S-Block

Alkali Metals

$\boxed{ns^1}$

H

$Li \rightarrow [He]2s^1$

$Na \rightarrow [Ne]3s^1$

$K \rightarrow [Ar]4s^1$

$Rb \rightarrow [Kr]5s^1$

$Cs \rightarrow [Xe]6s^1$

$Fr \rightarrow [Rn]7s^1$

~~Physical Properties~~

- * Occurs in the form of comp.
- * Highly reactive
- * One e^- in outermost shell (Na & K store in kerosene)

General Characteristics

① Electronic Configuration

$Li \rightarrow [He]2s^1$

② Atomic Size

largest size

* Down the grp, size ↑es

Reason :- Due to dec. in Z_{eff}

③ Ionisation Energy

lowest I.E

* I.E ↓es down the grp.

* $I.E_1 \Rightarrow$ low value

$I.E_2 \Rightarrow$ very high

$I.E_2 > I.E_1$

Physical Properties

① M.P & B.P

(soft metals)

* weak interatomic bonds are due to their large atomic radii & presence of only one $v\,e^-$.

* Dec. order

$Li > Na > K > Rb > Cs$

Reason :-

$$\text{Atomic size} \propto \frac{1}{\text{strength of M.B}} \propto \text{softness} \propto \frac{1}{\text{M.P \& B.P}}$$

② Metallic & electropositive character

* ↑es down the grp.

Reason I.E ↓es

* Cs is the most metallic

③ Photoelectric effect

due to low I.E

④ Lattice Energy

$$L.E \propto \frac{|q|}{r^2}$$

eg :- (i) ~~[illegible]~~ $LiCl > NaCl > KCl > RbCl > CsCl$

(ii) $NaCl$, Mg_2SO_4 $Al_2(SO_4)_3$

⑤ Hydration Energy

$$H.E \propto \frac{|q|}{r^2}$$

~~Chemical Properties~~

⑥ Flame test

Alkali metals & their salts give characteristic colour to bunsen flame. flame is due to the excitation of outermost e^- which rebounds to it ground state emits energy ~~as visible~~ whose λ in visible region.

Li → Crimson red Rb → Red violet

Na → Golden yellow Cs → Blue

K → violet Reason :- They have largest size & lowest I.E ∴ energy bunsen flame easily excites valence e^- to higher energy level. when these excited e^- return to their ground state, they emit energy which fall in visible region hence they appear coloured

Chemical Properties

show high chemical reactivity

Reason :- * low I.E

* low enthalpy of atomisation

① Oxidation st :-

+1 in their ~~[illegible]~~ combine form

& 0 in native form

② Reactivity towards Air

formation of oxides, peroxides, super oxide

O^{2-} O_2^{2-} O_2^-

$Li + O_2 \rightarrow Li_2O$

$Na + O_2 \rightarrow Na_2O_2$

$K + O_2 \rightarrow KO_2$

↳ Down the grp, the ~~tendency~~ stability of peroxide & superoxide ↑es

Reason:- The increasing stability of peroxide & superoxide, as the size of the metal ion ↑es is due to the stabilisation of large anions by larger cations through L.E effects.

Note:- These oxides are easily hydrolysed by water to form their corresponding hydroxide.

$M_2O + H_2O \longrightarrow 2M(OH)$

$M_2O_2 + 2H_2O \rightarrow 2M(OH) + \underline{H_2O_2}$

$2MO_2 + 2H_2O \rightarrow 2M(OH) + \underline{H_2O_2} + \underline{O_2}$

③ Reactivity towards H_2O :-

Alkali metals react vigorously with water forming hydroxides with liberation of H_2.

$2M + 2H_2O \longrightarrow MOH + H_2$

Reactivity ↑es down the grp.

Basic strength order

CsOH > RbOH > KOH > NaOH > LiOH

- Note:- They also react with proton donor such as alcohol, ~~amm~~ gaseous ammonia & terminal alkynes.

