

## CHAPTER – 3

### METALS AND NON-METALS

#### PHYSICAL PROPERTIES OF METALS AND NON-METALS

- 1) SOLIDS
- 2) LUSTROUS (Shiny Surface)
- 3) MALLEABILITY ( Property/Ability of a substance to be beaten into sheets)
- 4) DUCTILITY (Property/Ability of a substance to be drawn into wires)
- 5) CONDUCTS ELECTRICITY
- 6) CONDUCTS HEAT
- 7) SONOROUS
- 8) HIGH MELTING POINT

**NOTE: THE PROPERTIES OF NON-METALS ARE JUST THE OPPOSITE OF THAT OF THE METALS (DO THAT AS AN ASSIGNMENT)**

#### EXCEPTIONS:

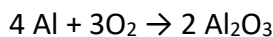
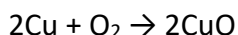
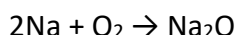
- 1) Hg (Mercury) exist as a liquid at room temperature.
- 2) Ga (gallium) and Cs (Caesium) have very low melting points.
- 3) Alkali metals (Li [Lithium], Na [Sodium], K [Potassium]) are soft (contrary to the hard nature of metals). They can be cut by a knife. They have low densities as well as low melting point.
- 4) I<sub>2</sub> is a non-metal and is lustrous.
- 5) Carbon is a non-metal that can exist in different allotropic forms.
  - (i) Diamond is an allotrope of a carbon. It is the 'Hardest' known substance in the world despite being a non-metal.
  - (ii) Graphite is an allotrope of carbon. It is a conductor of electricity.

#### CHEMICAL PROPERTIES OF METALS AND NON-METALS

##### 1) REACTIONS WITH OXYGEN/AIR

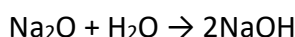


Examples:



##### a) METAL OXIDES: BASIC OXIDES

⇒ Metal oxides that get dissolved in water, forms alkalis. For Eg:



NaOH (Sodium Hydroxide) formed is alkaline in nature.

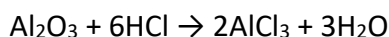
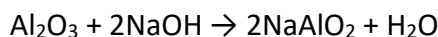
b) NON-METAL OXIDES: ACIDIC OXIDES

⇒ Non-metal oxides that gets dissolved in water, forms acidic solution. For Eg:



$\text{H}_2\text{CO}_3$  (Carbonic Acid) formed is acidic in nature.

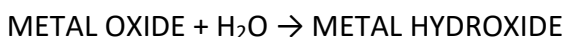
c) AMPHOTERIC OXIDES: METAL OXIDES THAT REACT WITH BOTH ACIDS AND BASES TO PRODUCE SALT AND WATER ARE CALLED AMPHOTERIC OXIDES.



In the first reaction,  $\text{Al}_2\text{O}_3$  behaves as an acid!!

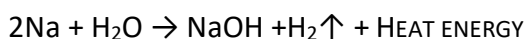
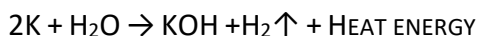
In the second reaction,  $\text{Al}_2\text{O}_3$  behaves as a base!!

## 2) REACTIONS WITH WATER



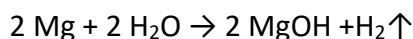
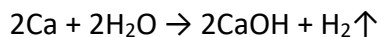
If the metal oxide dissolves in water then only it further reacts with water to form its hydroxide.

a) METALS REACTING VIOLENTLY WITH WATER: Na , K , etc (Alkali Metals)

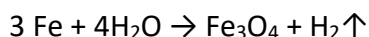
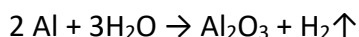


Na and K react violently with cold water and releases massive amount of heat energy. The  $\text{H}_2$  gas evolved catches fire!!

b) METALS REACTING WITH WATER: Mg and Ca



c) METALS REACTING WITH STEAM: Fe and Al



Lead (Pb) , copper (Cu) , silver (Ag) and gold (Au) do not react with steam.

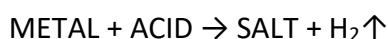
QUESTION: Why does  $\text{H}_2$  gas catches fire when Na or K is reacted with water?

ANSWER: Na and K react violently with water and release a huge amount of heat energy in the reaction. The  $\text{H}_2$  gas evolved from the react of metal and water catches fire (as  $\text{H}_2$  is a flammable gas) due to the heat from the reaction.

QUESTION: Why do Mg and Ca start floating when immersed into water?

ANSWER: The  $\text{H}_2$  gas bubbles formed during the reaction of metal and water sticks to the surface of the metal. This creates an upward force which brings the metal upwards.

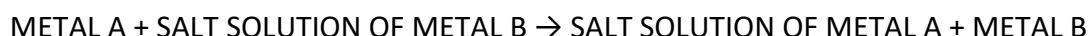
## 3) REACTIONS WITH ACIDS



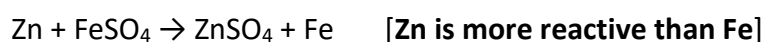
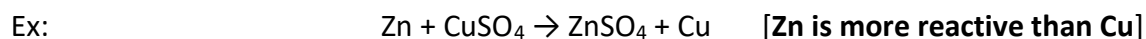
All acids give hydrogen gas effervesce except for Nitric Acid ( $\text{HNO}_3$ )

- a) Nitric acid is a strong oxidising agent and oxidises the hydrogen gas evolved to water and itself gets reduced to Nitrogen Oxides ( $\text{N}_2\text{O}$ ,  $\text{NO}$ ,  $\text{NO}_2$ ).
- b) However, for VERY DILUTE NITRIC ACID Magnesium (Mg) and Manganese (Mn) gives  $\text{H}_2$  gas.

