

## CHAPTER # 08:

## CHEMICAL REACTIVITY

**METALS:** Metals are the elements (except hydrogen) which are electropositive and form cation by losing electrons.

**CATEGORIES OF METALS:** There are three basic categories of metals.

- 1) Very reactive
- 2) Moderately reactive
- 3) Less reactive

### IMPORTANT PROPERTIES OF METALS:

- i) Except mercury all the metals are solids.
- ii) They have high melting and boiling points.
- iii) Metals are good conductors of heat and electricity.
- iv) Metals have high density.
- v) Metals possess metallic luster and their surface can be polished.

**IMPORTANCE OF COPPER:** Copper is an important metal. It is used to make electrical cables, Ornaments, Coins and alloys. It is also used to make artificial jewelry.

**ELECTROPOSITIVITY:** The tendency of a metal to lose electrons is called electropositivity



**TREND IN GROUPS:** As we move from top to bottom in a group then electropositivity increases. This is because in a group the size of an atom increases but ionization energy decreases.

**Example:** In group I–A sodium is more electropositive than lithium.

**TREND IN PERIOD:** As we move from left to right in a period then electropositivity decreases. This is because in a period the size of an atom decreases but ionization energy increases.

**Example:** In second period lithium is more electropositivity than Beryllium.

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### QUESTION: What are alkali Metal?

The elements of group I–A except hydrogen are known as alkali metals. These elements include lithium, Sodium, Potassium, Rubidium, Cesium and Francium. The alkali metals have one electron in their valence shell. Therefore alkali metals have electron configuration  $ns^1$  in their valence shell. They react with hydrogen, Oxygen and halogens. They also react with water.

### QUESTION: What are Alkaline Earth Metals?

The elements of group II–A are called alkaline earth metals. These elements include beryllium, magnesium, Calcium, Strontium and Radium. They are given name alkaline earth metal because they are found in earth's crust. These metals are very reactive therefore they are always found in combined forms. Alkaline earth metals have two electrons in their valence shell. Therefore alkaline earth metals have electron configuration  $ns^2$  in their valence shell.

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## ELECTROPOSITIVE CHARACTER AND IONIZATION ENERGY:

The electropositive character of metal depends upon their ionization energy if an element has high value of ionization energy then its electropositive character is very small. And if an element has small value of ionization energy than its electropositivity is large.

**CHEMICAL REACTIVITY:** The tendency of an element to lose or gain electrons in a chemical reaction is called chemical reactivity. **OR**

The ability of a substance to react with other substance is called reactivity.

**TREND OF CHEMICAL REACTIVITY IN GROUP:** The chemical reactivity of metals increases from top to bottom in a group. The chemical reactivity of non – metals decreases from top to bottom in a group.

**TREND OF CHEMICAL REACTIVITY IN PERIOD:** The chemical reactivity of metals decreases from left to right in a period. The chemical reactivity of Non – metals increases from left to right in a period.

### PAGE NO – 152: EXAMPLE NO – 8.1:

**In each o the following pair of elements, Identify which element is more metallic**

a) Na, k

b) Be, Na

a) Na, K:

We know that in any group if we move from top to bottom the metallic character increases. Both sodium (Na) and Potassium (K) belongs to group I–A of the periodic table. But potassium (K) lies below than sodium (Na) therefore ‘K’ is more metallic than ‘Na’.

b) Be, Na:

Sodium (Na) belongs to group I–A and beryllium (Be) to group II–A of the periodic table. We know that elements of group I–A are more metallic than elements of group II–A. Therefore sodium (Na) is more metallic than beryllium (Be).

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### PAGE – NO – 152: SELF ASSESSMENT EX – NO – 8.1

**In each of the following pairs identify, which element is more metallic:**

a) Be, B

b) Si, Al

c) K, Li

a) Be, B:

We know that in any period if we move left to right then metallic character decreases. Beryllium (Be) and Boron (B) both belongs to 2<sup>nd</sup> period of the periodic table. But beryllium (Be) lies more left than Boron (B). Therefore ‘Be’ is more metallic than ‘B’.

**b) Si, Al:**

Both Aluminum (Al) and silicon (Si), lies in 3<sup>rd</sup> period of the periodic table. But aluminum (Al) lies more left than silicon (Si). Therefore 'Al' is more metallic than 'Si'.