④ Reactivity towards H_2

(Hydrides)

	Stability	Ionic	Red. Character
LiH NaH KH RbH CsH	↓es	↑es	↑es

Note:- All metal hydrides are ionic sol. with high M.P

⑤ Reactivity towards Halogens

MX

* Reactivity of alkali metals with halogens to form halides ↑es on moving down the grp. due to ↑es in electropositive nature.

$\underbrace{LiCl}_{\text{covalent}} < NaCl < KCl < RbCl < CsCl$

* Reactivity of halogens with alkali metals to form halides ↓es on moving down the grp. due to ↓es in electronegative nature of halide

$LiF > LiCl > LiBr > \underbrace{LiI}_{\text{covalent}}$

⑥ Reducing power :-

They ~~are~~ have strong reducing power lithium being the most. because it's hydration energy is high which accounts for its high -ve E° value.

⑦ Solⁿ in liq. NH_3

$M + (x+y)NH_3 \rightarrow [M(NH_3)_x]^+ + [e(NH_3)_y]^-$

- The alkali metals dissolve in liq. NH_3 giving deep blue solⁿ which are conducting in nature.

~~* When white light falls on~~

* The blue colour of solⁿ is due to ammoniated e^- which absorbs energy in visible region & thus imparts blue colour to the solⁿ.
* The solⁿ are paramagnetic in nature due to presence of large no. of unpaired ammoniated e^-s.
* conducting in nature due to presence of ammoniated cations & e^-s.
* In conc. solⁿ,

$M^+_{(am)} + e^- + NH_3 \rightarrow MNH_{2(am)} + \frac{1}{2}H_2 \uparrow$

& on standing slowly liberate H_2 with amide

Anomalous Properties of Li

Because of
(i) exceptionally small size
(ii) High Polarising power
(iii) High I.E
~~Absence of vacant~~

* Diff. b/w Li & other alkali metals

(i) Li is much harder, its M.P & B.P is higher than other alkali metals.

(ii) Li is the strongest reducing agent

(iii) Li reacts with air to form mono oxide & nitride unlike other alkali metals

$Li + O_2 \longrightarrow Li_2O$

$Li + N_2 \longrightarrow Li_3N$

$(Li_3N + H_2O \rightarrow LiOH + NH_3)$

(iv) LiCl is deliquescent & crystallises as a hydrate $LiCl.2H_2O$ whereas other alkali metal chlorides do not form hydrates.

(v) $LiHCO_3$ is not obtained in solid form whereas other ~~$MHCO_3$~~ elements form solid $MHCO_3$.

(vi) $LiNO_3$ gives Li_2O on ~~un~~ heated but other nitrates gives nitrites as

$LiNO_3 \longrightarrow Li_2O + NO_2 + O_2$

$NaNO_3 \longrightarrow NaNO_2 + O_2$

$KNO_3 \longrightarrow KNO_2 + O_2$

(vii) LiF & Li_2O comparatively less soluble in water than the other corresponding alkali metals.

* Points of similarities b/w Li & Mg

It arises due to their similar size.

(i) Both Li & Mg are harder & lighter.

(ii) LiOH & $Mg(OH)_2$ are weaker base & decompose on heating

(iii) Both only forms mono oxides & nitrides as

$Li + O_2 \longrightarrow Li_2O$, $Mg + O_2 \longrightarrow MgO$

$Li + N_2 \longrightarrow Li_3N$, $Mg + N_3 \longrightarrow Mg_3N_2$

(iv) $MgCl_2$ & LiCl are deliquescent & crystallises as a hydrate $MgCl_2.8H_2O$

(v) solid $LiHCO_3$ & $Mg(HCO_3)_2$ is not formed.

Chemical Properties

⑧ Carbonates

M_2CO_3

order of stability

$Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$

Li_2CO_3 is unstable towards heat as

$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$

while others are stable

⑨ Nitrates

MNO_3

stability order

$LiNO_3 < NaNO_3 < KNO_3 < RbNO_3 < CsNO_3$

$LiNO_3$ on heating,

$LiNO_3 \longrightarrow Li_2O + NO_2 + O_2$

& other nitrates as

$MNO_3 \xrightarrow{\Delta} MNO_2 + O_2$

⑩ Sulphates

M_2SO_4

stability order

$Li_2SO_4 < Na_2SO_4 < K_2SO_4 < Rb_2SO_4 < Cs_2SO_4$

$\longrightarrow$ ionic character inc

* Li_2SO_4 least soluble in water due to more covalent character.

