S - Block element

Introduction :-

- The S-block element constitute a group of element in which differentiating electron enters into outermost 'S' orbital.

- S-orbital can accommodate one or two electrons.

- There are two group IA & II A in S-block.

- Group I A is called alkali metals & Group II A is called alkaline earth metals.

Group I A

$_{3}Li$ $1s^2 2s^1$

11 Na $1s^2 2s^2 2p^6 3s^1$

19 K $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

37 Rb $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2_{3d^{10}} 4p^6 5s^1$

55 Cs $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2_{3d^{10}} 4p^6 5s^2 5p^6 6s^1$

87 Fr

Group II A

Be

Mg

Ca

Sr

Ba

Ra

- general electronic configuration of alkali metal is ns^1 while alkaline earth metal is ns^2.
- Last electron enters in the outermost s-orbital & hence they belongs to s-block of periodic table.
- Due to similar outer electronic configuration these elements resemble closely in their physical & chemical properties.

General properties of S-block

1] Flame colouration :-

Due to their low ionisation energy electron easily excited to higher energy state by absorbing heat energy from non luminous flame. At excited state $\bar{e}$ is unstable & fall back to ground state emitting energy in the visible region.

In oxidising flame metal shows colour

metal	Li	Na	K	Rb	Cs
colour	Crimson	yellow	violet	Red violet	Blue

S-Block element

* General characteristics of S-block element :⇒

- In Group IA of the periodic table contains six elements (except Hydrogen) which are Li, Na, K, Rb, Cs and Fr.
- These elements are collectively called as alkali metals since they form strongly alkaline oxide and hydroxide.
  Fr is radioactive element.
- In Group II A of the periodic table contain six elements which are Be, Mg, Ca, Sr, Ba, Ra. These element are called as alkaline earth metals.

General properties :→ Characteristics

1] Metallic properties :-

The 'S'-block element have typical metallic properties. They show good metallic luster and electrical as well as thermal conductivity.
All element of S-block have highly electropositive. Ex:- Cs

2] Ionisation potential :→

It is decrease as down the group & increases as we move from left to right in periodic table.

3] Electron affinity :-

on moving down a group the increase atomic size, tends to decrease the electron affinity values.

4] Melting point & Boiling point :-

The melting & boiling point do not show regular trends. However, these are higher than those of alkali metals. The M.P. decrease as atomic size increase down the group.
∴ weak metalic bonding & soft in nature.

5] Electropositive (Metalic) character :-

on moving down the group increases the electropositive character.

$$M \longrightarrow M^{+2} + 2e^{\ominus}$$

6] Hydration of Ions :-

The extent of hydration of these ion decreases with increase in atomic number & molar mass.

7] Density :-

Group IA - The density increase from Li — Cs on moving down a group.
Group II A - Density slightly decreases on moving down the group upto Ca but increase considerably up to Ra.
∴ Density of K is less than Na. i.e. K is lighter than Na.

8] Flame coloration :→ When energy is supplied to these elements in a flame, their electrons are excited to higher energy state, as is the case with alkali metals under similar conditions.

	Flame color
Ca -	Brick Red
Ra -	crimson
Na -	yellow
Sr -	crimson
Li -	crimson Red
K, Cs, Rb	violet

9) Atomic radii :- The largest alkali metals atoms have the largest atomic radii in their respective periods.
In alkali metals, on moving down group, a new shell is being added, so atomic size increases. Hence, atomic radii also increase from Li to Cs.
i.e. $Cs > Rb > K > Na > Li$

9) conductivity :- The alkali metals are good conductors of heat & electricity. Due to presence of loosely held valence electrons which are free to move throughout the metal structure.

10) Oxidation state :-

Group-I element shows only +1 oxid^n state. due to their first low ionisation energy. These metals lose outer most S-electron to form unipositive ion & aquire noble gas configuration. So there is no unpaired electron. So they are diamagnetic & colourless. In fact all comp. are colourless except paramagnetic.

Group II element show +2 oxidation state. ex:- Mg^{+2}, Ca^{+2}, Be^{+2}

11) Hydration (energy) of ion :->

All alkali metal salts are ionic (except Li) & soluble in water (a solvent of high dielectric constant) because cation (M^+) get hydrated by water molecules.

Hydration of ions is exothermic process. The energy is released in the hydration of ions. is known as hydration energy.

Degree of hydration depend on size of cation i.e. smaller size of cation greater is hydration energy.

∴ Hydration energy of alkali metal ions decrease from Li^+ to Cs^+.

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

Variation in properties.

1] Variation of atomic radius :-

- The alkali metals have largest atomic radii in their respective periods & those of alkaline earth are smaller than alkali metals.
- Ex:- Na (Sodium) has maximum atomic radius than Mg.
- As we move down the group atomic radii increase.

Element	Li	Be	B	C	N
Atomic radius in A°	1.23	0.90	0.85	0.77	0.70

Na	1.54 A°
K	1.03 A°
Rb	2.19 A°
Cs	2.35 A°

* Variation in Ionisation energy

Def: "Minium amount of energy required to remove the most loosely bound electron from an Isolated gaseous neutral atom to form a positive ion".