**c) K, Li:**

Both potassium (K) and Lithium (Li) belongs to group I–A of the periodic table. But potassium (K) lies below than lithium (Li). Therefore 'K' more metallic than 'Li'.

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**QUESTION: Describe the trends in electropositivity from the nature of oxide.**

**Metal Oxides:** Metal oxides are generally basic in character. This is because they produce bases in water.

**BASIC CHARACTER OF OXIDES:** The basic character of oxide of main group element increases from top to bottom in a group and decrease from left to right in a period.

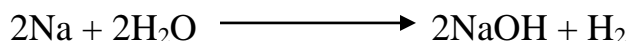
**Non-metallic character:** The non-metallic oxides are generally acidic in character. This is because they produce acids in water.

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**QUESTION: Write important properties and uses of sodium.**

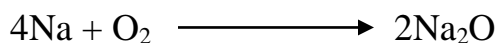
**PROPERTIES:**

- i) Sodium is silvery white soft metal. It is very reactive metal.
- ii) It is very soft metal therefore it can be cut with a knife.
- iii) Its melting point is 97.8<sup>o</sup>C and boiling point is 881.4<sup>o</sup>C.
- iv) It is a good conductor of heat and electricity.
- v) It reacts with water violently to form sodium hydroxide.

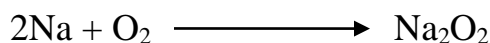


This reaction is highly exothermic a lot of heat is released in this reaction. Therefore it should not be picked with fingers.

- vi) In limited supply of oxygen sodium oxide is formed (N<sub>2</sub>O).



- vii) In excess supply of oxygen sodium per oxide is formed.

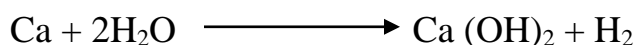
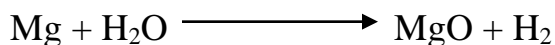


## USES OF SODIUM METAL

- i) Sodium metal is used in sodium lamps to illuminate high ways.
  - ii) When sodium is mixed with potassium then a liquid alloy is formed. This liquid alloy is used as coolant in nuclear reactors.
  - iii) Sodium metal is used in petroleum industry in the production of antiknock compound for gasoline (petrol).
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**QUESTION: Write properties of important alkaline earth Metal. OR  
Write properties of Calcium and magnesium.**

- i) Calcium and magnesium are the most common alkaline earth metals.
- ii) They belong to second group of the periodic table and contain two electrons in their valence shell.
- iii) These metals are relatively soft but much harder than alkali metals.
- iv) These metal are less reactive than alkali metals.
- v) Magnesium reacts with steam but calcium react with cold water.



- vi) Magnesium reacts with oxygen at high temperature but calcium react with oxygen at room temperature. Due to this we can say that calcium is more reactive than magnesium.

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**QUESTION: What is importance of magnesium? OR Write uses of Magnesium.**

- i) Magnesium has relatively low density therefore it is used in making light weight alloy with aluminum. These light weight alloy are used for making frames of automobiles, air craft, space ship and cameras.
- ii) Magnesium burns brilliantly therefore it is used in photo flash guns.
- iii) Magnesium hydroxide  $\text{Mg}(\text{OH})_2$  is also called milk of magnesia. It is used as antacid. (It decreases the acidity of stomach).

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**QUESTION: What is importance of calcium? OR Write uses of calcium.**

- i) Calcium is an important component of bones and teeth.
- ii) Calcium ions are found in all living cells.
- iii) Calcium ions are involved in clotting of blood.
- iv) A proper  $\text{Ca}^{+2}$  and  $\text{K}^{+1}$  ions balance is required for normal heart function.

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**INERTNESS OF NOBLE METALS:** Some metals such as copper, silver, gold and platinum are relatively difficult to oxidize therefore these metals are called noble metals.

**EXPLANATION:** All active metals react with 'HCl' but noble metals do not react with 'HCl' copper and silver react with concentrated nitric acid ( $\text{HNO}_3$ ) but gold and platinum react only with aqua regia.

**AQUA REGIA:** Gold and platinum react only with aqua regia. Aqua regia is a mixture of three parts by volume of conc HCl and one part by volume of conc  $\text{HNO}_3$  it is also called royal water.