⑪ Comps. of alkali metals

① Sodium

Prep: Dow's Process

By electrolysis of fused $NaCl + CaCl_2 + NaF$

At anode $2Cl^- \longrightarrow Cl_2 + 2e^-$

At cathode $Na^+ + e \longrightarrow Na(s)$

Note

- * ($CaCl_2 + NaF$) is used to lower M.P (800°C) of NaCl to about 600°.
- * Aq. NaCl cannot be used because H_2 will be liberated at cathode.

Properties

- * Crystalline soft metal
- * Highly reactive, so kept in kerosene
- * Na dissolves in liq. NH_3 to give blue solⁿ.

② Sodium Chloride (NaCl)

Prep.ⁿ

By evaporation of sea water

Properties

(i) white crystalline solid

(ii) M.P = 1081 K

(iii) soluble in H_2O

(iv) Hygroscopic in water (tendency to absorb moisture from the air)

(v) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

③ Sodium Hydroxide (NaOH)

By Electrolysis

1) **Nelson Cell of Diaphragm Cell** (Cathode → Perforated steel)

At anode

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

At cathode

$$Na + e^- \rightarrow Na$$

$$NaCl + H_2O \rightarrow NaOH + H_2 + Cl_2$$

2) **Castner-Kellner Cell** (Hg-cathode process)

At anode

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

At cathode

$$Na^+ + e^- \rightarrow Na$$

$$Na + Hg \rightarrow Na.Hg$$

$$Na.Hg + H_2O \rightarrow NaOH + Hg + H_2\uparrow$$

Properties

(i) It is deliquescent white crystalline solid.

(ii) It absorbs CO_2 from air forming Na_2CO_3.

(iii) strong base

$$NaOH \xrightarrow{SiO_2} Na_2SiO_3 + H_2O$$

$$NaOH \xrightarrow{Al_2O_3} NaAlO_2 + H_2O$$

(iv) **Reaⁿ with non-metals**

no reaⁿ with H_2, N_2 & C

$$NaOH \xrightarrow{B} Na_3BO_3 \text{ (sodium borate)}$$

$$NaOH \xrightarrow{Si} Na_2SiO_3 \text{ (sodium silicate)}$$

$$NaOH \xrightarrow{P_4} NaH_2PO_2 + PH_3 \text{ (sodium hydro phosphate)}$$

(v) **Reaⁿ with halogens**

$$X_2 \xrightarrow{NaOH \text{ (cold/dil)}} NaX + NaOX \text{ (sodium hypohalite)}$$

$$X_2 \xrightarrow{NaOH \text{ (hot/conc.)}} NaX + NaOX_3 \text{ (sodium halate)}$$

