ILM KI DUNYA **CHEMISTRY: 12TH CLASS**

CHAPTER – 2 **SECTION – LONG QUESTIONS**

S – BLOCK ELEMENTS

Q.1 Give the names and electronic configuration of alkaline earth metals. **GWL- 2008**

Ans: Electronic configuration of Alkaline Earth Metals.

Beryllium	Be	4	$1s^2, 2s^2$
Magnesium	Mg	12	$1s^2, 2s^3, 2p^6, 2s^2$
Calcium	Ca	20	$1s^2, 2s^2, 2p^6, 3s^1, 3p^6, 4s^2$
strontium	Sr	38	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2$
Barium	Ba	56	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2$
Radium	Ra	88	$1s^2, 2s^2, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2, 4f^{14}, 5d^{10}, 6p^6, 7s^2$

Q.2 Give the names and electronic configuration of Alkali metals. **SGB-2008, MTN-2014,F.B -2015**

Ans: Electronic configuration of Alkali Metals.

Elements	Symbol	At.No.	Electronic Configuration.
Lithium	Li	3	$1s^2, 2s^2$
Sodium	Na	11	$1s^2, 2s^2, 2p^6, 3s^1$
Potassium	K	19	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
Rubidium	Rb	37	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^1$
Cesium	Cs	55	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^1$
Fransium	Fr	87	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2, 5d^{10}, 6p^6, 7s^1$

Continue……p/2……..

Q.3 What happen when?

(i) Lithium carbonate is heated
(ii) Be is treated with NaOH
(iii) Lithium hydride is treated with water
(iv) Lithium hydroxide is heated to red hot.

Ans: (i) $Li_2CO_3 \longrightarrow Li_2O + CO_2$

(ii) $Be + NaOH \longrightarrow Na_2BeO_2 + H_2O$

(iii) $LiH + H_2O \longrightarrow LiOH + H_2$

(iv) $LiOH \longrightarrow Li_2O + H_2O$

Q.4 Explain the trends in chemical properties of alkaline earth metals.

Ans: 1. **Reaction with air:**

The alkaline earth metals burn in oxygen to form normal oxides except barium which forms peroxides. Beryllium is the least reactive metal in the group. It is resistant to complete oxidation and stable in air at ordinary temperature but oxidase rapidly °C. Therefore beryllium is not tarnished by atmospheric attack but the metal soon loses the silvery appearance.

$2He + O_2 \xrightarrow{800\ oC} 2BeO$

When exposed to air, magnesium quickly becomes coated with the layer of Mgo. This layer protect The surface from further corrosion at ordinary temperature.

$2Mg + O_2 \longrightarrow 2MgO$

When magnesium is burnt in air. A small amount of nitride is also formed along with magnesium oxide.

When barium is heated in air or oxygen at 500 – 600 °C, its peroxide is formed.

$Ba + O_2 \xrightarrow{500\text{-}600\ oC} BaO_2$

2. **Reaction with Hydrogen:**

Hydrides are produced by treating the molten alkaline earth metals with hydrogen, usually under high pressure.

Magnesium reacts with hydrogen at high pressure and in the presence of a catalyst (MgI_2) forming magnesium hydride.

$$Mg + H_2 \xrightarrow[(MgI_2)]{Pressure} MgH_2$$

3. **Reaction with nitrogen:**

All group II A elements react with nitrogen on heating giving nitrides. For example. Magnesium reacts with nitrogen to give magnesium nitride.

$3Mg + N_2 \longrightarrow Mg_2N_2$

The nitrides hydrolyze vigorously when treated with water, giving ammonia and the respective hydroxides.

$Mg_2N_2 + 6H_2O \longrightarrow 2NH_3 + 3Mg(OH)_2$

4. **Reaction with Sulphur:**

Elements of group II – A react sulphur, to form metal sulphides. e.g.

$Mg + S \longrightarrow MgS$

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5. **Reaction with Water:**

Magnesium is more reactive than beryllium, even though it is not attacked by cold water. Magnesium reacts slowly with boiling water and quite rapidly with steam to liberate hydrogen.

$$Mg_{(s)} + H_2O_{(g)} \xrightarrow{100\,^oC} MgO_{(s)} + H_{2(g)}$$

6. **Reaction with Halogens;**

All group II – A elements react directly with halogens giving halides of the type MX_2. e.g

$$Ca + Cl_2 \longrightarrow CaCl_2$$

Q.5 Discuss the peculiar behavior of lithium with respect to the other members of alkali metals. OR Discuss peculiar behavior of Li? OR Give any eight difference of "Li" from other Alkali metals.

