

The s-Block Elements

1. **Group 1 Elements: Alkali Metals**
 2. **Some Important Compounds of Sodium**
 3. **Biological Importance of Sodium and Potassium**
 4. **Group 2 Elements : Alkaline Earth Metals**
 5. **Some Important Compounds of Calcium**
 6. **Biological Importance of Magnesium and Calcium**
-

The s-Block of the periodic table constitutes Group 1 (alkali metals) and Group 2 (alkaline earth metals). They are so called because their oxides and hydroxides are alkaline in nature.

The alkali metals are characterised by one s-electron and the alkaline earth metals by two s-electrons in the valence shell of their atoms.

Group 1 consists of following elements: lithium, sodium, potassium, rubidium, caesium and francium.

Group 2 include following elements: beryllium, magnesium, calcium, strontium, barium and radium.

Group 1 Elements: Alkali Metals

Physical properties of alkali metals

- **Large atomic radii:** The atomic radii of alkali metals increases down the group. They have largest atomic radii in their respective period.
- **Large ionic radii:** The ionic radii increase as we go down the group.
- **Low ionization enthalpy:** The ionization enthalpies of the alkali metals are the lowest due to loosely held s-electron.
- **Hydration enthalpy:** The hydration enthalpy of Li ion is maximum and the hydration enthalpy of Cs ion is the minimum.

- **Oxidation state:** The alkali metals show oxidation state of +1 in their compounds. They are strongly electropositive. The electropositive character increases from Li to Cs.
- **Metallic character:** The metallic character increases as we go down the group.
- **Nature of bonds formed:** These metals form ionic bonds. The ionic character increases down the group.
- **Flame colouration:** All alkali metals give a characteristic colour to the flame with which they can be identified.
- **Photoelectric effect:** Except Li, all Alkali metals exhibit photoelectric effect.

The first element in each of these groups, lithium in Group 1 and beryllium in Group 2 shows similarities in properties to the second member of the next group. Such similarities are termed as the 'diagonal relationship' in the periodic table. As such these elements are anomalous as far as their group characteristics are concerned.

Chemical features of alkali metals:

The alkali metals are silvery white, soft and low melting. They are highly reactive. The compounds of alkali metals are predominantly ionic. Their oxides and hydroxides are soluble in water forming strong alkalies.

- **Reaction with dihydrogen:** Alkali metals react with dry hydrogen at about 673 K to form crystalline hydrides which are ionic in nature and have high melting points.
- **Oxides and hydroxides:** Alkali metals on reaction with limited quantity of oxygen form normal oxides
(M_2O) $M = Li, Na, K, Rb, Cs$
- **Reaction with halogens:** Reactivity of alkali metals with particular halogen increases from Li to Cs.
- **Reaction with water:** Alkali metals react with water and other compounds containing acidic hydrogen atoms such as hydrogen halides, etc. to liberate hydrogen gas.

Important compounds of sodium include sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate. Sodium hydroxide is manufactured by using Castner-Kellner process and sodium carbonate by Solvay process.

Biological importance of sodium and potassium

- Sodium ions help to regulate flow of water across the cell membranes, transportation of sugars and amino acids inside the cells.
- Potassium ions activate many enzymes, takes part in oxidation of glucose.
- Potassium ions together with sodium ions are responsible for transmission of nerve signals and maintenance of ionic gradient across the cell.

Group 2 elements: Alkaline earth metals

The chemistry of alkaline earth metals is very much like that of the alkali metals. However, some differences arise because of reduced atomic and ionic sizes and increased cationic charges in case of alkaline earth metals. Their oxides and hydroxides are less basic than the alkali metal oxides and hydroxides.

- **Atomic radii:** The atomic radii of alkaline earth metals are larger but smaller compared to corresponding alkali metals. It increases down the group.
- **Ionic radii:** The ionic radii increase as we go down the group.
- **Ionization enthalpy:** value decreases down the group.
- **Hydration enthalpy:** decreases as the size of the metal ion increases down the group.
- **Oxidation State:** All the members of the family exhibit +2 oxidation state and form divalent cations.

Chemical features of alkali metals:

- **Reducing character:** Alkaline earth metals are weak reducing agents.
- **Reaction with oxygen:** Form oxides (MO) on heating with excess of oxygen with exception of Ba and Ra which form peroxides (MO_2)
- **Reaction with halogen:** combine directly with halogen to form corresponding halides.
- **Reaction with water:** Elements of this group are less reactive with water because they are less electropositive in nature.
- **Reaction with hydrogen:** The members of this group except Be combine with hydrogen directly upon heating to form metal hydrides.

Uses of some important compounds:

Industrially important compounds of calcium include calcium oxide (lime), calcium hydroxide (slaked lime), calcium sulphate (Plaster of Paris), calcium carbonate (limestone) and cement.

Portland cement is an important constructional material. It is manufactured by heating a pulverised mixture of limestone and clay in a rotary kiln. The clinker thus obtained is then mixed with some gypsum (2-3%) to give a fine powder of cement. All these substances find variety of uses in different areas.

- Caustic soda is used in soap, textile and petroleum industry.
- Sodium carbonate is used in soap and glass industry, in making paints and dye, in metal refining process.
- Quick lime is used in the preparation of cement, glass and calcium carbide. It is used as a flux in the extraction of metal.
- Lime stone is used as building material and in the manufacture of quick lime.
- Cement is used in concrete and reinforced concrete, in plastering and the construction of buildings.
- Plaster of Paris is used in making moulds for pottery, ceramics, etc. It is used in surgical bandages for healing broken bones of the body.

Biological importance of Ca and Mg

- Magnesium ion act as cofactor for all enzymes that utilize ATP.
- Magnesium is present in chlorophyll pigment found in green plants.
- Calcium ions are required for bone formation, blood clotting and are required to trigger the contraction of muscles. They also regulate heart beat.