Chemistry Study Materials for Class 11

(NCERT Based Revision Notes of Chapter- 10)

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s- block element

• Uses of Alkali Metals

Uses of Lithium

(i) Lithium is used as deoxidizer in the purification of copper and nickel.

(ii) Lithium is used to make both primary and secondary batteries.

(iii) Lithium hydride is used as source of hydrogen for meteorological purposes.

(iv) Lithium aluminium hydride ($LiAlH_4$) is a good reducing agent.

(v) Lithium carbonate is used in making glass.

Uses of Sodium

(i) Used as sodium amalgam in laboratory (synthesis of organic compounds).

(ii) Sodium is used in sodium vapour lamp.

(iii) In molten state, it is used in nuclear reactors.

(iv) An alloy of sodium-potassium is used in high temperature thermometers.

Uses of Potassium

(i) Salts of potassium are used in fertilizers.

(ii) Used as reducing agent.

Uses of Cesium

(i) In rocket propellant

(ii) In photographic cells.

• Group 2 Elements: Alkaline Earth Metals

Alkaline Earth Metals: They were named alkaline earth metals since they were alkaline in nature like alkali metals oxides and they were found in the earth's crust. Example, Be (Beryllium), Ca, Mg, Sr etc.

• Electronic Configuration

Their general electronic configuration is represented as [noble gas] ns^2.

Element	*Symbol*	*Electronic configuration*
Beryllium	Be	$ls^2 2s^2$
Magnesium	Mg	$ls^2 2s^2 2p^6 3s^2$
Calcium	Ca .	$ls^2 2s^2 2p^6 3s^2 3p^6 4s^2$
Strontium	Sr	$ls^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ $4s^2 4p^6 5s^2$
Barium	Ba	$ls^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$ $4p^6 4d^{10} 5s^2 5p^6 6s^2$ or $[Xe]6s^2$
Radium	Ra	$[Rn]7s^2$

• Atomic and Ionic Radii

Atomic and ionic radii of alkaline earth metals one comparatively smaller than alkali metals. Within the group atomic and ionic radii increases with the increase in atomic number

Reason: Because these elements have only two valence electrons and the magnitude of the force of attraction with the nucleus is quite small.

• Ionization Enthalpies

These metals also have low ionization enthalpies due to fairly large size of atoms. As the atomic sizes increase down the group ionization enthalpies are expected to decrease in the same manner.

Due to their small size in comparison to alkali metals first ionization enthalpies of alkaline earth metals is higher than that of alkali metals.

• Hydration Enthalpies

The hydration enthalpies of alkaline earth metal ions are larger than those of the alkali metals. Thus alkaline earth metals have more tendencies to become hydrate. The hydration enthalpies decrease down the group since the cationic size increases.

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

Metallic character: They have strong metallic bonds as compared to the alkali metals in the same period. This is due to the smaller kernel size of alkaline earth metal and two valence electrons present in the outermost shell.

• Physical Properties

(i) They are harder than alkali metals.

(ii) M.P and B.P are higher than the corresponding alkali metals due to their small size.

(iii) The electropositive character increases down the group.

(iv) Except Be and Mg, all these metals impart characteristic colour to the flame.

(v) The alkaline earth metals possess high thermal and electrical conductivity.

• Chemical Properties

1. Reaction with oxygen- Beryllium and magnesium are kinetically inert to oxygen because of the formation of a thin film of oxide on their surface.

Reactivity towards oxygen increases as going down the group.

2. Reaction with water- Since these metals are less electropositive than alkali metals, they are less reactive towards water.

Magnesium reacts with boiling water or steam. Rest of the members reacts even with cold water.

$Mg + 2H_20 \longrightarrow Mg(OH)_2 + H_2$

$Ca + 2H_20 \longrightarrow Ca(OH)_2 + H_2$

3. Reaction with halogens-They combine with the halogens at appropriate temperature to form corresponding halides MX_2.

$M + X_2 \longrightarrow MX_2$ (X = F, Cl, Br, I)

Thermal decomposition of $(NH_4)_2\ BeF_4$is used for the preparation of BeF_2.

4. Reaction with hydrogen- These metals except Be combine with hydrogen directly upon heating to form metal hydrides.

$$M + H_2 \xrightarrow{\text{Heat}} \underset{\text{Metal hydride}}{MH_2}$$

$$BeCl_2 + LiAlH_4 \xrightarrow{\text{Ether}} 2BeH_2 + LiCl + AlCl_3$$

• General Characteristics of Compounds of Alkaline Earth Metals

Oxides and Hydroxides

(i) The alkaline earth metals bum in oxygen to form MO (monoxide).

(ii) These oxides are very stable to heat.

(iii) BeO is amphoteric in nature while oxides of other elements are ionic.

(iv) Except BeO, they are basic in nature and react with water to form sparingly soluble hydroxides.

$MO + H_2O \longrightarrow M(OH)_2$

(v) Hydroxides of alkaline earth metals are less stable and less basic than alkali metal hydroxides.

(vi) Beryllium hydroxide is amphoteric in nature.

Halides

The alkaline earth metals combine directly with halogens at appropriate temperatures forming halides, MX_2.

They can also be prepared by the action of halogen acids (HX) on metals, metal oxides, metal hydroxides.

$M + 2HX \longrightarrow MX_2 + H_2$

$MO + 2HX \longrightarrow MX_2 + H_20$

` $M(OH)_2 + 2HX \longrightarrow MX_2 + 2H_20$

(i) Except beryllium halides, all other halides of alkaline earth metals are ionic in nature.

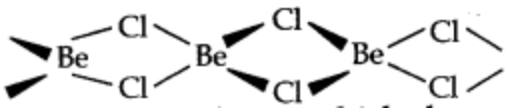
(ii) Except $BeCl_2$ and $MgCl_2$ other chlorides of alkaline earth metals impart characteristic colours to flame.

$CaCl_2$	$SrCl_2$	$BaCl_2$
Brick red	Crimson	Grassy green

(iii) The tendency to form halide hydrates decreases down the group.

For example, ($MgCl_2$– 8 H_20, $CaCl_2$– 6 H_20, $SrCl_2$– 6 H_20, $BaCl_2$– 2 H_2O)

(iv) $BeCl_2$ has a chain structure in the solid phase as shown below.



In vapour phase the compound exist as a dimer which decomposes at about 1000K to give monomer in which Be atom is in sp hybridisation state.

Sulphates

(i) The sulphates of alkaline earth metals are white solids and quite stable to heat.

(ii) $BeS0_4$ and $MgS0_4$ are readily soluble in water. Solubility decreases from $BeS0_4$ to $BaS0_4$.

Reason- Due to greater hydration enthalpies of Be^{2+} ions and Mg^{2+} ions they overcome the lattice enthalpy factor. Their sulphates are soluble in water.

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