

"INORGANIC CHEMISTRY"

"Points"

metal oxides found in earth's crust + oxides & hydroxides (alkalies)

↓ LOOK: alkali earth metals - Be, Mg, Ca, Sr, Ba, Ra rarest

• ns^{1-2} alkali metals - Li, Na, K, Rb, Cs, Fr Fr²²³ has life - 21 min
 ↓ +H₂O (abundant)
 hydroxides (strongly alkaline in nature)

• Li → Be → Mg → Al (diagonal relationship)
 ↓
 due to ionic size & charge / radius ratio is similar

• Biological fluids - Na⁺, K⁺, Mg²⁺, Ca²⁺

• $[ns^2]$ (+1) → most electro + metals
 → forms M⁺ ions (cations)
 → never found in free state
 → high reactivity towards air & water: kept in kerosene oil.
 → Li - most ⊖ E^o value - reducing agent - reactⁿ with H₂O is less vigorous

least powerful reducing agent
 → Na - least ⊖ E^o value due to small size & high H-E
 → lithium halides - covalent - due to high polarizing ability of Li⁺
 (LiI - most covalent)
 → oxides & hydroxides easily hydrolysed.
 → oxides & peroxides are colorless when pure
 → superoxides are yellow / orange
 → alkali metal hydroxides - strongest base.
 → all halides are soluble
 → LiF is less soluble due to high lattice enthalpy
 → CsI " " " " " " small H-E.
 → LiCl is soluble in pyridine also.
 → salts of all oxo acids - soluble in H₂O + thermally stable
 → Li₂CO₃ is not stable to heat & LiHCO₃ do not exist as solid

• Sodium carbonate (washing soda) (Na₂CO₃ · 10H₂O)

↳ Solvay Process
 ↳ low solubility of sodium hydrogencarbonate

• NaCl → by crystallization of urine pool

→ MgCl₂ & CaCl₂ - deliquescent
 ↳ (MgCl₂ · 8H₂O)

→ solubility = 36g in 100g

• Sodium hydroxide (NaOH) → Leclanche-Kellner cell (electrolysis of NaCl)

→ Brine salt is electrolysed using Hg cathode & carbon anode
 → Na at cathode + Hg → Na-Hg amalgam
 → Cl₂ ↑ (g) at anode

"TRACED ANTS CHEMISTRY"

• K^+ → most abundant cation within cell fluid.

[n 52]

• Ca (Elixir med) Sr (crimson) Ba (Apple green) - Color

Be & Mg do not impart color.

- Oxides & hydroxides of Be - amphoteric
- complex ions - $[Be(OH)_4]^{2-}$
- silicate ions - $[Al(OH)_4]^{2-}$

• Reducing agent. • Be - less \ominus e⁻ value but large H.E. ∴ reducing nature (large \ominus e⁻ values)

• $Mg(OH)_2 + H_2O \rightarrow$ Milk of magnesia (antacid)

• BeO - amphoteric, covalent & all other MO have ionic structures. + basic.

• Be halides - covalent + soluble in organic solvents

• $BeCl_2 \rightarrow$ 3c-4e⁻; vapour phase \uparrow Cl-bridged dimer Δ monomer

• Be & Mg Δ hydrolysis

• Carbonates insoluble in H_2O & Be CO_3 - unstable & kept in CO_2 .

• CaO absorbs CO_2 & $H_2O \rightarrow$ basic + cheap

• addition of H_2O to breaks lump of lime - slaking of lime

• Quick lime slaked with soda = solid soda lime

• Aq. soln of $Ca(OH)_2$ - slaked lime \rightarrow lime water

• Suspension of slaked lime in $H_2O \rightarrow$ milk of lime.

• Calcium sulphate ($CaSO_4 \cdot \frac{1}{2} H_2O$) - hemihydrate - plaster of Paris

• Gypsum - $CaSO_4 \cdot 2H_2O$.

