CHEMISTRY

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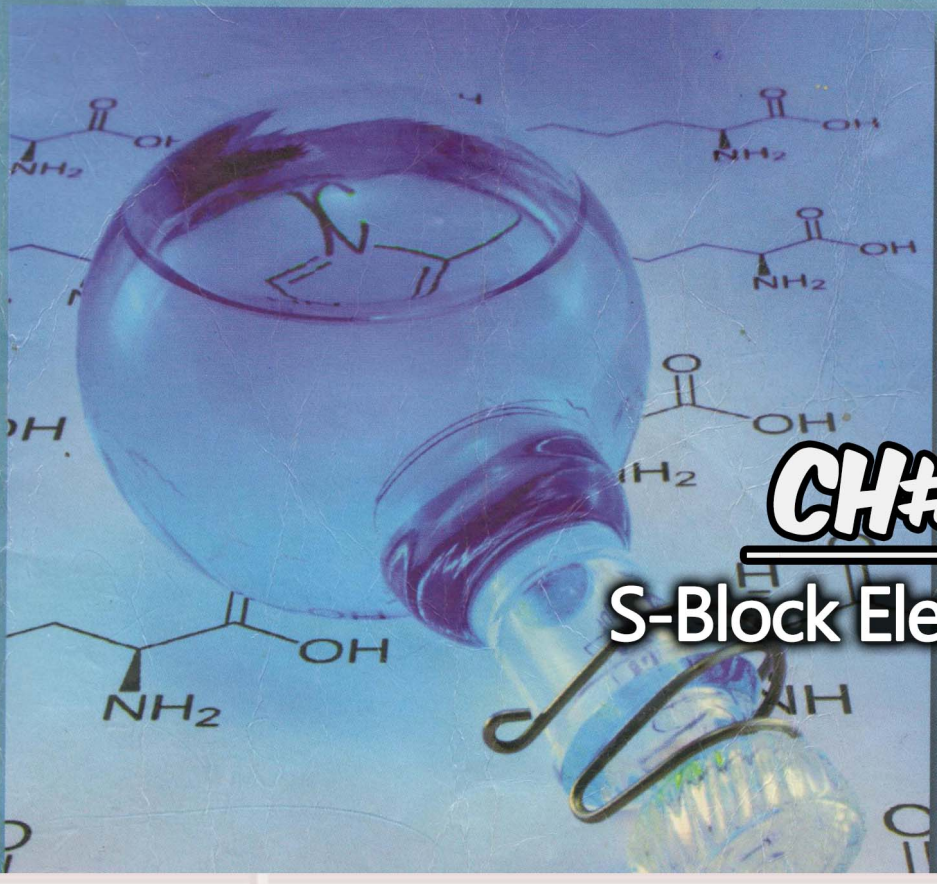

CH#2

S-Block Elements

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Chapter 2
S-BLOCK ELEMENTS

Introduction:- The elements of groups IA and IIA are called S-Block elements because their valence electrons are present in S-Orbitals The elements of group IA except hydrogen are called **Alkali metals** because they Produce Strong alkalies with Water. The alkali metals are Lithium, Sodium, Potassium, Rubidium Caesium and Francium. The word alkali is an Arabic which means "The Ashes". The reason is that Sodium and Potassium are present in the ashes of Plants.

The elements of group II A are called **Alkaline earth metals** because they Produce alkalies with water and are widly distributed in earth's Crust (زمین). The alkaline earth metals are Berylium, Magnesium, Calcium Strontium, Barium and Radium.

Electronic Configuration of alkali Metals

Alkali metals have one electron in their Valence "S" orbital. They lose their valence electron to form monopositive ion M^+. They show oxidation state of +1

Occurrence of Alkali Metals

Alkali metals are very reactive. So they are not found in free state. They are found in Combined state. Their important minerals (ores) are given below.

Lithium occurs as Spodumene $LiAl(SiO_3)_2$

Sodium occurs as Rock salt (Halite) $NaCl$,
Chile saltpetre $NaNO_3$, Natron $Na_2CO_3 \cdot H_2O$
Trona $Na_2CO_3 \cdot 2NaHCO_3 \cdot 2H_2O$,
Borax $Na_2B_4O_7 \cdot 10H_2O$

Potassium occurs as Sylvite KCl,
Carnallite $KCl \cdot MgCl_2 \cdot 6H_2O$,
Alumstone (Alunite) $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 4Al(OH)_3$,

Out of alkali metals Francium is not found in nature. It has been prepared by artificial means. It is very unstable. So that a very little is known about this metal.

Occurrence of Alkaline Earth Metals

Like alkali metals, the alkaline earth metals are also very reactive. So they are not found in free state. They are found in Combined state. Magnesium is an important Component of Chlorophyll. Calcium is

found in bones, teeth, sea shells and egg shells
Radium is rare and radioactive element.
The important minerals (ores) of alkaline earth metals are given below.

Beryllium occurs as

Beryl	$Be_3Al_2(SiO_3)_6$
Chrysoberyl	Al_2BeO_4

Magnesium occurs as

Magnesite	$MgCO_3$
Dolomite	$MgCO_3 CaCO_3$
Carnallite	$KCl\ MgCl_2 \cdot 6H_2O$
Epsom Salt	$MgSO_4 \cdot 7H_2O$
Asbestos	$CaMg_3(SiO_3)_4$
Soap Stone (talc)	$H_2Mg_3(SiO_3)_4$

Calcium occurs as

Calcite (Lime stone, Marble)	$CaCO_3$
Gypsum	$CaSO_4 \cdot 2H_2O$
Fluorite	CaF_2
Phosphorite	$Ca_3(PO_4)_2$

Strontium occurs as Strontionite $SrCO_3$

Barium occurs as Barite $BaSO_4$.

