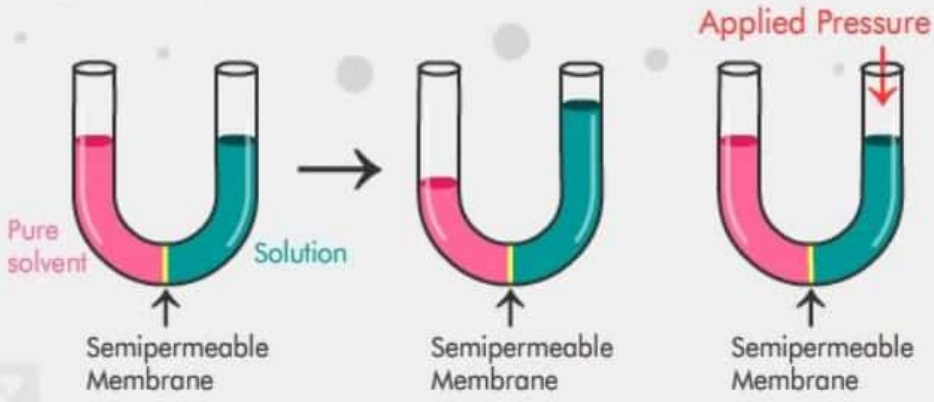
OSMOTIC PRESSURE & VAN'T HOFF FACTOR

WHAT IS? OSMOTIC PRESSURE

The minimum pressure that stops the osmosis is equal to the osmotic pressure of the solution.



$$\pi = iMRT$$

π = Osmotic pressure | i = Van't Hoff factor

M = Molar concentration of solution (mol/L)

R = Ideal gas constant (0.08206 L atm Mol^{-1} K^{1})

T = Temperature in Kelvin (K)

VAN'T HOFF' FACTOR

Colligative properties are directly proportional to the number of mole of solute, dissociation or association may cause some abnormal increase or decrease in the measured values of colligative properties. Van't Hoff factor is a factor that takes into account this abnormal behaviour and can be defined as,

$$i = \frac{\text{Observed magnitude of any colligative property}}{\text{Normal magnitude of the same colligative property}}$$

Since, colligative properties are inversely related to the molar mass of the solute, hence, one can write,

$$i = \frac{\text{Normal molar mass}}{\text{Observed molar mass (obtained from a colligative property)}}$$

Thus, the value of i depends upon the state of solute in the solution. Following cases are possible:

- When, $i = 1$ then the solute remains unaffected (i.e., normal) in solution.
- When, $i > 1$ then the solute undergo dissociation in solution.
- When, $i < 1$ then the solute undergo association in solution.

Part-I

GROUP – 1 THE ALKALI METALS

Group-1 elements are Shiny, Soft, and highly reactive metals, none of them occur as a natural free element

3 Li Lithium

11 Na Sodium

19 K Potassium

37 Rb Rubidium

55 Cs Caesium

87 Fr Francium

MELTING POINTS

All of the Group-1 Metals have one Valence Electron

The reactivity of the GROUP-1 METALS increases down the group as the outer electron gets further from the nucleus & becomes easier to remove.

The alkali metals react with water to form

METAL HYDROXIDES

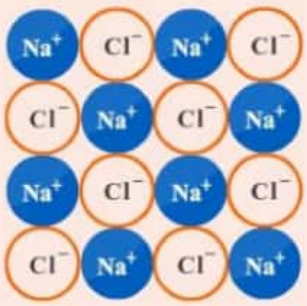
LiOH NaOH KOH RbOH CsOH

Alkali metals react with oxygen to form

METAL OXIDES

Alkali metals react with halogens to form

IONIC SALTS



PROPERTIES OF ALKALI METALS


Silver-like lustre


Low melting point


High Ductility


High malleablity


Excellent conductor of heat and electricity

Properties of Alkali Metals

Part-II

FLAME TEST COLORS

- Li^{3}
- Na^{11}
- K^{19}
- Rb^{37}
- Cs^{55}
- Fr^{87}

VERY SOFT

- Alkali metals can be easily cut with a knife
- Among all alkali metals lithium is hardest.