• $CaSO_4$ - dead burnt plaster

" INORGANIC CHEMISTRY "

" Trends: "

s block: ns¹

- alkali metals have largest size.
- Atomic & ionic radii: $Li < Na < K < Rb < Cs < Fr$.
- I.E.: $Li > Na > K > Rb > Cs > Fr$
- H.E.: $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$
max degree of hydration (LiCl · 2H₂O)
- Density: $Li < K < Na < Rb < Cs < Fr$ (except white, soft & light metals)
- MP & BP: due to weak metallic bonding (1 valence e⁻)
- Color: Li (pale violet), Na (yellow), K (violet), Rb (red violet), Cs (blue)
- Reactivity: $Li < Na < K < Rb < Cs < Fr$
- Stability of peroxides & superoxides: $Li \rightarrow Cs \uparrow$
- $\Delta_f H^\circ$ becomes less negative from F to I.
- MP & BP: $F > Cl > Br > I$ (halides) • solubility $AcCl < Br < I$
- Stability of carbonates & bicarbonates: $Li \rightarrow Cs \uparrow$

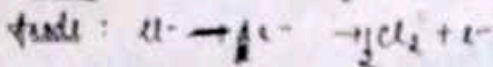
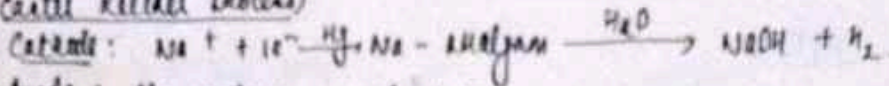
ns²

- Atomic & ionic radii: $ns^1 > ns^2$ $Be < Mg < Ca < Sr < Ba < Ra$
- I.E.: $\propto \frac{1}{r}$ at radii: $Be > Mg > Ca > Sr > Ba > Ra$
- | | |
|---|--|
| $\left. \begin{array}{l} I.E_1: ns^1 < ns^2 \\ I.E_2: ns^1 > ns^2 \end{array} \right\}$ | • thermal stability of halides ↓
hydrates ↓ |
|---|--|
- H.E.: $Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+} > Ra^{2+}$
- solubility, thermal stability, basic nature: $Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$
- Tendency to form halide hydrates: $MgCl_2 \cdot 8H_2O > CaCl_2 \cdot 6H_2O > SrCl_2 \cdot 6H_2O > BaCl_2 \cdot 2H_2O$
- Thermal stability of carbonates: (↑ with at size): $MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$
- solubility of sulphates: $CaSO_4 > SrSO_4 > BaSO_4$
- Tendency to form hydrates: $Mg > Ca > Sr > Ba$

back bonding ↑ Lewis acids ↑
 $BF_3 > BCl_3 > BBr_3 > BI_3$

• NaCl (sodium chloride) - superoxide Na_2O_2 , HgCl_2 , CaCl_2 , CaSO_4

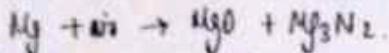
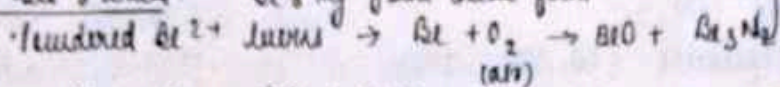
• NaOH (caustic soda / caustic alkali)



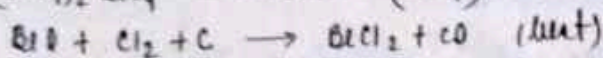
• $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow 2\text{NaHCO}_3$ (Baking soda - sodium hydrogencarbonate)

ASZ

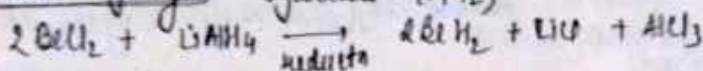
→ towards air & water: Be & Mg form oxide film: "critically" inert leaf:



→ towards halogens: forms halides $\text{M} + \text{X}_2 \rightarrow \text{MX}_2$



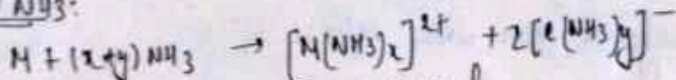
→ towards hydrogen: hydrides (MH_2)