Electronic Configuration of Alkali Metals

Alkali Metal	Li	Na	K	Rb	Cs
Atomic number	3	11	19	37	55
Electronic Configuration	$1s^2 2s^1$	$[Ne]3s^1$	$[Ar]4s^1$	$[Kr]5s^1$	$[Xe]6s^1$
Melting point (°C)	186.1	97.5	62.7	39.0	26.0
Ionization Energy ($Kj\,mol^{-1}$)	520	495	420	400	380
Ionic radius (Pm)	60	95	133	148	169
Density (g/cm^3)	0.53	0.97	0.86	1.53	1.93
Heat of hydration ($Kj\,mol^{-1}$)	505	475	384	345	310

Electronic Configuration of Alkaline Earth Metals

Alkaline earth metals have two electrons in their valence S-orbitals. They lose two electrons to form dipositive ion M^{+2}.

Alkali earth metal:-	Be	Mg	Ca	Sr	Ba
Atomic number:-	4	12	20	38	56
Electronic Configuration:-	$1s^2 2s^2$	$[Ne]4s^2$	$[Ar]4s^2$	$[Kr]4s^2$	$[Xe]4$
Melting Point (°C)	1289	651	851	771	849
2nd Ionization Energy ($Kj\,mol^{-1}$)	1800	1450	1150	1060	970
Ionic Radius (Pm)	31	65	99	113	135
Density (g/cm^3)	1.85	1.74	1.55	2.6	3.5
Heat of Hydration ($Kj\,mol^{-1}$)	2337	1897	1619	1455	1254

Peculiar behaviour of Lithium
(Differences of Li from other members)

1:- Lithium has small size and high charge density than other alkali metals.

2:- Lithium is much harder than the other alkali metals

3:- Lithium forms waterless soluble salts with anions of high charge density. e.g LiOH, LiF, Li_2CO_3, Li_3PO_4 etc.

4:- Lithium is the least reactive alkali metal

5:- Lithium reacts slowly with water but other alkali metals react violently.

6:- Lithium forms Carbide but other alkali metals do not form Carbides.

7:- Lithium forms nitride but other alkali metals do not form nitrides

$$6Li + N_2 \longrightarrow 2Li_3N$$

8:- Lithium hydroxide shows thermal decomposition but other alkali metals hydroxides do not

$$2LiOH \xrightarrow{\text{Red hot}} Li_2O + H_2O$$

9:- Lithium chloride gives an exothermic heat of solution but other alkali metals chlorides give endothermic heat of solution.

10 :- Lithium forms only normal oxide but other alkali metals form peroxides and superoxides.

11 :- Lithium forms complexes but other alkali metals do not form such complexes. e.g $Li(NH_3)_4$

12 :- Lithium does not react with acetylene but other alkali metals react with acetylene to form acetylides. e.g

$$HC \equiv CH + 2Na \longrightarrow \overset{+}{N}a\overset{-}{C} \equiv \overset{-}{C}\overset{+}{N}a + H_2$$

(Sodium Acetylide)

13 :- Compounds of Lithium are covalent but the compounds of other alkali metals are ionic

14 :- Lithium hydride is more stable than the hydrides of other alkali metals.

15 :- Lithium does not form bicarbonate and tri-iodide but other alkali metals form such compounds. e.g $KHCO_3$ and KI_3

16 :- Lithium carbonate shows thermal decomposition but other alkali metal carbonates do not show thermal decomposition.

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

17 :- $LiNO_3$ and other alkali metal nitrate give different products on thermal decomposition.

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

$$2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$$

Peculiar behaviour of Beryllium
(Differences between Be and other members)

1:- Be has small size and high electro-negativity as compared to other members of its family.

2:- Be has high melting and boiling point than other members of its family (group).

3:- Be is much harder than other members of its own family. Be is as hard as iron and can scratch glass.

4:- Be reacts with alkalies but other members of its family do not

$$Be + 2NaOH \longrightarrow Na_2BeO_2 + H_2$$

(Sodium ...)

5:- Be does not oxidize ... formation of BeO ...

6:- Be cannot reduce water ... other alkali earth metals act ... reducing agents for water.

General behaviour of alkali metals

A substance which can lose ... reducing agent. Alkali metals ... reducing agents due to low ... They are highly electropositive ... halides.

Chemical Properties of alkali-metals

1 :- Alkali metals are very reactive due to their low ionization energies.

2 :- The oxidation number of alkali metals is +1 (not higher than one) due to very high second ionization energy.

3 :- The alkali metal cations have low charge, and big size. So they have low charge density. Thus salts of alkali metals have low values of lattice energies. Hence most of the salts of alkali metals are dissociated and completely soluble in water.

4:- Reaction with Oxygen:-

Alkali metals react with oxygen and their surface tarnishes. Lithium forms normal oxide.

$$4Li + O_2 \longrightarrow 2Li_2O$$ (Lithium Oxide) White Solid

Li_2O reacts with atmospheric CO_2 to form Carbonate $Li_2O + CO_2 \longrightarrow Li_2CO_3$

Sodium forms Sodium Peroxide in an excess of O_2

$$2Na + O_2(Excess) \longrightarrow Na_2O_2$$

Sodium Peroxide (Pale yellow)

Potassium, Rubidium and Caesium react with

oxygen to form Superoxides.

i $K + O_2 \longrightarrow KO_2$ (Potassium Superoxide (Orange yellow)

5:- Reaction with Water:-

Alkali metals react with water rapidly. They Produce hydrogen and metal hydroxide. The reaction is highly exothermic so that produced hydrogen Catches Fire (ignites بھڑک اٹھتا ہے)

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2$$

The reaction becomes more and more vigorous with from Li to Cs. The K, Rb and Cs can react with ice at $-100^{\circ}C$.

