INDIAN SCHOOL AL WADI AL KABIR

Class: X	**Department: SCIENCE 2020 -21** **SUBJECT : CHEMISTRY**	
HANDOUTS	**CHAPTER: METALS AND NON-METALS**	**Note:** **A4 FILE FORMAT**
Name of the student:	**Class & Sec:**	**Roll No:**

CHAPTER-3-METALS AND NON-METALS

PHYSICAL PROPERTIES OF METALS:-

- Metals are hard solids.
  Exception:-Sodium, potassium and lithium are soft metals. Mercury is a liquid metal.
- Metals have metallic lustre.(shining appearance on the new cut surface of metals)
- Metals are malleable. (Metals can be beaten into thin sheets.)
  Gold and silver are the most malleable metals.
- Metals are ductile. (Metals can be drawn into thin wires.)
  Gold is the most ductile metal.
- Metals are sonorous. (Metals produce a ringing sound on striking a hard surface.)
- Metals are good conductors of heat and electricity.
  The best conductors are silver and copper. Lead and mercury are poor conductors of heat.
- Metals have high melting and boiling points.
  Exception:-Gallium and caesium are metals with low melting points.

PHYSICAL PROPERTIES OF NON-METALS:-

- Non-metals are either solids or gases.
  Bromine is a liquid non-metal.
- Non-metals do not have metallic lustre.
  Exception: - Iodine is a non-metal which has metallic lustre.
- Non-metals are non-malleable, non-ductile and non-sonorous.
- Non-metals are bad conductors of heat and electricity.
  Exception: - Graphite is a good conductor of electricity.
- Non-metals have low melting and boiling points.
  (Carbon is a non-metal that can exist in different forms. Diamond, an allotrope of carbon is the hardest natural substance known and has very high melting and boiling point. Graphite another allotrope of carbon, is a conductor of electricity.)

CHEMICAL PROPERTIES OF METALS:-

1. **REACTION OF METALS WITH OXYGEN**

$$\boxed{\text{Metal} + \text{Oxygen} \rightarrow \text{Metal oxide}}$$

- Metal oxides are basic in nature.

  Eg:- $2Cu + O_2 \rightarrow 2CuO$

  $4Al + 3O_2 \rightarrow 2Al_2O_3$
  (Aluminium oxide)

Some metal oxides show both acidic as well as basic properties. Such metal oxides are known as **amphoteric oxides.** Amphoteric oxides react with both acids as well as bases to produce salt and water.(Eg:- Aluminium oxide and Zinc oxide)

$$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$$

$$Al_2O_3 + 2NaOH \rightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + H_2O$$

Different metals show different reactivities towards oxygen.

- Metals like sodium and potassium react vigorously with oxygen and catch fire. So to prevent accidental fires and to protect these metals, they are stored in kerosene.
- Metals like Magnesium, Aluminium, Zinc, lead etc. are covered with a thin layer of oxide. This protective oxide layer prevents the metal from further oxidation.
- Iron does not burn on heating. Iron filings burn vigorously at high temperatures.
- Copper does not burn, but the hot metal is coated with a black coloured layer of copper oxide.
- Least reactive metals like gold, silver etc. do not react with oxygen even at high temperatures.

REACTION OF METALS WITH WATER:-

Metal + water→ metal oxide +hydrogen
Metal oxide + water→ Metal hydroxide.

- Metals like sodium and potassium react vigorously even with cold water. The reaction is exothermic and the heat evolved is sufficient for hydrogen gas to catch fire.

$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$ + heat energy
$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$ + heat energy

- Calcium reacts less violently with water. The heat evolved is not sufficient for hydrogen to catch fire.

  $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$

Calcium starts floating because the bubbles of hydrogen gas formed stick to the surface of the metal.

- Magnesium reacts with hot water. Magnesium starts floating because bubbles of hydrogen gas stick to its surface.
  $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$
- Metals like aluminium, iron and zinc react with steam to form metal oxide and hydrogen gas.
  $2Al(s) + 3H_2O(g) \rightarrow Al_2O_3(s) + 3H_2(g)$
  $3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$
- Metals like lead, copper, silver and gold do not react with water at all.