ELECTRONIC CONFIGURATION

ns^1

- They have one valence shell electron.
- General valence electronic configuration

USES

LITHIUM

- Anti depressants
- Batteries

SODIUM

- Street lamps
- Salt

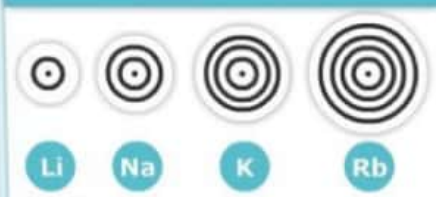
POTASSIUM

- Fertilizers

CAESIUM

- Atomic Clocks

ATOMIC SIZE



Size increases down the group due to added extra orbit.

ELECTROPOSITIVE

It is the ability to remove an electron

Cs

- Electropositivity increases down the group.
- **Caesium** has the highest electropositive character.

STORED IN KEROSENE

Alkali metals react with air easily to form oxide layer therefore they are stored in kerosene.

REACTS WITH WATER

H_2O

- They reacts violently with water and form hydroxides.
- Don't even dare to go near when **caesium** reacts with water.

REACTS WITH AMMONIA

On dissolving NH_3 forms Ammoniated cation and electron. Solution turns blue

$$M^+ + x\ NH_3 \longrightarrow [M(NH_3)_x]^+$$

$$e^- + y\ NH_3 \longrightarrow [e(NH_3)_y]^-$$

ALKALINE EARTH METALS

4	12	20	38	56	88
Be	Mg	Ca	Sr	Ba	Ra
Beryllium	Magnesium	Calcium	Strontium	Barium	Radium

ELECTRONIC CONFIGURATION

Valence Electrons = 2

FLAME COLOUR TEST

Group II Element	Flame Colour
Beryllium	Colourless
Magnesium	Colourless
Calcium	Brick red
Strontium	Crimson red
Barium	Apple green

DO YOU KNOW ?

Kidney stones generally consist of calcium oxalate. $CaC_2O_4.H_2O$ which dissolves in dilute strong acids but remains insoluble in bases.

They are commonly called alkaline earth metals because their oxides are alkaline in nature and are found in earth's crust.

REACTION WITH WATER

Be does not react even with boiling water and **Ba** react vigorously even with cold water. Thus increasing order of reactivity with water is

$$Mg < Cr < Sr < Ba$$

ATOMIC SIZE

Size increases down the group due to added extra orbit.

ELECTROPOSITIVITY

Strong electropositive elements due to large size, electropositivity increases down the group.

REACTION WITH NITROGEN

These metals react with nitrogen to form nitrides of the types M_3N_2 which are hydrolysed with water to evolve NH_3.

$$3M + N_2 \rightarrow M_3N_2$$

$$M_3N_2 + 6H_2O \rightarrow 3M(OH)_2 + 2NH_3$$

Ammonia

USES

BERYLLIUM
Corrosion resistant alloys

MAGNESIUM
Present in chlorophyll, helps in photosynthesis

CALCIUM
Hydrated $CaCl_2$ used for melting ice on roads

STRONTIUM
Glass for colour television cathode ray tubes

BARIUM
Nuclear Medicine

DIFFERENCE BETWEEN ALKALI METALS AND ALKALINE EARTH METALS

PROPERTIES	ALKALI METALS	ALKALINE EARTH METALS
Physical properties	Soft, Low melting point, Paramagnetic.	Comparatively harder. High melting point, Diamagnetic
Valency	Monovalent	Bivalent
Electropositive nature	More electropositive	Less electropositive
Hydroxides	Strong base, highly soluble and stable towards heat.	Weak base, less soluble and decomposes on heating.
Bicarbonates	These are known in solid state.	These are not known in free state. Exist only in solution
Carbonates	Soluble in water. Do not decomposes on heating ($LiCO_3$ is an exception)	Insoluble in water. Decomposes on heating.
Action of carbon	Do not directly combine with carbon	Directly combine with carbon to form carbides
Solubility of salts	Sulphates, phosphates, fluorides, chromates, oxides etc are soluble in water.	Sulphates, phosphates, fluorides, chromates, oxalates etc are insoluble in water
Reducing power	Stronger as ionization potential values are low and oxidation potential values are high	Weaker as ionization potential values are high and oxidation potential values are low.
Electronic configuration	One electron is present in the valence shell. The configuration is ns^1 (monovalent)	Two electrons are present in the valence shell. The configuration is ns^2 (bivalent)