

1/1/2024  
Monday.

## METALS AND NON-METALS

### PHYSICAL PROPERTIES:

METALS: (Eg: Copper, iron, aluminium, magnesium ... etc).

- Lusture  $\Rightarrow$  shining surface of metals.
- Hardness  $\Rightarrow$  metals are generally hard.
- Malleable  $\Rightarrow$  metals can be beaten into thin sheets
- Ductile  $\Rightarrow$  metals drawn into thin wires.  
 $\rightarrow$  Gold is the most ductile metal
- Metals are good conductors of heat and have high melting points.  
(Best: silver and copper).  
(Poor: Lead and Mercury).
- Sonority  $\Rightarrow$  the sound which metals make when hit with some force.

NON-METALS: (Eg: Carbon, Sulphur, Iodine, Oxygen, Hydrogen ... etc).

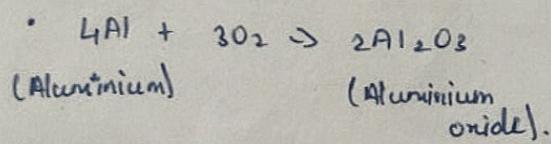
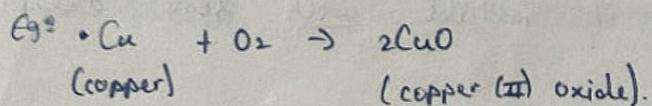
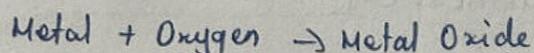
Opposites of metals with some exceptions.

- We cannot group elements only on the basis of physical properties, as there are many exceptions:
  - Mercury is a metal which is in the form of liquid at room temperature.
  - Iodine is a non-metal but lustrous.
  - Carbon is a non-metal, it can exist in different forms. Each form is called allotrope.
    - ↳ Diamond is the most hardest natural substance and is an allotrope.
  - Graphite is a conductor of electricity.
  - Alkali metals (sodium, potassium) can be cut by knife.

Metals and Non-Metals can be classified more clearly from their chemical properties:

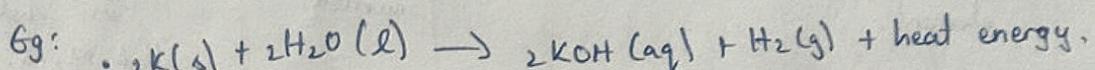
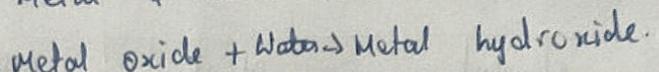
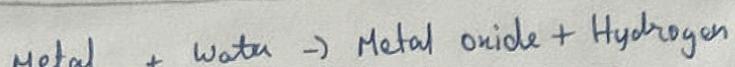
#### CHEMICAL PROPERTIES OF METALS:

- Metal reacts with air:

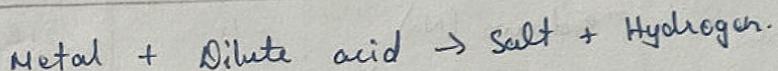


Note: Anodising is a process of forming a thick oxide layer of aluminium.

- Metal reacts with water:



- Metal reacts with acid:



- Metal reacts with solutions of other metal salts:



### THE REACTIVITY SERIES:

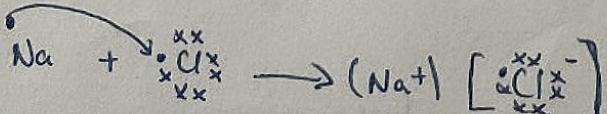
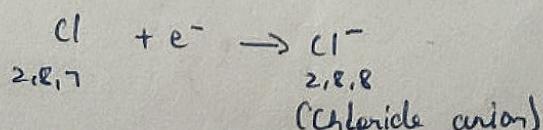
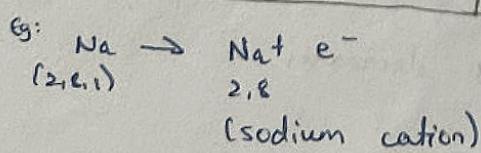
K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	Reactivity decreases
Fe	Iron	
Pb	Lead	
[H]	[Hydrogen]	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive.

## HOW DO METALS AND NON-METALS REACT:

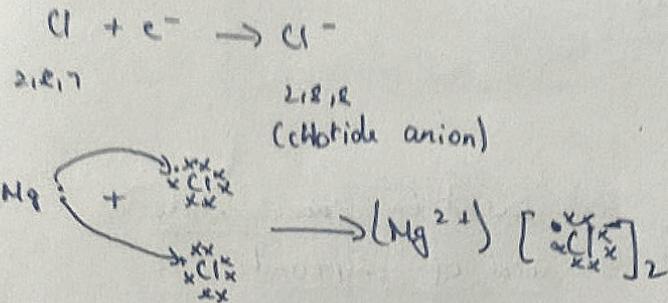
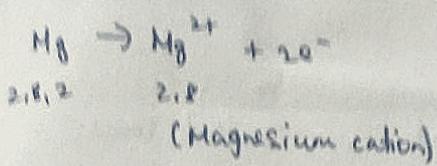
Noble gas: Elements which have completely filled valence shell.