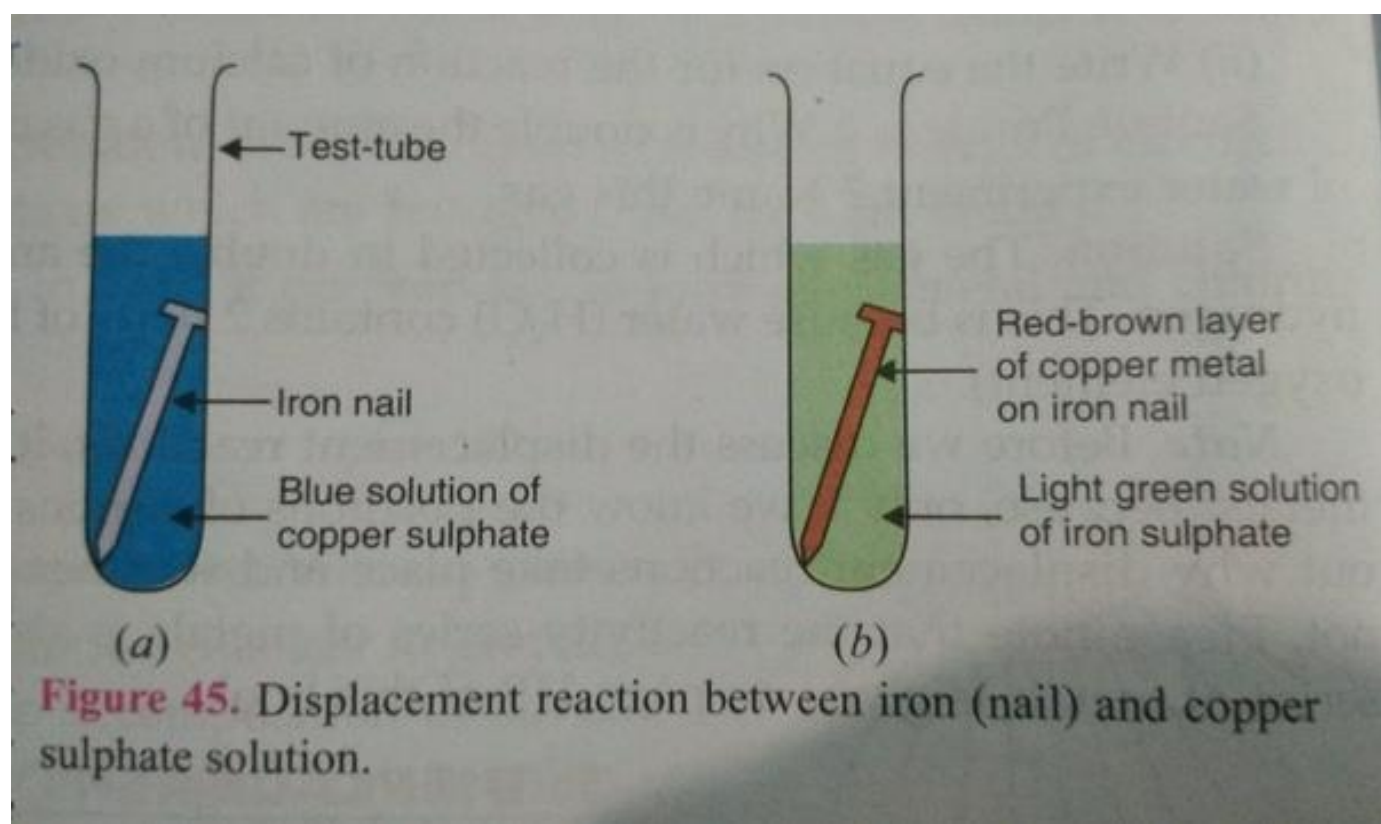
#### 4) REACTIONS WITH SALTS OF OTHER METALS



The above reaction is also called DISPLACEMENT REACTION!!



CLASSIC EXAMPLE: When an iron nail is dipped in  $\text{CuSO}_4$  solution then the blue coloured solution of  $\text{CuSO}_4$  solution turns blue-greenish in colour. This indicates the formation of  $\text{FeSO}_4$  solution.



QUESTION: Why is Na metal kept immersed in kerosene oil?

ANSWER: Na metal reacts violently with atmospheric oxygen. This reaction can cause fires! To prevent this Na metal is kept immersed in kerosene oil to prevent the contact of Na metal and oxygen gas.

QUESTION: Why does Al not corrode easily??

ANSWER: Al forms a thin protective layer of oxide which further prevents the corrosion of the Al article as it prevents the contact of Al and atmospheric oxygen.

QUESTION: What is Aqua Regia??

ANSWER: Aqua Regia is a freshly prepared mixture of concentrated  $\text{HCl}$  and  $\text{HNO}_3$  in the ratio of 3:1. It can even dissolve gold, while none of the two acids are able to do this.

### REACTIVITY SERIES:

Based on the reactive nature of the metals a series consisting of several metals are arranged in order of there reactivity.

## REACTIVITY SERIES

K	Kidar	MOST REACTIVE
Na	Nath	
Ca	Ca	
Mg	Mali	
Al	Aloo	
Zn	Zara	DECREASING REACTIVITY
Fe	Fekke	
Sn	Se	
Pb	Pakkata	
H	Hai	
Cu		LEAST REACTIVE
Hg		
Ag		
Au		

**[NOTE: FOR IONIC BOND, REFER TO CLASS NOTES!!!]**