RWP- 2010, GUJ -2014,SGD-2015,BWP,SGD,FBD-2017,SGD, SWL-2018

Ans: In many properties lithium has different behavior from other members of group IA. The deviation from the regular trend is due to the following reasons.

- **The atomic radius of lithium is very small** as compared to the other members of group I- A .
- The ionic radius of Li+ is 60 pm while that of Na+ is 95 pm.
- Li+ ion has greater charge density. Charge density is the ratio of charge to volume.
- The nuclear charge of Li+ is screened by only two electrons of K-Shell. Due to these reasons lithium is less electropositive than other members of group I-A.

Some important difference of lithium from other metals are given below.

1. Lithium is much harder and lighter than the other alkali metals.
2. The lithium salts of anions with high density are generally less soluble in water than those of the other alkali metals; e.g. LiOH, LiF, Li_2PO_4, Li_2CO_3 are not soluble in water.
3. Lithium forms stable complex compounds, although complex formation generally is not a properly of alkali metals. One of the stable complexes formed by lithium, is $[Li(NH_3)_4]^2$
4. Lithium hydride is more stable than the hydrides of other alkali metals.
5. Lithium compounds are more covalent, that is why its halides are more soluble in organic solvent and the alkyls and aryls of lithium are more stable than those of other alkali metals.
6. Lithium is the least reactive metal of all the alkali metals.
7. Lithium carbide Li_4C, is the only alkali metal carbide formed readily by direct reaction of carbon with lithium.

$$4Li + C \longrightarrow Li_4C$$

8. Lithium reacts very slowly with water, while other alkali metals react violently.

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

9. Lithium reacts with nitrogen to form nitride while the other members of the group do not give this reactions.

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

Q.6 Mention the properties of beryllium in which it does not resemble with its own family. OR How and why "Be" differs from its group members?

LHR-2014,DGK,LHR-2015, SGD,FBD-2016,MTN-2017, BWP ,FBD-2018

Ans: **Peculiar Behavior of Beryllium from other Member.**

Beryllium is the lightest member of the series and differs from the other group II –A elements in many ways. This is due to its small atomic size and comparatively high electronegativity value.

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The main points of difference are:

1. **Hardness:**
   Beryllium metal is almost as hard as iron and hard enough to scratch glass. The other alkaline earth metals are much softer than beryllium but still harder than the alkali metals.
2. **Melting and Boiling point:**
   The melting and boiling points of beryllium are higher than other alkaline earth metals.
3. **Reducing behaviors:**
   As reducing agents, the group II-A, metals are all powerful enough to reduce water. However, with water, beryllium forms insoluble oxide (BeO) coating that protects it from further attack.

4. **Oxidation:**
   Complete oxidation of Beryllium does not occur in the presence of an acid it forms a protective layer which stops the further attack of an acid.

5. **Reaction with alkali:**
   Beryllium reacts with alkali NaOH to form sodium beryllate while other members do not react with alkali NaOH
   $Be + 2NaOH \longrightarrow Na_2BeO_2 + H_2$

6. **Behaviours of oxides:**
   Oxides of beryllium is amphoteric while oxides of magnesium, calcium, strontium and barium are basic in nature. Amphoteric oxides have both acidic and basic properties.

Q.7 State chemical properties of Alkali Metals. **G.B-2010**

Ans: Alkali Metals are good reducing agents:

Alkali metals are good reducing agents. Reducing property of an element depend upon the ionization energy value. Elements with **low ionization energy** value, are good reducing agents. Reducing agent is a substance which can lose electrons and its oxidation increase during a chemical reaction. Alkali metals have low ionization energy value and are good reducing agents. They are highly electropositive. They react with halogens and form alkali metal halides.

Some other properties of alkali metals are given below.

1. **Reactivity:**
   Low ionization energies make the alkali metals the most reactive family of metals.
2. **High second ionization energy:**
   Very high second ionization energies indicate that oxidation number higher than +1 is not found to alkali metals.
3. **Solubility in water:**
   The cations of alkali metals e.g. Na+ , K+ , Rb+ have low charge and large radii than the radius of any cation from the name period, no the lattice energies of their salts are relatively low. Consequently, most of the simple salts of the alkali metals are water soluble. Most of the salts are among the strongest bases available.
4. **Reaction with Oxygen:**
   They react with oxygen and the surface in tarnished due to the oxides formed. Only lithium burns in air to form the normal oxide, Li_2O. In normal oxides, oxidation state of oxygen in -2.

