S-BLOCK ELEMENTS

ALKALI METALS

3 **Li** 6.941 — Lithium — [He]2s¹ — Li/Li⁺ — Crimson Red

11 **Na** 22.990 — Sodium — [Ne]3s¹ — Na/Na⁺ — Golden Yellow

19 **K** 39.098 — Potassium — [Ar]4s¹ — K/K⁺ — Violet

37 **Rb** 84.468 — Rubidium — [Kr]5s¹ — Rb/Rb⁺ — Red Violet

55 **Cs** 132.905 — Caesium — [Xe]6s¹ — Cs/Cs⁺ — Blue

87 **Fr** 223.020 — Francium — [Ra]7s¹

ATOMIC SIZE
Li < Na < K < Rb < Cs
$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

IONISATION ENERGY
Li > Na > K > Rb > Cs

ELECTROPOSITIVE CHARACTER / REACTIVITY
$\propto \frac{1}{IE}$
Li < Na < K < Rb < Cs

MELTING POINT
Li > Na > K > Rb > Cs

BOILING POINT
Li > Na > K > Rb > Cs

HYDRATION ENERGY
$Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

COMPLEX FORMATION
In alkali metals, only Li form complex due to small size
eg: $LiCl.2H_2O$

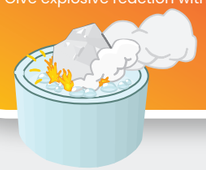
IONIC MOBILITY
$\left(\propto \frac{I}{\text{hydration}}\right)$
$Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

DENSITY
Li < Na < K < Rb < Cs

METAL HYDRIDES
$2M + H_2 \rightarrow 2MH$
LiH, NaH, KH, RbH, CsH
- **THERMAL STABILITY**
  LiH > NaH > KH > RbH > CsH
- **REDUCING CHARACTER**
  LiH < NaH < KH < RbH < CsH

REACTION WITH OXYGEN
Li forms only normal oxide Li_2O
Na forms normal oxide (Na_2O) & Peroxide (Na_2O_2)
K forms normal oxide, Peroxide & Superoxide (KO_2)
Rb forms normal oxide, Peroxide & Superoxide
Cs forms normal oxide, Peroxide & Superoxide
KO_2, RbO_2, CsO_2 (Superoxide) - Paramagnetic & coloured

REACTION WITH H_2O
Li React with water
Na, K React easily with water (fast reaction)
Rb, Cs Give explosive reaction with water



METAL HYDROXIDES
BASIC CHARACTER
LiOH < NaOH < KOH < RbOH < CsOH

REACTION WITH NITROGEN
Only Li react with N_2 gas to form Li_3N which on hydrolysis give NH_3 gas.
$6\,Li_{(s)} + N_{2(g)} \rightarrow 2Li_3N$
$Na/K/Rb/Cs + N_2 \rightarrow$ no reaction
$Li_3N + 3H_2O \rightarrow 3LiOH + NH_3$

Sodium carbonate/ washing soda
$Na_2CO_3 . 10H_2O$
Solvay Process:
Reactants- NH_3, CO_2
Regeneration of NH_3 - Using $Ca(OH)_2$
Byproduct - $CaCl_2$
we can't obtain K_2CO_3 Because $KHCO_3$ obtained in 2nd step is water soluble

Caustic Soda NaOH
(i) It is a white crystalline solid
(ii) Deliquescent in nature
(iii) Reaction with acidic oxide
$NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

Sodium bicarbonate/ Baking Soda/ $NaHCO_3$
(i) It is white crystalline solid
(ii) It is sparingly soluble in water
(iii) It is not stored with strong bases like NaOH, because it has acidic H
$NaHCO_3 + NaOH \rightarrow Na_2CO_3 + H_2O$

COMPOUNDS OF SODIUM

Anomalous behaviour of Li (Due to small size & High charge density)
- The melting point and boiling point of lithium are higher that than other alkali metals.
- The hardness of lithium is higher than other metals.
- The alkali metal chlorides do not have the capability to form hydrates but lithium chloride crystallizes to form a hydrate
- Lithium nitrate decomposes to form an oxide whereas other metals on heating give nitrites.
- Compounds of lithium are partially soluble in water whereas the alkali metals are highly soluble in water.