$\{X_2 = Cl_2, Br_2, I_2\}$

(vi) **Reaⁿ with Metal**

$$\xrightarrow{\text{Alkali metal}} \text{No reaⁿ}$$

$$2Al + 2H_2O \rightarrow NaAlO_2 + H_2 \text{ (sodium meta aluminate)}$$

$$\xrightarrow{Be} Na_2BeO_2 + H_2 \text{ (sodium Beryllate)}$$

$$\xrightarrow{Zn} Na_2ZnO_2 + H_2 \text{ (sodium zincate)}$$

$$\xrightarrow{Sn} Na_2SnO_2 + H_2 \text{ (sodium stannite)}$$

$$\xrightarrow{Pb} Na_2PbO_2 + H_2 \text{ (sodium plumbite)}$$

(vii) **Reaⁿ with $ZnCl_2$ or $ZnSO_4$**

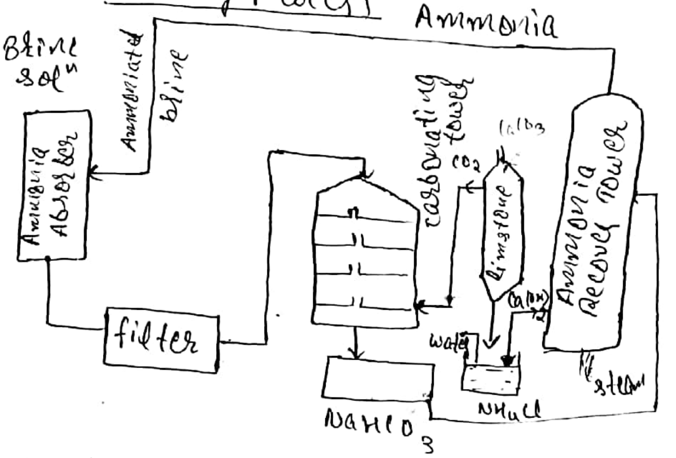
$$ZnCl_2 + NaOH \rightarrow Zn(OH)_2\downarrow + NaCl$$

$$Zn(OH)_2 + NaOH \rightarrow Na_2[Zn(OH)_4]$$

soluble complex

sodium bicarbonate OR 'baking soda' ($NaHCO_3$)

Solvay process



~~$NaCl + H_2O + NH_3 + CO_2$~~

$NH_3 + H_2O + CO_2 \rightarrow NH_4HCO_3$

$NH_4HCO_3 + NaCl \rightarrow NH_4Cl + NaHCO_3$

$NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + NH_3 + H_2O$ (By-product)

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

$CaO + H_2O \rightarrow Ca(OH)_2$

Properties

(i) Hydrolysis

$NaHCO_3 + H_2O \rightleftharpoons NaOH + H_2CO_3$

(ii) Effect of heat :-
(T > 100°C)

$2NaHCO_3 \xrightarrow{\Delta} \underbrace{Na_2CO_3}_{\text{basic in nature}} + H_2O + CO_2 \uparrow$

* some tartaric acid is used to neutralise Na_2CO_3, otherwise bitter in taste

(iii) Reaⁿ with acids

$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

(iv) Reaⁿ with base

$NaHCO_3 + NaOH \rightarrow Na_2CO_3 + H_2O$

⑤ Sodium Carbonate OR Washing soda ($Na_2CO_3.10H_2O$)

$NH_3 + H_2O + CO_2 \rightarrow NH_4HCO_3$

$NH_4HCO_3 + NaCl \rightarrow NaHCO_3 + NH_4Cl$

$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2$

$Na_2CO_3 + H_2O \rightarrow Na_2CO_3.10H_2O$

Properties :-

(i) white crystalline solid
(ii) soluble in H_2O
(iii) On heating

$Na_2CO_3.10H_2O \xrightarrow{\Delta} Na_2CO_3.H_2O + 9H_2O$

$Na_2CO_3.H_2O \xrightarrow{\Delta} \underset{\text{soda ash}}{Na_2CO_3} + H_2O$

~~(iv) Reaⁿ with~~

Alkaline Earth Metals

Be → $[He]2s^2$
Mg → $[Ne]3s^2$
Ca → $[Ar]4s^2$
Sr → $[Kr]5s^2$
Ba → $[Xn]6s^2$
Ra → $[Rn]7s^2$
{ Radioactive

~~Ch.~~ General characteristics

① Electronic Configuration

② Atomic & Ionic Radii

* Grp 1 > Grp II

Reason :- Due to ↑es in Z_{eff} across the period

* Be < Mg < Ca < Sr < Ba (size)

Reason :- Down the grp, Z_{eff} ↓es

③ Ionisation Energy :-

$$I.E \propto \frac{1}{At.\ size}$$

* $I.E_1$ (Grp I) < $I.E_1$ (Grp II)

Reason :- Due to fully filled E.C

* $I.E_2$ (Grp I) >> $I.E_2$ (Grp I)

Reason :- Group 1 acquires the noble gas configuration.