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$$4Li + O_2 \longrightarrow 2Li_2O$$

The exposed metals are oxidized almost immediately by oxygen in air and in the presence of moisture, the oxides formed react with CO_2 in the atmosphere to form carbonates.

$$Li_2O + CO_2 \longrightarrow Li_2CO_3$$

Sodium will undergo a similar reaction, but only if the supply oxygen is limited.

$$4Na + O_2 \longrightarrow Na_2O$$

5. **Reaction with Water:**
Very rapid reactions occur when alkali metals react with water. A small piece of sodium floated on water reacts vigorously to liberate energy produced by the reaction may even ignite the hydrogen.

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

The reaction becomes increasingly vigorous from lithium to cesium. Potassium, rubidium and cesium are so highly reactive that they react with ice even at -100 °C.

6. **Reaction with hydrogen:**
Alkali metals form ionic hydrides with hydrogen. In ionic hydrides, oxidation state of hydrogen is – 1.

$$2M + H_2 \longrightarrow 2M + H$$

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

Rubidium and cesium react violently with hydrogen at room temperature. The other three metals require high temperature in order of form the hydride. Lithium and sodium hydrides are useful sources of hydrogen when treated with water.

7. **Reactions with Nitrogen and Carbon:**
Lithium is the only Group IA metal that combines with nitrogen and carbon to form nitride and carbide respectively.

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

$$4Li + C \longrightarrow Li_4C$$

8. Reactions with Halogens:
Alkali metals react easily with halogens to give halides. Lithium and sodium, react slowly with chlorine at room temperature. Molten sodium burns with brilliant yellow flame in a chlorine atmosphere to form sodium chloride.

$$2Na + Cl_2 \longrightarrow 2NaCl$$

Potassium, rubidium and cesium react vigorously with all the halogens, forming metal halides.

Q.8 Describe the process for the preparation of sodium metal on industrial scale by Down's cell? What are advantages of this process? OR
Summarize extraction of sodium from molten sodium chloride by Down's cell method? OR
Explain the construction of Down's Cell. Give reactions taking place at cathode and anode? OR
Describe with diagram the manufacturing of sodium by Down's cell.

LHR-2009,F.B-2008,2014,2015,BWP-2008,RWP-2014,205,DGK-2010,2014,2015,GUJ.2011,2015, MTN-2015,GUJ,LHR,2014,,GUJ,RWP-2015,SGD,RWP-2016, BWP ,RWP LHR-2017, MTN,BWP-2018

Ans: **Manufacture of Sodium Metal by Down's Cell.**
Most of sodium metal is produced by the electrolysis of fused sodium chloride. Since the melting points of sodium chloride is 801 °C, some Calcium Chloride is added to lower its melting point and permit the furnace to operate at about 600 °C.

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Construction of Cell:

- In the electrolytic cell, the large block of Graphite at the centre acts as anode above which there is a dome for the collection of chlorine.
- The cathode is a circular bar of copper or iron which surrounded the anode but is separated from it by an iron screen. Which terminated in gauze.
- The arrangement permits the electric current to pass freely but prevents sodium and Chlorine from mixture after they have been set free at the electrodes.
- Sodium metal rises in a special compartment from which it is taken out at intervals. The cell produces dry chlorine and 99.9 percent pure sodium. The process is carried out at 600 °C and it has the following reaction.

Reactions:

When sodium chloride is heated at high temperature, it ionizes as follows:

$$NaCl_{(s)} \rightleftharpoons Na^{+} + Cl^{-}$$

Na^{+} ions move towards cathode and Cl^{-} ions move towards anode.

At cathode: $Na^{+} + e^{-} \longrightarrow Na$ (Reduction)

At anode $Cl^{-} \longrightarrow \frac{1}{2} Cl_2 + e^{-}$ (Oxidation)

Net Cell reaction: $NaCl \longrightarrow Na + 1/2\ Cl_2$

Q.9 Describe manufacture of sodium hydroxide by Nelson Cell method. OR
Commercial Preparation of Sodium Hydroxide by the Diaphragm cell.

LHR-2012, 2013, GUJ-2013,FBD -2014,SGD-2014,MTN , LHR-2015,AJK,DGK-2016, SGD, LHR-2017, DGK - 2018

Ans: **Manufacture of Sodium Hydrodied.**

Sodium hydroxide NaOH is also called caustic soda or lye.
"Caustic" means "to corrode the skin."
On large scale, sodium hydroxide is prepared by the Nelson cell method or Diaphragm cell.
Construction of Nelson Cell:

- The cell is made of steel tank provided with a constant level device to keep the inner part of the tank filled the specified level with brine. Saturated solution of NaCl is called brine.
- An oblong perforated steel vessel lined inside with asbestos diaphragm serves as a cathode.
- A graphite anode is held within the U shape diaphragm and it projects into the salt solution.
- The steam is blown during the process which keeps the electrolyte warm and helps to keep the perforations clear.
- The chlorine released at the anode, rises into the dome at the top while hydrogen released at the cathode, escapes through a pipe. The sodium hydroxide solution slowly percolates into a catch basin.

Working of Nelson's Cell:
Reaction at anode:

$$2Cl_{(aq)} \longrightarrow Cl_{2(g)} + 2e^{-}$$

Reaction at Cathode:
At the cathode, hydrogen is discharged by the reduction of water. Reduction potential of H_2O is greater than Na^{+} ion.

$$2H_2O + 2e^{-} \longrightarrow 2OH^{-}_{(aq)} + H_{2(g)}$$

Net Cell reaction:
The overall result of the above reaction is that the brine loses its chloride ions and the solution turns increasingly alkaline in cathode compartment.

$$2Cl^{-} + 2H_2O \longrightarrow 2OH^{-} + H_2 + Cl_2$$ OR

$$2NaCl + 2H_2O \longrightarrow 2NaOH + H_2 + Cl_2$$

Na^{+} ions are not oxidized or reduce din this cell. The ions which do not undergo oxidation or reduction.

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We Cam face two major problems during the working of the diaphragm cell.

1. Chlorine produced can react with hydroxide ions in cold giving hypo chlorite ions.
   $Cl_2 + 2OH \longrightarrow OCl^- + Cl^- + H_2O$
2. Hydroxide ions may be attracted towards anode. Where they can be discharged releasing oxygen gas. This oxygen gas may contaminate the chlorine and renders it impure.

Solution of the two problems of diaphragm cell:

1. The first problem is solved by using asbestos diaphragm. This keeps the two solutions separate while allowing sodium ions to move towards the cathode. This movement of ions keep the current following through the external circuit.
2. The second problem is solved keeping the level of brine in anode compartment slightly higher, this keeps the direction of flow of liquid toward the cathode and thus preventing the possibility of hydroxides ions to reach the anode.

Collection and purification of NaOH.

The solution that flows out of the cathode compartment contains 11% NaOH and 16% NaCl. Evaporation of this solution crystallizes the less soluble NaCl which is filtered off, the liquid left contains about 50% NaOH and only 1% NaCl as an impurity. For commercial purposes this small impurity is not important.

Q.10 Role of Gypsum in Agriculture and Industry. OR
What is the role of Gypsum in Industry OR
Write Four roles of Gypsum in industries. **DGK-2015,GUJ-2017, MTN- 2018**
GUJ-2012,LHR-2012,RWP-2014,SGD-2014, MTN-2008,BWP,LHR-2014

Ans: **GYPSUM:**

Its chemical name is calcium sulphate di-hydrate and chemical formula $CaSO_4.2H_2O$. It is a mineral that occurs in large deposits throughout the world.

Uses of Gypsum:

I. Role in agriculture:

- Gypsum is applied to the soil as a **Source of calcium and sulphur.**
- The Calcium supplied by gypsum in fertilizers of importance in crop production in area where soils are subject to extensive leaching.

Role of sulphur in plants:

- Sulphur has been recognized as an essential constituent of plants. For centuries, sulphur compounds had been applied to soils because of their observed beneficial effect on plant growth.
- Acids from serving as a **Constituent of Protein** and various other compounds in plants, sulphur has an influence on **Chlorophyll development** in plant leaves. Although it is not a Constituent of chlorophyll but plants deficient in sulphur exhibits a pale green colour.
- **The root system** of several plants has been observed to be greatly enlarged by the application of sulphur.
- It has been reported that good crops are produced by the application of sulphur containing materials such as gypsum.

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Q.11 Complete and balance the following equations:

(i) $Mg(NO_3)_2$
(ii) $CaSO_4.2H_2O$
(iii) $Be + O_2$
(iv) $Be + NaOH$
(v) $Mg(OH)_2$
(vi) $Li_2O + H_2O$
(vii) $Na_2O_2 + H_2O$
(viii) $NaNO_3$

Ans:

(i) $2Mg(NO_3)_2 \longrightarrow 2MgO + 4NO_2 + O_2$

(ii) $2CaSO_4.2H_2O \xrightarrow{100\ ^oC} (CaSO_4)_2.H_2O + 3H_2O$

(iii) $Be + O_2 \longrightarrow BeO_2$

(iv) $Be + NaOH \longrightarrow Na_2BeO_2 + H_2$

(v) $Mg(OH)_2 \longrightarrow MgO + H_2O$

(vi) $Li_2O + H_2O \longrightarrow 2LiOH$

(vii) $2Na_2O_2 + H_2O \longrightarrow 4NaOH + O_2$

(viii) $2NaNO_3 \xrightarrow{Heat} 2NaNO_2 + O_2$

Q.12 Discuss two roles of lime in agriculture and six role of lime in industry.

DGK-2015, 2017,SGD-2014,BWP-2014, LHR -2014, AJK-2015, MTN-LHR-DGK-2016

Ans: **Role of lime in agriculture:**

- Large quantities of calcium oxide is used in agriculture for neutralizing acidic soil and for preparing sprays. It increase the pH and increases the amount of readily soluble phosphorus in soil.
- Calcium oxide is used in large amounts for making **Lime-sulphur** sprays which have a strong fungicidal action.

Slaking of Lime:

The hydroxide of calcium is obtained when the oxide of the calcium is allowed to react with water. The process is called **Slaking of Lime** and it is an exothermic reaction.

Function of Calcium in Plant Growth:

- The presence of calcium is essential for the normal development of plants. The quantity of calcium required by different plants varies considerably.
- An adequate supply of calcium appears to stimulate the **development of root hairs** and in fact the entire root system.
- Calcium is also necessary for normal leave development and tends to accumulate in leaves as well as in bark.
- An adequate supply of calcium is also essential for the optimum activity of micro-organisms that produce nitrates.
- The effect of calcium on the supply of available phosphorus in the soil is of special significance. Soils containing sufficient calcium are slightly alkaline in nature.
- When a deficiency of calcium exists various substances such as aluminum and manganese may accumulate in plants in harmful concentrations.

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Uses of Lime. $(CaO)_2$:

1. Large quantities of lime are used in the extraction and refining of metals.
2. Lime in also used in paper industries.

Q.13 Give formulas of the followings. **MTAN-2015, BWP-2015**

(i) Dolmite
(ii) Sylvite
(iii) Trona
(iv) Chale saltpatre
(v) Asbestos
(vi) Alunite
(vii) Beryl
(viii) Natron

Ans:

(i)	Dolmite	Formula	$MgCO_3$. $CaCO_3$
(ii)	Sylvite	Formula	KCl
(iii)	Trona	Formula	Na_2CO_3 $2NaHCO_3$. $2H_2O$
(iv)	Chale saltpatre	Formula	$NaNO_3$
(v)	Asbestos	Formula	$CaMg_3$ $(SiO_3)_4$
(vi)	Alunite	Formula	$K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3$
(vii)	Beryl	Formula	$Be,Al_2(SiO_3)_2$
(viii)	Natron	Formula	$Na_2CO_3.H_2O$

Q.14 Discuss the trend in chemical properties of compounds like Oxides, Carbonates. **SGD-2015, SWL-2015**

Ans: **Oxides:**

Solubility of group I – A Oxides:

Normal oxide of group IA and II A reacts with water to form hydroxides. Peroxides, on dissolving in water forms hydroxides and oxygen gas.

The reaction of an alkali metals oxide with water in an acid-base reaction and not an oxidation reduction reaction since no element undergoes a change in its oxidation number. The reaction simply involves the decomposition of water molecule by an oxide ion.

Carbonates of Alkali Metals:

Effect of Heat:

The carbonates of alkali metals are all **soluble in water** and are stable towards heat except Li_2CO_3. Which is not only insoluble but also decompose on heating to lithium oxide.

THE END