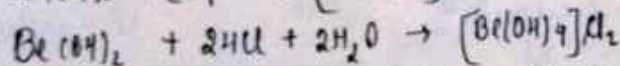
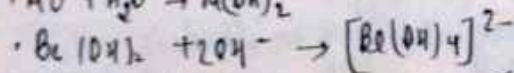
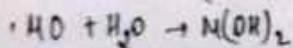
→ towards acids:



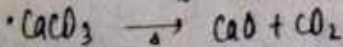
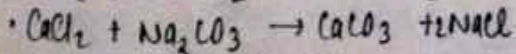
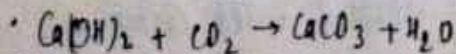
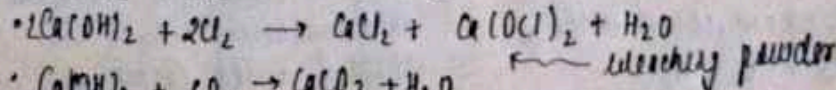
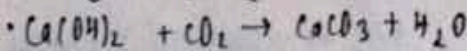
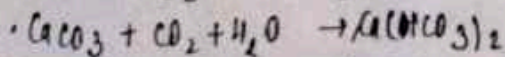
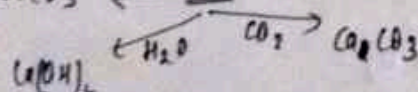
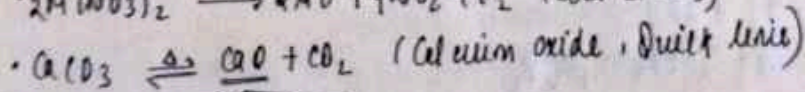
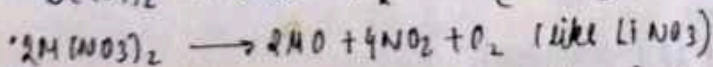
→ liquid NH₃:



anion $[\text{H}(\text{NH}_3)_6]^{2+}$ can be recovered.



amphoteric behaviour



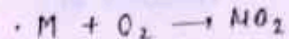
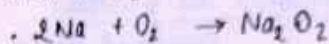
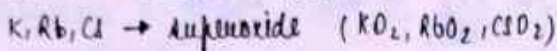
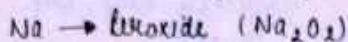
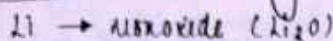
" INORGANIC CHEMISTRY "

" Reactions "

S block: [ns¹]

• highly reactive due to large size & low I.E.

→ towards O₂: tarnish in dry air → oxides + H₂O → hydroxides (moisture)



• alkali metal = +1

→ towards water: M + H₂O → MOH + H₂

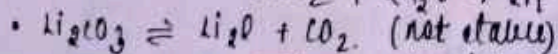
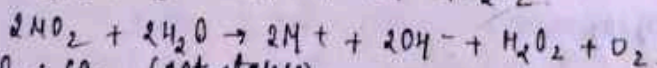
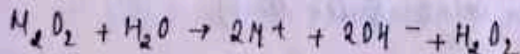
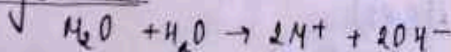
Li - least vigorously
other metals react with water vigorously & with proton donors like gases NH₃, alcohols, aldehydes etc

→ towards H₂: 2M + H₂ → 2M⁺H⁻
H⁻ with group I & II metals → ionic hydrides with high M.P.

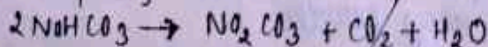
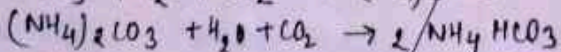
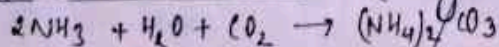
→ towards halogen: reacts vigorously to form ionic halides M⁺X⁻

→ liquid ammonia:
M + (x+y)NH₃ → [M(NH₃)_x]⁺ + [(NH₃)_y]⁻
blue color due to solvated e⁻ + paramagnetic → on standing; H₂ ↑ + amide
conc. soln → blue → brown + diamagnetic.

→ oxides → hydroxides:



• Na₂CO₃ · 10H₂O (sodium carbonate) - (Solway process)



• NH₃ is recovered when the soln containing NH₄Cl is treated with Ca(OH)₂.