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## QUESTION: What is Karat system?

Pure gold is a soft metal so it cannot be used alone for making jewelry. It is alloyed with copper to make it harder. A karat system is used to express the purity of gold. Pure gold is 24 karat, coinage gold is 22 karat. In Pakistan coins are made from copper – Nickel alloy.

$$\text{Formula} = \frac{\text{Karat}}{24} \times 100$$

$$24 \text{ karat} = \frac{24}{24} \times 100 = 100\% \text{ gold}$$

$$22 \text{ karat} = \frac{22}{24} \times 100 = 92\% \text{ gold}$$

$$18 \text{ karat} = \frac{18}{24} \times 100 = 75\% \text{ gold}$$

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**IMPORTANCE OF SILVER GOLD:** Silver and gold are used to make jewelry and ornaments, for thousands of years. These metals have beautiful luster and high malleability therefore they can be transformed easily into different shapes. But these two metal silver and gold are soft metals therefore they cannot be directly used to make jewelry. To make them harder these two metals are alloyed with copper. In old days gold and silver were used to make coins. But now-a day's copper nickel alloys are used to make coins.

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## QUESTION: Write importance of platinum. OR Write uses of platinum.

1) Platinum is a very reactive metal therefore it is used as catalyst for many chemical reactions.

**Example:** 100% pure sulphuric acid is prepared by the contact process. In this process platinum is used as catalyst.

2) Platinum is used as an electrodes in the process of electrolysis.

3) **Catalytic Converters:** Automobiles exhaust is a major source of air pollution. To decrease this air pollution new model cars are installed with catalytic converter. These catalytic converter contain platinum metal. This platinum metal helps for the complete combustion of carbon-monoxide (CO) and hydrocarbon's.

4) A platinum compound called Cis – platin is used as anti – cancer agent.

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**NON – METALS:** Elements that conducts heat and electricity poorly are called non – metals.

Non – metals are generally gases or dull brittle solids. Bromine is a non – metal which is present in liquid state.

**METALLOIDS:** Those elements which have mixed properties of metals and non – metals are called metalloids. Metalloids they play a very important role in modern electronic materials.

**Examples:** Silicon and germanium are metalloids. These elements are use in computer chips and solar cells.

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**ELECTRONEGATIVE CHARACTER:** The tendency of an atom to gain electrons to form anions is called electronegativity character. Electronegative character is the reverse of electropositive character.

**TREND IN GROUPS:** If we move from top to bottom in a group then electronegative character decreases.

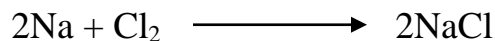
**TREND IN PERIODS:** If we move left to right in period then electronegative character increases.

Halogens are the most electronegative elements in their respective periods.

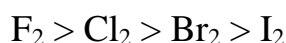
**HALOGENS:** The element of group VII–A of the periodic table are called halogens. The name halogen is derived from the Greek word ‘Halos’ meaning ‘salt’ and ‘gen’ meaning former. Therefore the word halogen means salt former. Halogen group contain elements fluorine, chlorine, bromine, iodine and astatine all halogens are reactive non–metals and they exist as diatomic molecules.

## COMPARISON OF REACTIVITY OF HALOGENS

1) All the halogens react with metals to form salts and halides. In these reactions metals are oxidized so halogens act as oxidizing agents.



2) Fluorine is the most reactive element known. Chlorine is less reactive. The reactivity of halogen’s decreases from top to bottom in a group. The order of reactivity if



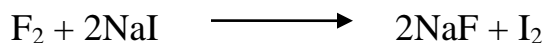
3) Halogen’s react with hydrogen to form hydrogen halides:



The reaction of fluorine with hydrogen is explosive.

4) The acidic strength of halogens increases in the following order:  $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$

5) The oxidizing power of fluorine is the highest and oxidizing power of iodine is lowest. Therefore fluorine can oxidize all the halide ions to free halogen.



**STRONTIUM – 90:** Strontium – 90 is a radioactive isotope. It is a major product of an atomic bomb explosion. Constant exposure of the human body to high energy radiations of strontium – 90 can cause anaemia, Leukemia and other chronic diseases.

**ROLLED GOLD:** Rolled gold is a thin layer of gold alloy that is bounded onto brass or nickel–silver alloy.