Electronic Configuration of some elements:

Types of element	Element	Atomic number	Number of electrons in shells K, L, M, N.
Noble gases.	Helium (He)	2	2
	Neon (Ne)	10	2, 8
	Argon (Ar)	18	2, 8, 8
Metals	Sodium (Na)	11	2, 8, 1
	Magnesium (Mg)	12	2, 8, 2
	Aluminium (Al)	13	2, 8, 3
	Potassium (K)	19	2, 8, 8, 1
	Calcium	20	2, 8, 8, 2
Non - Metals	Nitrogen (N)	7	2, 5
	Oxygen (O)	8	2, 6
	Fluorine (F)	9	2, 7
	Phosphorous (P)	15	2, 8, 5
	Sulphur (S)	16	2, 8, 6
	Chlorine (Cl)	17	2, 8, 7



FORMATION  
OF  
SODIUM CHLORIDE.



### PROPERTIES OF IONIC COMPOUNDS:

- Physical Nature: Somewhat hard because of strong force of attraction between positive and negative ions.
- Melting and Boiling points: Have high melting and boiling points.
- Solubility: Are generally soluble in water and insoluble in solvents such as kerosene, petrol...etc...
- Conduction of Electricity: Involve a movement of charged particles. They conduct electricity in molten state.

### Melting and Boiling points of some compounds:

NaCl : Melting : 1074K ; Boiling 1626K

LiCl : 887K ; 1600K

CaCl<sub>2</sub> : 1045K ; 1900K

CaO : 2850K ; 3120K

MgCl<sub>2</sub> : 981K ; 1685K.

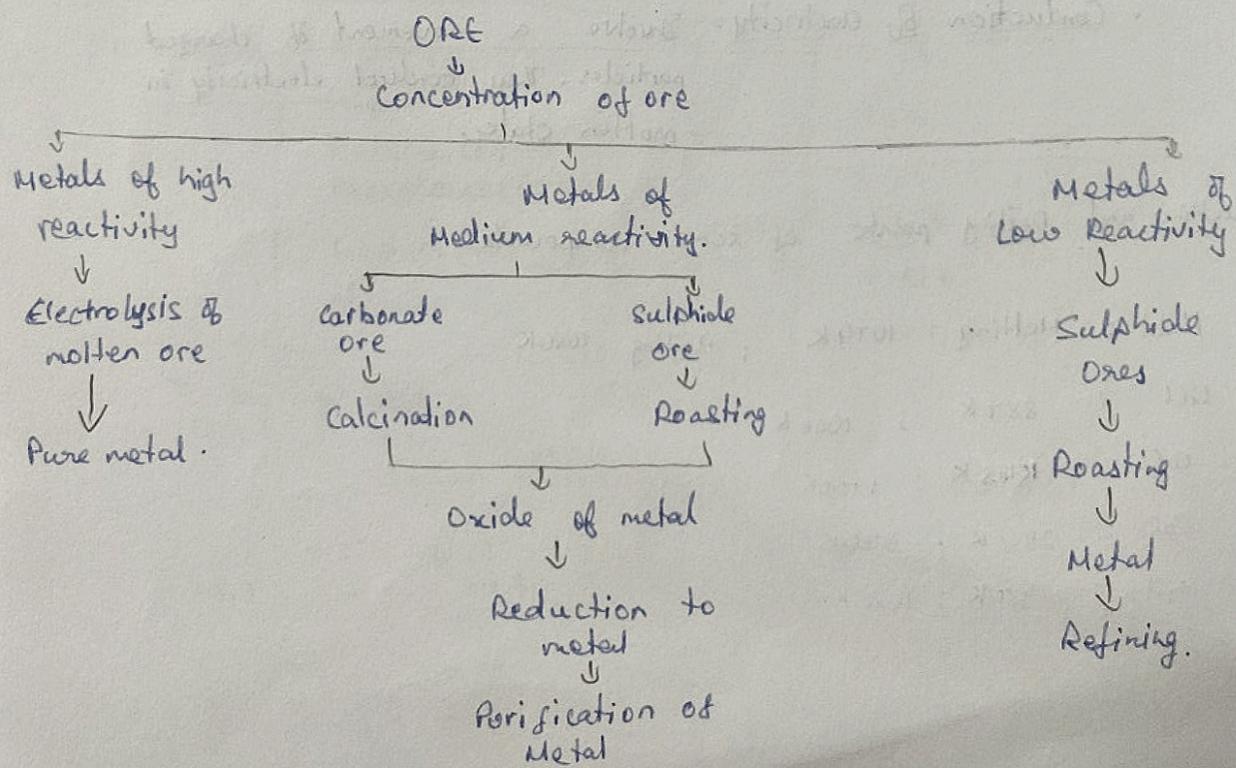
## OCCURRENCE OF METALS:

Metals found in impure state are called ores.  
(Minerals are called ores).

## EXTRACTION OF METALS:

- Some metals are found in free state.
- Some are in the form of compounds.
- Metals which are less reactive are found in free state. (e.g: Gold, silver, platinum, copper. →)
- Copper and silver are also found in combined state as their sulphide or oxide ores.
- Metals which are very reactive (K, