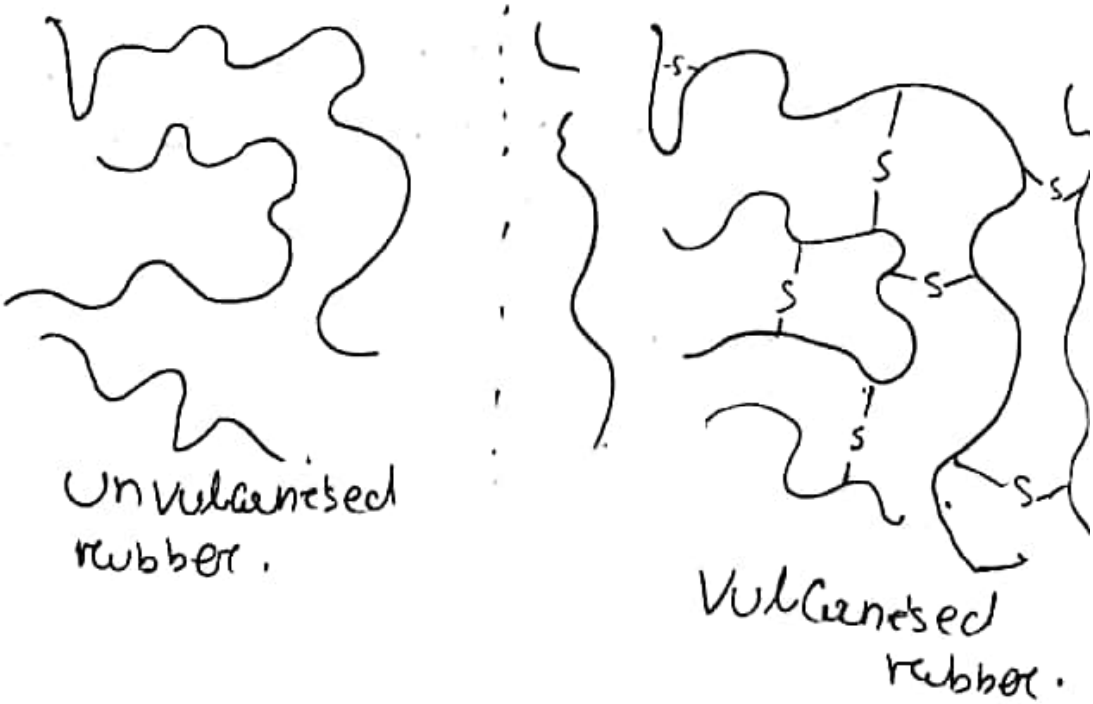
$$\left[CH_2-\underset{\displaystyle CH_3}{\overset{|}{C}}-CH_2-\underset{\displaystyle CH_3}{\overset{|}{C}}=CH-CH_2\right]_n$$

Butyl rubber

The Vulcanisation rubber has.



Vulcanised rubbere has excellent ~~elasticity~~ elasticity, resistance to oxidation and organic solvent & low curtere absorption tendencus.



Unvulcanised rubber.

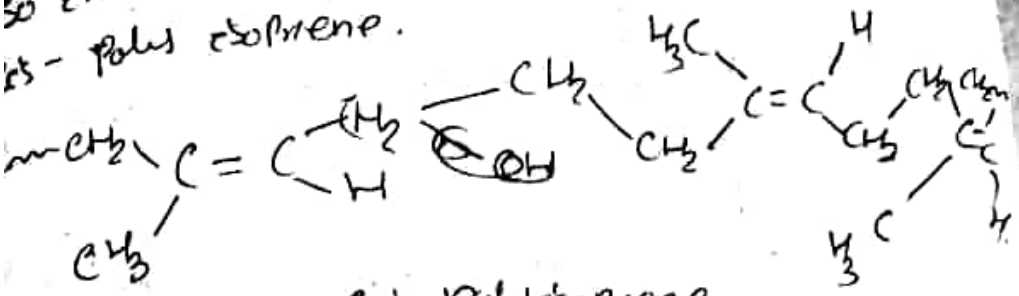
Vulcanised rubber.