6:- Reaction with Hydrogen

Alkali metals react with hydrogen to form ionic Hydrides.

$$2M + H_2 \longrightarrow 2MH$$

$$2Li + H_2 \xrightarrow{Heat} 2LiH$$

$$LiH + H_2O \longrightarrow LiOH + H_2$$

Due to presence of (H^-) hydride ion, the ionic hydrides **are used as** Powerful reducing agents

7:- Reaction with Carbon and Nitrogen

Out of alkali metals only Lithium reacts with Carbon and Nitrogen.

$$6Li + N_2 \longrightarrow 2Li_3N \text{ (Lithium nitride)}$$

$$4Li + C \longrightarrow Li_4C \text{ (Lithium Carbide)}$$

3:- Reaction with Halogens

Alkali metals react with halogens to form halides e.g Sodium burns with a brilliant yellow flame in the atmosphere of Chlorine.

$$2Na + Cl_2 \rightarrow 2NaCl$$

The reaction of Li and Na is slow but K, Rb and Cs react vigorously with halogens.

4:- Reaction with Sulphur:-

All alkali metals react with molten sulphur to form sulphides

$$2M + S \longrightarrow M_2S$$

$$2Na + S \longrightarrow Na_2S$$

Chemical Properties of Alkaline earth metals

1:- Reaction with Oxygen:- Out of alkaline earth metals only Ba forms Peroxide, but all other metals form normal oxides

$$2Be + O_2 \xrightarrow{600^\circ C} 2BeO$$

When Mg burns in air a small amount of magnesium nitride is also formed alongwith MgO.

$$2Mg + O_2 \longrightarrow 2MgO$$

$$3Mg + N_2 \longrightarrow Mg_3N_2$$

Magnesium Nitride

$$Ba + O_2 \xrightarrow{500-600^\circ C} BaO_2$$

(Barium Peroxide)

2:- Reaction with Hydrogen

Alkali earth metals react with hydrogen to give hydrides under high pressure

$$Mg + H_2 \xrightarrow[MgI_2]{\text{High Pressure}} MgH_2$$

$$Ca + H_2 \xrightarrow{\text{Pressure}} CaH_2$$

3:- Reaction with Nitrogen

Alkali earth metals react with N_2 to give nitride

$$3Mg + N_2 \xrightarrow{\text{Heat}} Mg_3N_2$$

(Magnesium nitride)

The Magnesium nitride shows vigorous hydrolysis

$$Mg_3N_2 + 6H_2O \longrightarrow 2NH_3 + 3Mg(OH)_2$$

4:- Reaction with Sulphur Alkali earth metals react with Sulphur to give Sulphides. e.g

$$Mg + S \xrightarrow{\text{Heat}} MgS \text{ (Mag Sulphide)}$$

5:- Reaction with Halogens Alkali earth metals react with halogens to give halides. e.g

$$Ca + Cl_2 \longrightarrow CaCl_2$$

6:- Reaction with water:- Be does not react with water. Mg reacts with boiling water to give MgO and H_2

$$Mg + H_2O \xrightarrow{100^\circ C} MgO + H_2$$

Other alkali earth metals react with water to produce metal hydroxide and hydrogen

$$M + 2H_2O \xrightarrow{100^\circ C} M(OH)_2 + H_2$$

Compounds of alkali and alkaline earth Metals

1:- Oxides Alkali metal oxides react with water to produce hydroxide. This reaction is considered as an acid-base reaction but not a oxidation reduction reaction because there is no change in oxidation number of any element

$$Li_2O + H_2O \longrightarrow 2LiOH$$

$$2Na_2O_2 + 2H_2O \longrightarrow 4NaOH + O_2$$

In these reactions water molecule decomposes by an oxide ion

$$O^{-2} + H_2O \longrightarrow 2OH^-$$

The Potassium Superoxide (KO_2) reacts with CO_2 to give K_2CO_3 and Oxygen.

Imp: $4KO_2 + 2CO_2 \longrightarrow 2K_2CO_3 + 3O_2$

Due to above reaction KO_2 is used in breathing equipments (سانس لینے کے آلات) for mountaineers (پہاڑ پر چڑھنے والے) and in space Crafts (خلائی جہاز). The basic character of alkali metal oxides increases down the group. The basic character of alkaline earth metal oxides increases down the group. The oxides of group IIA are less basic than those of IA group. In IIA group, BeO and MgO are insoluble in water but CaO, SrO and BaO are soluble in water and react to give hydroxide.

$$CaO + H_2O \longrightarrow Ca(OH)_2$$

Amphoteric nature of BeO :-

A Substance which shows both acidic and basic Properties is called an amphoteric e.g BeO

BeO reacts with both acids and bases.

$$BeO + H_2SO_4 \longrightarrow BeSO_4 + H_2O$$

$$BeO + 2NaOH \longrightarrow Na_2BeO_2 + H_2O$$

(Sodium beryllate)

2:- Hydroxides:- The alkali metal hydroxides are Crystalline Solids. Except LiOH, all other are water Soluble. Because they absorb moisture so they are **Hygroscopic**. Except LiOH all other are Stable to heat

$$2LiOH \xrightarrow{Heat} Li_2O + H_2O$$

The solubility of alkali earth metal hydroxides increases down the group. $Be(OH)_2$ is insoluble, $Mg(OH)_2$ is Sparingly(little) Soluble and $Ba(OH)_2$ is more Soluble. The reason is that ionic size increases from top to bottom of group. So Lattice energy of hydroxides decreases. Hence Solubility increases down the group. The alkali earth metals hydroxides decompose on heating.

$$Mg(OH)_2 \xrightarrow{Heat} MgO + H_2O$$

Lime Water:- The Suturated Solution of $Ca(OH)_2$ in water is called lime water. It is used as a test for CO_2. The CO_2 turns lime-water milky due to formation of Calcium Carbonate.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

Milk of magnesia:- A suspension of $Mg(OH)_2$ is called milk of magnesia. It is used for acidity treatment in Stomach.

3:- Carbonates:- The Carbonates of alkali metals except Li_2CO_3 are soluble in water. All alkali metal Carbonates except Li_2CO_3 are stable to heat. Li_2CO_3 is insoluble in water and decompases on heating $Li_2CO_3 \xrightarrow{Heat} Li_2O + CO_2$

Sodium Carbonate (Na_2CO_3) is called **Soda ash**. $Na_2CO_3 \cdot 10H_2O$ is called Washing Soda. It is Crystallized from aqueous solution of Na_2CO_3 below 35.2°C. In air $Na_2CO_3 \cdot 10H_2O$ slowly losses water and changes into white Powder. $Na_2CO_3 \cdot H_2O$ The alkali earth metal Carbonates are very slightly soluble (insoluble) in water. They decompase on heating. e.g.

$$CaCO_3 \xrightarrow{Heat} CaO + CO_2$$

The ease of decomposition of Carbonates decreases down the group.

4:- Nitrates:- Nitrates of alkali and alkaline earth metals are soluble in water.
The nitrates of Li, Mg and Ba decompose on heating and give O_2, NO_2 and metal oxide.

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

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

The nitrates of Na, K and Ca decompose on heating to give O_2 and metal nitrite.

$$2NaNO_3 \xrightarrow{Heat} 2NaNO_2 + O_2$$

$$Ca(NO_3)_2 \xrightarrow{Heat} Ca(NO_2)_2 + O_2$$

5:- Sulphates:- All alkali metals sulphates are soluble in water. In case of alkali earth metals sulphates, the solubility decreases down the group. $BeSO_4$, $MgSO_4$ are more soluble in water, $CaSO_4$ is slightly soluble and $SrSO_4$ and $BaSO_4$ are insoluble.
Calcium sulphate occurs as gypsum $CaSO_4 \cdot 2H_2O$
When gypsum is heated above 100°C, it loses three quarters (3/4th) of its water to give Plaster of Paris.

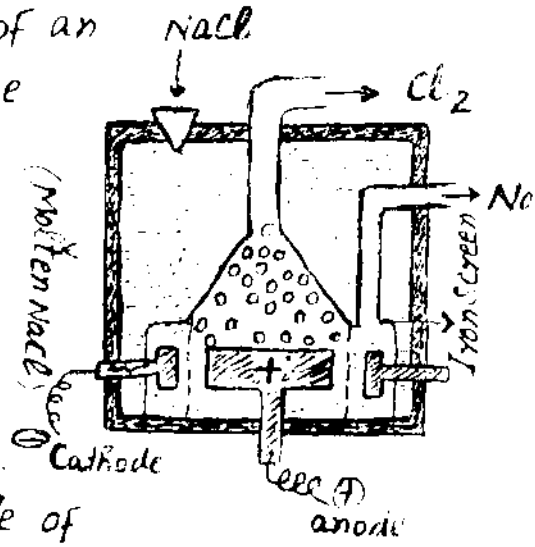
$$2(CaSO_4\,2H_2O) \xrightarrow[100^\circ C]{Above} (CaSO_4)_2H_2O + 3H_2O$$

Gypsum — Plaster of Paris

Commercial Preparation of Sodium by Down's Cell (V. Imp)

In down's cell Sodium is Prepared by electrolysis of molten (fused) Sodium chloride Some $CaCl_2$ is added to lower the melting Point of NaCl from 801°C to 600°C.

The cell consists of an iron vessel. A large block of graphite acts as an anode Above the anode there is an iron dome (lid) for the collection of Chlorine.



The cathode is made of iron or copper. It is separated from anode by iron gauze screen. When electric current passes through molten NaCl, following reactions take place.

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$Na^+ + e^- \longrightarrow Na \quad \text{(at Cathode)}$$

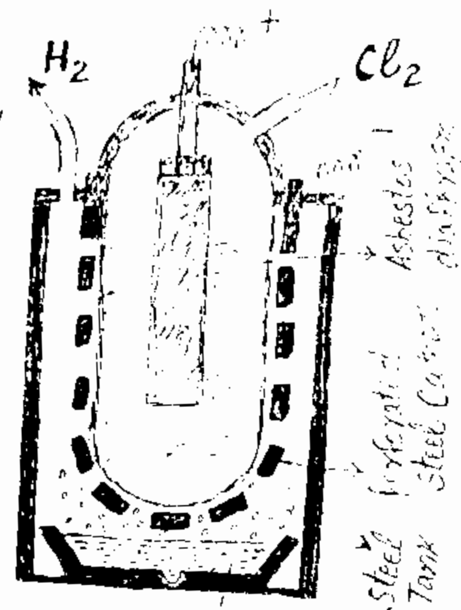
$$2Cl^- \longrightarrow Cl_2 + 2e^- \quad \text{(at anode)}$$

The Sodium Collects over Cathode and Chlorine Collects over anode. They are taken out from different holes. This Process has following

advantages.
i) The metallic fog is not produced
ii) Liquid Sodium is collected at 600°C
iii) It gives 99.9% pure Sodium.
(iv) Material of the cell is not attacked by the products formed during electrolysis.