Physical Properties

exceptional

① M.P

Be > Ca > Sr > Ba > Mg

B.P

Be > Ba > Ca > Sr > Mg

② Metallic & Electropositive character

$$\text{Metallic character} \propto \frac{1}{I.E}$$

③ Lattice Energy

④ Hydration Energy

$Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

* $MgCl_2$ & $CaCl_2$ exist as $MgCl_2.6H_2O$ & $CaCl_2.6H_2O$ while NaCl & KCl do not form such hydrates.

⑤ Flame test

* Be & Mg atom, due to high I.E & small size, do not able to give colour to flame.

& other element give flame test.

Ca → Brick red
Sr → Crimson red
Ba → Apple green

⑥ Softness

These metals are slightly harder than IA group because of

(i) smaller atomic size

(ii) stronger metallic bond due to presence of two ve^-s.

(iii) Be is the hardest metal in s-block.

Chemical Properties

* Chemical reactivity ↑es down the grp.

Reason :- Due to ↓es in I.E

① Reaction with air

formation of oxide type 'MO'

CaO SrO BaO

* Be & Mg are inert to oxygen

Reason :- Due to formation of oxide film on their surface.

$$\left\{\begin{matrix} Be + N_2 \xrightarrow{\Delta} Be_3N_2 \\ Mg + N_2 \longrightarrow Mg_3N_2 \end{matrix}\right\}$$

Note

* Reactivity of O_2 ↑es as we go down the grp because of ↑es in electropositive character as a result of ↓es in I.E

* Ca, Ba & Sr are stored in paraffin but Be & Mg are not because they form protective layer on their surface.

* Basic character of MO ↑es down the grp.

Reason :- electropositive character ↑es

$$\underbrace{BeO}_{\text{Amphoteric}} \quad \underbrace{MgO}_{\text{weakly basic}} \quad \underbrace{CaO \quad SrO \quad BaO}_{\text{strong basic}}$$

- $CaO + H_2O \rightarrow Ca(OH)_2$ water soluble base

② Reactivity towards H_2O

* On moving down the grp., reactivity ↑es toward H_2O

$Be + \underset{\text{cold}}{H_2O} \longrightarrow$ not rean.

Mg → react with boiled water & steam as

$$Mg + \underset{\text{(boiled)}}{H_2O} \longrightarrow Mg(OH)_2 + H_2$$

$$Mg + \underset{\text{steam}}{H_2O} \longrightarrow MgO + H_2O$$

* Ca, Sr & Ba even reacts with cold water to form hydroxide as

$$Ca + \underset{\text{(Cold)}}{H_2O} \rightarrow Ca(OH)_2 + H_2$$

Basic strength

* $Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$

Reason

Basic strength ↑es down the grp.

∵ → B.L ↑es

→ B.E ↓es

→ tendency to release OH^- ↑es

→ Hence basic strength ↑es

③ formation of Peroxide

On moving down the grp., the tendency to form peroxide ↑es.

④ Reactivity towards Hydrogen (formation of hydrides)

$$M + H_2 \longrightarrow MH_2$$

$M = \{Mg, Ca, Sr, Ba\}$

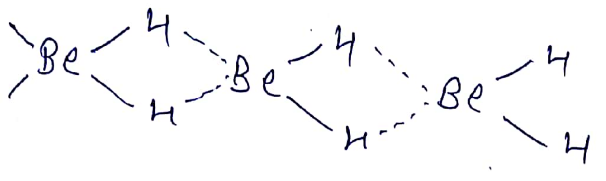
ionic in nature

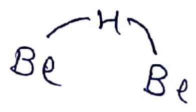
* Except Be, all the elements combine with H_2 to form hydrides MH_2

Formation of BeH_2

$BeCl_2 + LiAlH_4 \rightarrow 2BeH_2 + LiCl + AlCl_3$

* BeH_2 is polymeric in nature due to formation of 3 centered-$2e^-$ bond i.e banana bond.





Note :- CaH_2 is known as hydrolith.