Diagonal relationship with Mg
- Same $\frac{\text{Charge}}{\text{Radius}}$
- Li & Mg → harder
- Li & Mg react with cold water
- Li & Mg both form nitride which on hydrolysis give NH_3 gas

$Li_3N + 3H_2O \rightarrow 3LiOH + NH_3$
$Mg_3N_2 + 6H_2O \rightarrow 3\,Mg(OH)_2 + 2NH_3$

- LiCl and $MgCl_2$ both are deliquescent in nature.

ALKALINE EARTH METALS

4 **Be** — 12 **Mg** — 20 **Ca** — 38 **Sr** — 56 **Ba** — 88 **Ra**

Ca/Ca²⁺ — Brick Red
Sr/Sr²⁺ — Crimson
Ba/Ba²⁺ — Apple Green

ATOMIC SIZE
Be < Mg < Ca < Sr < Ba

IONISATION ENERGY
Be > Mg > Ca > Sr > Ba

ELECTROPOSITIVE CHARACTER / REACTIVITY
$\left(\propto \frac{1}{IE}\right)$
Be < Mg < Ca < Sr < Ba

MELTING POINT
Be > Ca > Sr > Ba > Mg

BOILING POINT
Be > Ba > Ca > Sr > Mg

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

COMPLEX FORMATION
Be, Mg & Ca form complexes
- $BeCl_2 + 2H_2O \rightarrow BeCl_2.2H_2O$
- $BeF_2 + 2F^- \rightarrow BeF_4^{2-}$ (max. C.N = 4)
- Ca+EDTA → $[Ca(EDTA)]^{2-}$ (C.N = 6)

IONIC MOBILITY
$\propto \frac{I}{\text{hydration}}$
$Be^{2+} < Mg^{2+} < Ca^{2+} < Sr^{2+} < Ba^{2+}$

DENSITY
Ca < Mg < Be < Sr < Ba

METAL HYDRIDES
MgH_2, CaH_2, SrH_2, BaH_2
- **THERMAL STABILITY**
  $BeH_2 > MgH_2 > CaH_2 > SrH_2 > BaH_2$
- **REDUCING CHARACTER**
  $BeH_2 < MgH_2 < CaH_2 < SrH_2 < BaH_2$

REACTION WITH OXYGEN
1) Be, Mg → Normal oxide BeO & MgO
2) Ca, Sr, Ba → Normal oxide & Peroxide. Peroxide is diamagnetic, but shows colour due to Lattice defect

REACTION WITH H_2O
1) Be → Steam
2) Mg → Hot water
3) Ca, Sr, Ba → React with cold water

METAL HYDROXIDES
BASIC CHARACTER
$Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$

REACTION WITH NITROGEN
All elements react with nitrogen to form nitrides of type M_3N_2
$Mg_3N_2 + H_2O \rightarrow Mg(OH)_2 + 2NH_3$

Calcium oxide/ Quick lime/ CaO
1) $CaO + H_2O \rightarrow Ca(OH)_2$
Quick lime — Slaked lime

Uses
Used as basic flux
$CaO + SiO_2 \rightarrow CaSiO_3$
basic flux — acidic impurity — slag

Slaked lime/$Ca(OH)_2$
1) Used in white wash
2) In manufacturing of bleaching powder, glass etc
$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$
Bleaching powder
3) In removing temporary hardness of water

$CaSO_4.2H_2O$
Gypsum
↓
$CaSO_4.1/2H_2O$
Plaster of Paris
↓
$CaSO_4$
Dead burnt plaster

COMPOUNDS OF CALCIUM

Anomalous behaviour of Be (Due to small size & High charge density)
1) The coordinate number of Be is not more than 4 where as other alkali metals have coordination number of 6
2) The M.P and B.P are higher when compared to the other elements of the group
3) They forms covalent bonds whereas the other members of the group forms ionic bonds
4) Be does not react with H_2O like the other companions of the group

Diagonal relationship with Al
- Same $\frac{\text{Charge}}{\text{Radius}}$
- Be & Al are not attacked easily by acids[HNO_3] forms protective layer
- $BeCl_2$ & $AlCl_3 \rightarrow$ Lewis acid and form dimer
- $BeCl_2$ in vapour as dimer and solid as polymer
- BeO, $Be(OH)_2$, Al_2O_3, $Al(OH)_3 \rightarrow$ Amphoteric
- Both form complexes - $[BeF_4]^{2-}$-sp^3 $[Al(H_2o)_6]^{3+}$-sp^3d^2

PHYSICS WALLAH