REACTION OF METALS WITH ACIDS:-

Metal +dilute acid → salt + hydrogen gas

Eg:- $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

- Hydrogen gas is not evolved when a metal reacts with nitric acid. Nitric acid is a strong oxidising agent. It oxidises the hydrogen produced to water and itself gets reduced to any of the nitrogen oxides(N_2O, NO_2, NO)
- Metals like magnesium and manganese react with very dilute nitric acid to release hydrogen gas.

REACTION OF METALS WITH SOLUTIONS OF OTHER METAL SALTS-(DISPLACEMENT REACTION):-

Metal A + Salt solution of B → Salt solution of A + Metal B

Highly reactive metals can displace less reactive metals from their compounds in solution or molten form.

Eg:- $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

THE REACTIVITY SERIES:-

Reactivity series is the arrangement of metals in the decreasing order of reactivity.

K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	Reactivity decreases
Fe	Iron	
Pb	Lead	
H	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

REACTION OF METALS WITH NON-METALS-(FORMATION OF IONIC COMPOUNDS):-

When **metals react** with **non-metals**, electrons are transferred from the **metal** atoms to the **non-metal** atoms, **forming ions**. (the metal atoms give electrons to the non-metal atoms. The **metal atoms become positive ions** and the **non-metal atoms become negative ions**.) There is a strong electrostatic force of attraction between these oppositely charged ions – this is called an **ionic bond**. The resulting **compound** is called an **ionic compound**.

ie, the compounds formed by the transfer of electrons from a metal to a non-metal are called ionic compounds or electrovalent compounds.

Formation of NaCl:-

Atomic number of sodium-11, electronic configuration- K L M
2 8 1
Sodium loses one electron from its outermost shell and forms Na+.
Atomic number of Chlorine is 17, electronic configuration- K L M
2 8 7
Chlorine has seven electrons in its outermost shell and it requires one more electron to complete its octect. It accepts one electron and forms Cl^- .

Sodium and chloride ions, being oppositely charged, attract each other and are held by strong electrostatic force of attraction to exist as Sodium chloride (NaCl)

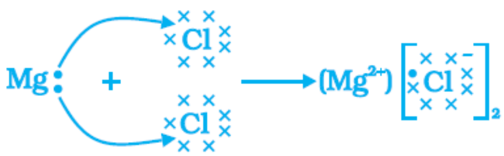
$$\underset{2,8,1}{Na} \rightarrow \underset{\substack{2,8\\ \text{(Sodium cation)}}}{Na^+} + e^-$$

$$\underset{2,8,7}{Cl} + e^- \rightarrow \underset{\substack{2,8,8\\ \text{(Chloride anion)}}}{Cl^-}$$

Formation of $MgCl_2$:-

$$\underset{2,8,2}{Mg} \longrightarrow \underset{\substack{2,8\\ \text{(Magnesium cation)}}}{Mg^{2+}} + 2e^-$$

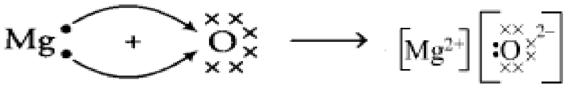
$$\underset{2,8,7}{Cl} + e^- \longrightarrow \underset{\substack{2,8,8\\ \text{(Chloride anion)}}}{Cl^-}$$



Formation of MgO:-

$$\underset{[2,8,2]}{Mg} \longrightarrow \underset{[2,8]}{Mg^{2+}} + 2e^-$$

$$\underset{[2,6]}{O} + 2e^- \longrightarrow \underset{[2,8]}{O^{2-}}$$



PROPERTIES OF IONIC COMPOUNDS:-

1. **Physical nature:-** Ionic compounds are solids and are hard because of the strong force of attraction between the positive and negative ions.These compounds are generally brittle and break into pieces when pressure is applied.

2. **Melting and boiling points:** - Ionic compounds have high melting and boiling points. This is because a considerable amount of energy is required to break the strong inter-ionic attraction.

3. **Solubility:** - Ionic compounds are generally soluble in water and insoluble in solvents such as kerosene, petrol etc.

4. **Conduction of electricity:** - Ionic compounds in the solid state do not conduct electricity because movement of ions in the solid is not possible due to their rigid structure. But ionic compounds conduct electricity in the molten state and in the solution form as ions are free to move to conduct electricity.