⑤ Reactivity towards Acid

$M + HX \longrightarrow MX_2 + H_2 \uparrow$

$MO + HX \longrightarrow MX_2 + H_2O$

$M(OH)_2 + HX \longrightarrow MX_2 + 2H_2O$

$MCO_3 + HX \longrightarrow MX_2 + H_2O + CO_2$

$BeCl_2$	$MgCl_2$	$CaCl_2$	$SrCl_2$	$BaCl_2$
Covalent	ionic			

Be → amphoteric

⑥ Reactivity towards halogens

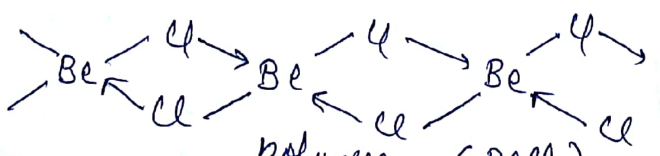
$BeCl_2$ $MgCl_2$ $CaCl_2$ $SrCl_2$ $BaCl_2$

* $BeCl_2$:- In solid phase

* polymeric straight chain

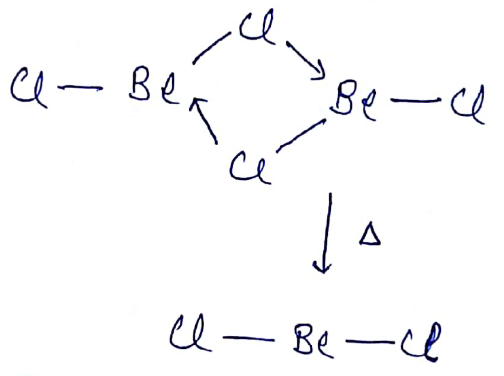
* Be is bonded to 4 chlorine,

2 by covalent bond & 2 by co-ordinate bond.



polymer $(BeCl_2)_n$

* $BeCl_2$:- In gaseous phase exist as dimer $(BeCl_2)_2$



⑦ Carbonates

$M(OH)_2 + CO_2 \longrightarrow MCO_3 + H_2O$

$BeCO_3$ $MgCO_3$ $CaCO_3$ $SrCO_3$ $BaCO_3$

$\longrightarrow$

Thermal stability ↑es

$\longrightarrow$

solubility ↓es due to ↓es in hydration energy

* $BeCO_3$ is unstable towards heat.

$BeCO_3 \xrightarrow{\Delta} BeO + CO_2$

⑧ Nitrates

$M(NO_3)_2$

* $Be(NO_3)_2$ $Mg(NO_3)_2$ $Ca(NO_3)_2$ $Sr(NO_3)_2$ $Ba(NO_3)_2$

$\longrightarrow$

Thermal stability ↑es

* All alkaline earth metals nitrates on heating gives oxides & $NO_2 + O_2$ as

$M(NO_3)_2 \xrightarrow{\Delta} MO + NO_2 + O_2$

eg :- $Ca(NO_3)_2 \xrightarrow{\Delta} CaO + NO_2 + O_2$

⑨ Sulphates

$BeSO_4$ $MgSO_4$ $CaSO_4$ $SrSO_4$ $BaSO_4$

$\xrightarrow{\hspace{6cm}}$

thermal stability ↑es

$\xrightarrow{\hspace{6cm}}$

solubility ↓es

$\xrightarrow{\hspace{6cm}}$

ionic character ↑es

⑩ Solution in liq. NH_3

Only Ca, Sr & Ba gives blue solⁿ of ammoniated e^-s.

$$M + (x+y)NH_3 \longrightarrow \underset{\text{Ammoniated cation}}{[M(NH_3)_x]^{2+}} + \underset{\substack{\text{ammoniated } e^-s \\ \text{(blue colour)}}}{2[e^{\ominus}(NH_3)_2]^{\ominus}}$$

* Be & Mg do not ~~give~~ react with NH_3.

(#) Anamolous behaviour of Be

(#) Diagonal Relationship between Be & Mg

(i) Al & Be forms covalent comps.