Commercial Preparation of Sodium Hydroxide by Nelson Cell (Diaphragm cell)

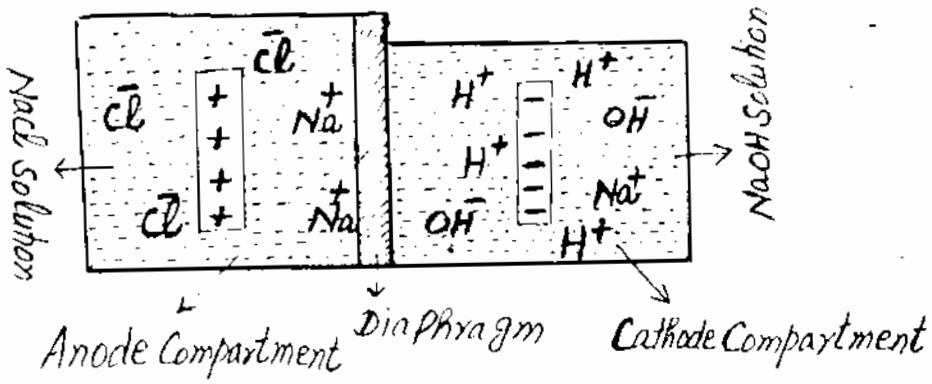
Sodium hydroxide is prepared on a large scale by electrolysis of aqueous solution of Sodium Chloride. It is done in a cell called **Nelson or diaphragm cell**. It is shown in figure.



The cell consists of a steel tank provided with a constant level device. This device keeps the brine level in inner part at a specific height (1m). An oblong (U-shaped) perforated steel vessel is lined inside with porous asbestos diaphragm. It acts as cathode. A graphite rod is suspended into U-shaped diaphragm containing

brine (salt solution). It acts as anode.

The **Purpose** of diaphragm becomes clear from following figure.



Reactions:- When electric current passes through solution of NaCl, then $\bar{Cl}$, $\bar{OH}$, $\overset{+}{Na}$ and $\overset{+}{H}$ ions are produced.

$$2\,\bar{Cl} \longrightarrow Cl_2 + 2\bar{e} \quad \text{(at anode)}$$

$$2\,H_2O + 2\bar{e} \longrightarrow 2\,\bar{OH} + H_2 \quad \text{(at cathode)}$$

The $\overset{+}{Na}$ ions migrate to the cathode through the asbestas diaphragm. The Cl_2 and H_2 gases are taken out from different outlets. The aqueous solution of NaOH remains in cathode compartment

Two Problems and their Solution:-

During the working of cell we can face two major problems.

(i) In anode compartment the Cl_2 can react with $\bar{OH}$ ions.

$$Cl_2 + 2\,\bar{OH} \longrightarrow \bar{Cl} + \bar{OCl} + H_2O$$

(ii) The $\bar{OH}$ ions may collect over anode. Their oxidation gives oxygen which contaminates (O)

the Cl_2.

$$4OH^- \longrightarrow 2H_2O + O_2 + 4e^-$$

The first problem is solved by using asbestas diaphragm. It keeps the two solutions separate and migrates Na^+ ions towards the cathode.
The second problem is solved by keeping the brine level slightly higher in anode compartment. So flow of liquid continues towards the cathode and OH^- ions can not reach the anode
The solution which flows out of the cathode collects in catch basin. It contains 11% NaOH and 16% NaCl. By evaporation, NaCl forms crystals and NaOH remains in solution. The solid NaCl is filtered off and mother liquor contains 50% NaOH and 1% NaCl as an impurity

Role of Gypsum in Agriculture(زراعت)

Gypsum ($CaSO_4 \cdot 2H_2O$) is used as fertilizer (کھاد)
It provides Calcium and Sulfhur to the soil.(زمین)
Calcium is important for crop production in the saline soils. The Sulphur compounds have good effect on plant growth. The Sulphur affects the function of Chlorophyll in plant leaves. If a plant has deficiency (کمی) of Sulfhur, its colour becomes pale green. The sulfhur also affects the root system of many plants

Role of gypsum in Industries

When gypsum is heated above 100°C it loses three quarters ($\frac{3}{4}$ th) of its water. The resulting product is called **Plaster of Paris**.

$$2CaSO_4 \cdot 2H_2O \xrightarrow{\text{Above } 100^\circ C} (CaSO_4)_2 \cdot H_2O + 3H_2O$$

Plaster of Paris

(i) Plaster of Paris is used for making Plaster Walls
(ii) Plaster of Paris is used in moulding and Casting of coins and Statuary (مجسمہ سازی)
(iii) Plaster of Paris is used in surgical bandages of fractured bones
(iv) Gypsum is used as filler and glaze in paper industries
(v) Gypsum is used in Chalk Pencils
(vi) The Plaster of Paris is used in making special types of Plasters. (a) Cement Plaster (b) Hard Plasters

(a) **Cement Plaster:-** When Plaster of Paris is mixed with glue or other oils its setting time decreases. It is called Cement Plaster.

(b) **Hard finish Plaster:-** When $CaSO_4$ is Calcinated (heated) with aluminium or borax, the product is called hard finish Plaster. This plaster sets very slowly. It is used to make wall boards and partitions.

(vii) Gypsum is very important component of cement because it increases setting time of cement.
A fine mixture of clay and limestone is strongly

heated to give a product called clinker. The clinker is cooled and finely ground with 2% gypsum. It is called portland cement.