Synthetic rubber :-

Synthetic rubbere is a general name used fore synthetic polymeric materials having rubbere-like properties

The

so in other words natural rubber is cis - poly isoprene.



cis - Polyisoprene.
(natural rubber)

Vulcanized rubber :-

Raw rubber obtained from rubber tree is a gummy material which has poor elasticity. It becomes soft and sticky on heating. The elasticity, tensile strength and resistance to abrasion can be increased by a process called Vulcanisation.

It consist of heating rubber with 3-5% sulphur. when sulphur react with the Polymer molecules forming a cross linked Polymer.

The double bond on the rubber molecule act as reactive sites. On Vulcanisation, sulphur from crosslink at those reactive sites.

The vulc

Natural & synthetic rubbers :-

During the last 5-6 decades, the demand for rubbers has increased tremendously. Therefore apart from natural rubbers a number of synthetic varieties of rubbers have also been developed.

Natural rubbers :-

It is the natural Polymers which is obtained from latex. Latex is a milk fluid which exudes from the rubber tree when an incision is made in the bark of the rubber trees found in tropical and semi tropical countries sutch as, India, Malaysia, Srilanka etc.

Structure :-

Chemically natural rubber is a 1,4-addition Polymer of isoprene.

It is obtained by the polymerisation of tetra fluoro ethylene in presence of acetyl peroxide.

$$n\,CF_2=CF_2 \xrightarrow{\text{acetyl peroxide}} \left(CF_2-CF_2\right)_n$$

tetra fluoro ethylene — PTFE

Characteristics :

i) It is inert substance and is resistant to heat.

ii) It is used as non-sticking coating on cooking utensils and also an insulator for making gaskets and valves

Poly Vinyl Chloride :

It is obtained by the polymerisation of vinyl chloride.

$$n\,CH_2=CH(Cl) \xrightarrow{\text{Peroxide}} \left(CH_2-CH(Cl)\right)_n$$

vinyl chloride — PVC

Characteristics : i) It is hard & horny materials and can be moulded easily.

Engg. chemistry

2nd semester.

F.M- 80

Duration-3hrs

(Q)(i) Do as directed (1×10 = 10)

(a) The nucleus of an atom contains — & — .

(b) Reducing agents ____ electrons.

(c) L-shell has ___ subshell.

(d) Neutron was discovered by ____ .

(e) Chemical name of permulti is ____ .

(f) Units of molarity are ____ .

(g) Cations are ____ charged ions.

(h) The functional gr. of ketone is ____ .

(i) Isotope have same no. of proton (T/F).

(j) A solution of three ~~month~~ component is binary sol(n)

3) (a) What are the composition of duralumin?
writes two uses of duralumin. [2]

4) Attempt ~~eight~~ nine question (9 × 5 = 45)

(i) What are the limitation of ~~Arrhenius~~ Lewis Bronsted-Lowery theory?

(ii) Differentiate between orbit & orbital.

(iii) Where are electrolytes & non-electrolytes? Explain with suitable example.

(iv) Define chemical bond. What is the cause of chemical combination?

(v) ~~What are the~~

(v) Explain Faraday 1st law of electrolysis?

(vi) Difference bet^n temporary & Permanent hardness of water.

(vii) Explain ~~and~~ Calcination & Roasting.

(viii) Calculate the % composition of various elements in $C_2H_2O_4$. [Atomic mass of C = 12 H = 1 O = 16]

(IX) What do you mean by pH of a Solution? Explain with suitable examples.

(X) Explain ~~caustic~~ water line Corrosion with suitable examples?

Attempt any ~~four~~ two question

5a) Name & explain quantum numbers. 15

(b) Explain the Process of electro plating. 15.

(6) (a) Explain molarity, normality, molality. 15.

(b) Write short notes on Aufbau Principle and hunds rule. 15.

(7) (a) Differentiate between alkane, alkene & alkyne with suitable examples. 15.

(b) Define Covalent bond. ~~Explain~~ Draw the Orbital diagramme of NH_3, CH_4, NaCl ~~etc~~. 15.

End of Lect. Notes