- The most loosely electron lie in the outermost shell.
- on moving down the group as atomic radius increase, the outer electron gets away from nucleous & ∴ ionisation energy decreases on moving down from Li to Cs.

Element	Li	Na	K	Rb	Cs
Ionisation energy KJ/mol	520	495	418	403	375

- In case of alkaline earth metals, two electrons from 'S'- orbital of outer level two ionisation energies are involved.

$$Be \longrightarrow Be^{+} + e^{-} \qquad E_1 = 895 \text{ KJ/mol}$$

$$Be^{+} \longrightarrow Be^{+2} + e^{-} \qquad E_2 = 1557 \text{ KJ/mol}$$

- Alkaline earth metals prefer to form +1 ion (M^{+}) rather than M^{+2} ions.
e.g. Mg^{+2}, Ca^{+2} etc.

* Reducing Nature of 'S' block element

or

or

Alkali Metals Good Reducing agents

- A substance easily impart its electron can act as good reducing agents.
- Electron donating tendency of a metal depend on its ionisation energy.
- Smaller Ionisation energy, greater is reducing power.
- ∴ alkali metals possess smaller value of I.E., they are good reducing agents.

$$Na \longrightarrow Na^{+} + e^{\ominus}$$

$$Ca \longrightarrow Ca^{+2} + 2e^{-}$$

- Some of reducing properties are give below

$$B_2O_3 + 6K \longrightarrow 2B + 3K_2O$$

$$AlCl_3 + 3Na \longrightarrow 3NaCl + Al$$

- Reducing character is related to high oxidation potential which represents tendency to release electrons & get oxidised.
- Group-I element have higher oxidation potential than group-2 elements.

* Variation of Metalic characters in period & down group in 's' block element

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- Alkali metals are highly electropositive elements
- They form ionic compounds e.g. NaCl, KCl
- Electropositive characters & metalic characters increase as we go down group 1 & 2.
- Cs is more electropositive than Li.
  Ba —"— —"— —"— —"— Mg.
- Cs is most electropositive element in periodic table.
- All S block element are soft, malleable metals
- They are good conductor of heat & electricity. They are characteristic of metalic nature
- Along a period, metallic properties decrease.

* Point of difference bet' Lithium & other alkali metals.

- Lithium possesses higher melting & boiling points.
- Lithium is much harder than other alkali metals.
- Lithium & Li^+ has smallest size (152 pm) in group. than other alkali metals.
- It has high ionisation energy & ~~Loco~~ Li does not react with O_2 below $0^\circ C$.
- Li is least reactive metals of all alkali metals.
- Li has high polarising power due to high charge density.
- Strong metallic bond in lithium due to small size.
- Lithium has greatest polarising power of Li^+ ion & form covalent bond. Thus salt of Li are covalent & soluble in non polar solvent (e.g. organic solvent). The salt of other alkali metals are insoluble in organic solvents & ionic.

- Li is only alkali metal react with nitrogen & silicon.

$$Li \xrightarrow{N_2} Li_3N$$

$$Li \xrightarrow{Si} Li_6Si_2$$

- $Li + O_2 \longrightarrow \underset{\text{oxide}}{Li_2O}$

Other alkali metal $+ O_2 \longrightarrow M_2O_2$ peroxide

Alkali metal $+ \xrightarrow{O_2} M_2O$ oxide

Alkali metal $\xrightarrow{O_2}$ Superoxide MO_2

- Li react with NH_3 to form imide Li_2NH.

- Other alkali metal react with NH_3 form amide $M.NH_2$.

- LiOH is less soluble in H_2O & much weaker base than NaOH & KOH.

Diagonal Relationship betⁿ Li and Mg.

The diagonal relationship betⁿ Li & mg is due to 2 reasons.

1] Both the element have almost same atomic & ionic radii

Li – 134 pm, Mg – 145 pm

Li^{+} – 90 pm (C.N = 6), Mg^{+2} = 86 pm (C.N. = 6)

2] Li & Mg have almost similar electronegativity

Li = 1 Mg = 1.2

II period	Li	Be		B
III period	Na	Mg	Al	Si

Digonal Relationship.

3] Like Mg metal, Lithium is hard and ductile metal.

4] LiF & MgF_2 are partially soluble in water.

5] Formation of hydrated salts :-

Li & Mg are give many hydrated salts like $LiCl \cdot 2H_2O$, $MgCl_2 \cdot 6H_2O$, $LiNO_3 \cdot H_2O$

6] LiOH & $Mg(OH)_2$ are both weak bases.

7] Action of heat :-

$$4\,LiNO_3 \xrightarrow{\Delta} 2\,Li_2O + 4NO_2 + O_2$$

oxide

$$2\,Mg(NO_3)_2 \xrightarrow{\Delta} 2MgO + 4NO_2 + O_2$$

$$LiCO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

$$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$$

oxide

8] Action of O_2 & H_2O :-

Li & Mg react with O_2 of air form normally Li_2O & MgO, both these oxides are sparingly soluble in water.

Both metal react with H_2O slowly & form hydroxide.

$$2\,Li + 2H_2O \longrightarrow 2\,LiOH + H_2\uparrow$$

$$Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2\uparrow.$$