Dead burnt plaster:-

When gypsum ($CaSO_4 \cdot 2H_2O$) is very strongly heated, it becomes anhydrous. This anhydrous salt absorbs water very slowly. It is called "dead burnt" plaster.

$$CaSO_4 \cdot 2H_2O \xrightarrow[\text{heating}]{\text{very strong}} CaSO_4 + 2H_2O$$
(Dead Burnt)

"Plaster of Paris is used in moulding". Why?

When plaster of Paris is mixed with water, it forms plastic type viscous mass. This process completes in 10--15 minutes. During this process about 1% volume expansion takes place. So moulds fill completely and give sharp casting.

Slaking of lime (Slaked lime)

When Calcium oxide reacts with water, then Calcium hydroxide is produced. This process is called slaking of lime. It is an exothermic reaction.

$$CaO + H_2O \longrightarrow Ca(OH)_2$$
(Slaked lime)

Role of Lime in Agriculture

Lime (CaO) is a Soft White Compound.

$$CaCO_3 \xrightarrow{Heat} CaO + CO_2$$

(Limestone) (Lime)

(i) Lime is used as a fertilizer. It is the best fertilizer for acidic soils because it neutralizes the soil acidity.

(ii) Lime is used for Preparation of agri sprays e.g Lime – Sulfur Spray has a strong fungicidal action.

(iii) Calcium is an essential element for the normal growth of Plants

(iv) Calcium has a good effect on the root system of plants. e.g it stimulates the growth of root hair.

(v) Calcium regulates the supply of Phosphorous in the soil.

(vi) Calcium is essential for growth of leaves.

(vii) Calcium is essential for the activity of nitrifying bacteria (micro-organisms)

(viii) Calcium regulates supply of other essential elements in plants. e.g Deficiency of Calcium accumulates Aluminium and Manganese upto harmful Concentration

Role of Lime in Industries

1:- Lime is used in paper industry

2:- Lime is used in leather industry

3:- Lime is used in preparation of bleaching Powder

4:- Lime is used in refining of Sugar.

5:- Lime is used in Ceramic industry

6:- Slaked lime is used as a White wash.

7:- Lime is used in manufacturing of glass

8:- Lime is used in extraction and refining of metals.

9:- Lime is used for preparation of Calcium Carbide whose hydrolysis gives acetylene.

$$CaO + 3C \xrightarrow[2800°C]{\text{electric furnace}} CaC_2 + CO$$

$$CaC_2 + 2H_2O \xrightarrow{\text{Hydrolysis}} Ca(OH)_2 + C_2H_2$$

10:- Lime is used as drying agent e.g preparation of absolute alcohol and drying of NH_3.

A mixture of NaOH and $Ca(OH)_2$ is called **Soda lime**. It is used to remove both water and CO_2 from dry gases.

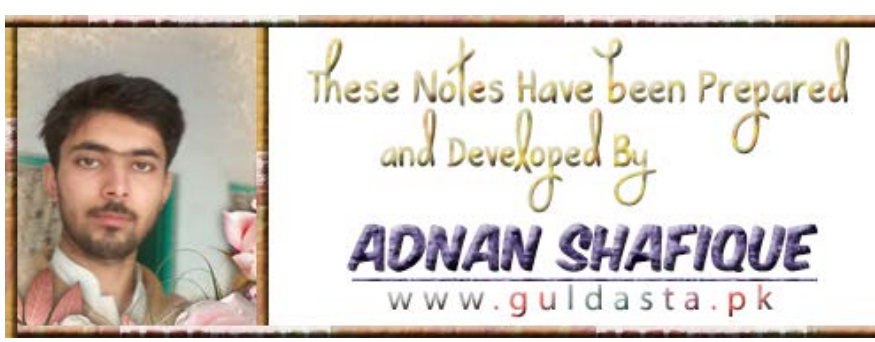
11:- Lime is used in making lime **Mortar**. When Slaked lime (one volume) and Sand (three or four volumes) are mixed with water, a thick paste is formed. It is called **Lime mortar**. The mortar binds the stones or bricks (اینٹ) firmly together When mortar hardens (سخت ہونا), then following chemical reactions take place.

$$CaO + H_2O \longrightarrow Ca(OH)_2$$

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

$$Ca(OH)_2 + SiO_2 \longrightarrow CaSiO_3 + H_2O$$

(Sand)



EXERCISE

Q.1. Fill in the Blanks.

(i) Alkali metals are _____ reactive than alkaline-earth metals.
(ii) Alkali metals decompose water vigorously producing _____ hydrogen.
(iii) When heated in a current of dry hydrogen,alkaline earth metals white crystalline _____ of the type MH_2
(iv) The beryllium hydroxide,like the hydroxide of aluminum is amphc while the hydroxide of the other members of the grou are_____
(v) The elements of the group IA are termed as alkali metals, bec their_____ are alkaline.
(vi) Spodumene is an ore of _____ metal.
(vii) Alkali metal nitrates on heating give the corresponding _____ oxygen.
(viii) Na_2CO_3 H_2O is the chemical formula of an ore of sodium which is kn as _____
(ix) Metallic bicarbonates are decomposed on heating into their carbon alongwith _____ and _____
(x) Metal nitrates other than the alkali metals on heating decompose the corresponding metal _____ alongwith the evolution of nitro peroxide and oxygen.

ANSWERS (i) More (ii) Metal Hydroxide (iii) Hydrides (iv) Basic (v) Oxides (vi) Lithium (vii) Nitride (viii) Natron (ix) Co_2, H_2O (x) Nitrite

Q.2. Indicate True or False.