(ii) The hydroxide & oxides of Be & Al are amphoteric in nature

(iii) Like Al, Be is not readily attacked by acids because of the presence of an oxide film

(iv) BeH_2 is a electron deficient & exist as polymeric form with multicentre bonding. just like ~~aluminium~~ aluminium hydride.

Important Comps. of Ca :-

1) Calcium Oxide → CaO :-
(Quick lime)

Preparation :-

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

Properties

(i) white amorphous solid

(ii) It has a tendency to absorb water

$$CaO + H_2O \longrightarrow \underset{\text{slaked lime}}{Ca(OH)_2} + \text{heat}$$

$$CaO + CO_2 \longrightarrow CaCO_3$$

(iii) Being a basic oxide, it combines with acidic oxides at high temp.

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

$$6CaO + P_4O_{10} \longrightarrow 2Ca_3(PO_4)_2$$

Uses :-

(i) It is the cheapest form of alkali

(ii) It is used in the manufacturing washing soda ($Na_2CO_3 \cdot 10H_2O$) & caustic soda (NaOH)

(iii) in purification of sugar

(iv) in drying gases & alcohol (as dehydrating agent)

② **Calcium hydroxide** → $Ca(OH)_2$

slaked lime

Preparation

$$CaO + H_2O \longrightarrow Ca(OH)_2 + heat$$

This is known as slaking of lime

Properties

(i) It is an amorphous powder.

(ii) Aqueous solⁿ of Calcium hydroxide is called 'lime water'. And suspension of it in water is called 'milk of lime'.

$$Ca(OH)_2 + CO_2 \longrightarrow \underset{white}{CaCO_3} + H_2O$$

:

$$CaCO_3 + \underset{excess}{CO_2} + H_2O \longrightarrow \underset{Transparent}{Ca(HCO_3)_2}$$

(iv) $$2Ca(OH)_2 + 2Cl_2 \longrightarrow CaCl_2 + Ca(OCl)_2 + 2H_2O$$

Calcium hypochlorite
(Constituent of bleaching powder)

Uses :-

(i) used as a building material

(ii) in white wash due to its disinfectant nature.

(iii) used for softening hard water

(iv) It is used to dry gases by absorbing water.

(v) It is used for preparing ammonia.

③ Calcium Carbonate
$(CaCO_3)$

Preparation

$CaCl_2 + (NH_4)_2CO_3 \longrightarrow CaCO_3 + 2NH_4Cl$

Properties

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

(ii) $CaCO_3 + H_2O + CO_2 \overset{boiling}{\rightleftharpoons} Ca(HCO_3)_2$

Uses :-

④ Calcium sulphate ($CaSO_4.2H_2O$)
(Gypsum)

Prep.

$CaSO_4.2H_2O$ is naturally occuring Calcium sulphate. It can be obtained by the action of dil H_2SO_4 on a soluble calcium salt below 60°

$CaCl_2 + \underset{dil}{H_2SO_4} \longrightarrow 2HCl + CaSO_4 \downarrow$

Prop. :-

(i) Action of heat :-

$2CaSO_4.2H_2O \xrightarrow[-3[H_2O]]{120^\circ C} (CaSO_4)_2 H_2O + 3H_2O$

$(CaSO_4)_2 H_2O \xrightarrow{200^\circ C} \underset{(Anhydride)}{2CaSO_4} + H_2O$

(ii) It forms an important fertilizer $(NH_4)_2SO_4$

$CaSO_4 + 2NH_3 + CO_2 + H_2O$
$\downarrow$
$CaCO_3 \downarrow + (NH_4)_2SO_4$.

Uses :-

⑤ Plaster of Paris
$(2CaSO_4.H_2O)$

Prep.

It obtained when gypsum is heated at 120°C.

$2(CaSO_4.2H_2O) \longrightarrow 2CaSO_4 \cdot H_2O + H_2O$

Properties

(i) It is a white powder.

(ii) When it heated at 200°C, anhydrous $CaSO_4$ is formed.