(i) Group IA element are called alkali metals because their chlorides are alkaline in nature.
(ii) Alkali metals are very good conductor of electricity.
(iii) The hydroxide of alkali metals and alkaline earth metals are soluble i water.
(iv) Plaster of Paris is a hemihydrate.
(v) Alkali metals have low melting and boiling points as compared to tho of alkaline earth metals.
(vi) Lithium carbonate is decomposed to its oxide, but the carbonates of other alkali metals are stable towards heat.
(vii) All alkali metal sulphates are insoluble in water.
(viii) Lithium combines with nitogen to form lithium nitride but otner alkal metals do not react with nitrogen.
(ix) Trona is an ore of Lithium.
(x) Alkaline earth metals are stronger reducing agents than alkali meta

ANSWERS (i) False (ii) True (iii) True
(iv) True (v) True (vi) True (vii) False
(viii) True (ix) False (x) False

Q.3 Multiple choice questions. Encircle the correct answer.

(i) Which one of the following does not belong to alkaline earth metals?
(a) Be (b) Ra (c) Ba (d) Rn
(ii) The oxides of beryllium are.
(a) Acidic (b) Basic
(c) Amphoteric (d) None of the above
(iii) Which ion will have the maximum value of heat of hydration.
(a) Na^+ (b) Cs^+ (c) Ba^{++} (d) Mg^{++}
(iv) Which one of the following is not an alkali metal?
(a) Francium (b) Caesium
(c) Rubidium (d) Radium
(v) Which of the following sulphates is not soluble in Water
(a) Sodium sulphate (b) Potassium sulphate
(c) Zinc sulphate (d) Barium sulphate
(vi) The element caesium bears resemblance with
(a) Ca (b) Cr (c) Both of the above (d) None of the above
(vii) Chile saltpeter has the chemical formula.
(a) $NaNO_3$ (b) KNO_3 (c) $Na_2B_4O_7$ (d) $Na_2CO_3.H_2O$
(viii) The ore $CaSO_4.2H_2O$ has the general name.
(a) Gypsum (b) Dolomite (c) Calcite (d) Epsom salt
(ix) Down's cell is used to prepare.
(a) Sodium carbonate (b) Sodium bicarbonate
(c) Sodium metal (d) Sodium hydroxide
(x) Which element is deposited at the cathode during the electrolysis of brine in Nelson's cell?
(a) H. (b) Na (c) Cl (d) O

ANSWER (i) d (ii) c (iii) d (iv) d (v) d
(vi) d (vii) a (viii) a (ix) c (x) b

Q4. (a) Give the names, electronic configurations and occurrence of s-block elements.

Ans:- S-block contains two groups of elements. They are IA and IIA groups. The members of gro. IA are Lithium, Sodium, Potassium, Rubidium, Caesium and Francium. They are also called alka. metals. The members of group IIA are. Beryllium Magnesium, Calcium, Strontium, Barium and Radium. They are also called alkaline earth metals.

Alkali metals

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

$_{11}Na$ $1s^2\ 2s^2\ 2p^6\ 3s^1$

$_{19}K$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

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

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

Alkaline earth metals

$_{4}Be$ $1s^2\ 2s^2$

$_{12}Mg$ $1s^2\ 2s^2\ 2p^6\ 3s^2$

$_{20}Ca$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

$_{38}Sr$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2$

$_{56}Ba$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2$

(b) Discuss the peculiar behaviour of lithium with respect to the other members of alkali metals.

Ans. See on Page No. 41

25. Discuss the trends in chemical properties of compounds like oxides, hydroxides, carbonates, nitrates and sulphates of IA and IIA group elements.

Ans. See on Page No. 48, 49, 50

Q6. Compare the chemical behaviour of lithium with magnesium.

Ans. Both Li and Mg are more electropositi than Be and less electropositive than Na

(ii) Both Li and Mg form normal oxides

(iii) Both Li^+ and Mg^{+2} ions have nearly equal s

(iv) Both Li^+ and Mg^{+2} ion show easy hydration

(v) Both Li and Mg can form nitrides.

(vi) Both the Carbonates of Li and Mg decomp

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

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

(vii) Nitrates of both show Similar decomposit

$$2Mg(NO_3)_2 \xrightarrow{Heat} 2MgO + 4NO_2 + C$$

Q7. (a) Mention the properties of beryllium in which it does not resemble with its own family.

Ans. See on Page No 43

(b) Why the aqueous solution of Na_2CO_3 is alkaline in nature.

Ans. Aqueous solution of Na_2CO_3 is alkaline due to hydrolysis. During hydrolysis a weak acid (H_2CO_3) and strong alkali (NaOH are formed. Due to strong alkali the aque Solution of Na_2CO_3 shows alkaline prope Thus it turns red litmus to blue

$$Na_2CO_3 + 2H_2O \longrightarrow 2NaOH + H_2CO_3$$

Q8. (a) Describe with diagram the manufacture of sodium by Down's cell.

Ans. See on Page No. 52

(b) Point out the three advantages of this process.

Ans. See on Page No. 53

Q9. (a) Compare the physical and chemical properties of alkali metals with those of alkaline-earth metals.

Ans. See on Page No. 44, 45, 46, 47

(b) What happens when.

(i) Lithium carbonate is heated

(ii) Lithium hydroxide is heated to red hot.

(iii) Beryllium is treated with sodium hydroxide.

(iv) Lithium hydride is treated with water.

Ans.

(i) $Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$

(ii) $2LiOH \xrightarrow{\text{red hot}} Li_2O + H_2O$

(iii) $Be + 2NaOH \longrightarrow Na_2BeO_2 + H_2$
(Sodium beryllate)

(iv) $LiH + H_2O \longrightarrow LiOH + H_2$
(Lithium hydride)

Q10. Give formulas of the following ores.

(a)	Dolomite	(b)	Asbestos
(c)	Halite	(d)	Natron
(e)	Beryl	(f)	Sylvite
(g)	Phosphorite	(h)	Chile salt peter

Ans.

(a) Dolomite $CaCO_3 \cdot MgCO_3$

(b) Asbestos $CaMg_3(SiO_3)_4$

(C) Halite $NaCl$ (d) Natron $Na_2CO_3 \cdot H_2O$

(e) Beryl $Be_3Al_2(SiO_3)_6$ (f) Sylvite. KCl

(g) Phosphorite $Ca_3(PO_4)_2$ (h) Chile Salt Peter $NaNO_3$

Q. 11: Answer the following questions briefly.

a) Why alkali and alkaline earth metals are among the reactive elements of the periodic tables

Alkali metals have one valence electron and alkaline earth metals have two valence electrons. Moreover they have very low ionization energies. So their valence electrons can be easily removed. It is the reason that alkali and alkaline earth metals are very reactive metals in periodic table.

b) Why lime water turns milky with CO_2 but becomes clear with excess CO_2?

When CO_2 passes through lime water, it becomes milky due to formation of insoluble $CaCO_3$. When excess CO_2 is passed, then soluble $Ca(HCO_3)_2$ is formed. So solution becomes clear.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

Lime water

$$CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$$

Calcium bicarbonate

c) How gypsum is converted into plaster of paris. **Ans: See Page No. 64**

d) Why 2% gypsum is added in the cement?

Gypsum is very important component of cement. It increases the setting time of cement and prevents very rapid hardening of cement. It is the reason that 2% gypsum is added in cement

e) **Why lime is added to an acidic soil?**

Lime is a good fertilizer for acidic soils because it neutralizes soil acidity. So amount (Content) of soluble Phosphates increases in soil. It is the reason that lime is added to acidic soil.

f) **How lime and sand are used to make glass?**

Lime reacts with Sand to form Calcium Silicate Glass is a mixture of alkali and alkaline earth metals Silicates with random structure.

$$CaCO_3 + SiO_2 \xrightarrow{Heat} CaSiO_3 + CO_2$$

Lime Stone Sand Calcium Silicate

Because Calcium Silicate is the main Component of glass. It is the reason that lime and Sand are used to make glass

g) **How lime mortar is prepared?**
Ans: See Page No. 68

h: **Why Li_2CO_3 shows easy thermal decomposition but decomposition of K_2CO_3 is more difficult.**

Li^+ ion has small ionic size than K^+ ion. So in Li_2O there is strong electrostatic attraction as compared to K_2O. Thus Li_2O has more lattice energy and high stability. It is the reason why Li_2CO_3 shows easy thermal decomposition and K_2CO_3 does not.

$$Li_2CO_3 \xrightarrow{Heat} Li_2O + CO_2$$

$$K_2CO_3 \xrightarrow{Heat} K_2O + CO_2$$

گلدستہ ڈاٹ پی کے کی جانب سے خوش آمدید

السلام علیکم ورحمتہ اللہ وبرکاتہ

مختصر تعارف

کافی عرصہ سے خواہش تھی کہ ایک ایسی ویب سائٹ بناؤں جس پر طالب العلموں کیلئے کچھ تعلیمی مواد جمع کر سکوں۔ اللہ تعالیٰ نے توفیق دی اور میں نے ایک سال کی محنت کے بعد ایک سائٹ "گلدستہ ڈاٹ پی کے" کے نام سے بنائی جو کہ قرآن و حدیث، اصلاحی، دلچسپ، تاریخی قصے واقعات، اُردو انگلش تحریریں، شاعری و اقوال زریں، F.Sc اور B.Sc کے مضامین کے آن لائن نوٹس، اسلامک، تفریحی، معلوماتی وال پیپرز، حمد و نعت، فرقہ واریت سے پاک اسلامی بیانات، پنجابی نظمیں و ترانے اور کمپیوٹر و انٹرنیٹ کی دنیا کے بارے میں ٹپس، آن لائن کمائی کرنے کے مستند طریقہ کار۔ کے ساتھ ساتھ اور بھی بہت سی چیزوں پر مشتمل ہے۔ اور انشاء اللہ میں مزید وقت کے ساتھ ساتھ اضافہ کرتا جاؤں گا۔ آپ کی قیمتی رائے کی ضرورت ہے۔ عرنان شفیق

اہم نوٹ

ذیل میں جو نوٹس مہیا کیے گئے ہیں وہ کئی گھنٹوں کی لگاتار محنت کے مرتب ہوئے ہیں۔ اور آپ کو بالکل مفت مہیا کر رہے کیے جارہے ہیں۔ آپ سے ان کی قیمت صرف اتنی سی متوقع ہے کہ ایک بار **درودّ ابراھیمی** اپنی زبان سے ادا کر دیں۔

اللّٰهُمَّ صَلِّ عَلٰى مُحَمَّدٍ وَعَلٰى آلِ مُحَمَّدٍ كَمَا صَلَّيْتَ عَلٰى
اِبْرَاهِيْمَ وَعَلٰى آلِ اِبْرَاهِيْمَ اِنَّكَ حَمِيْدٌ مَجِيْدٌ

اللّٰهُمَّ بَارِكْ عَلٰى مُحَمَّدٍ وَعَلٰى آلِ مُحَمَّدٍ كَمَا بَارَكْتَ عَلٰى
اِبْرَاهِيْمَ وَعَلٰى آلِ اِبْرَاهِيْمَ اِنَّكَ حَمِيْدٌ مَجِيْدٌ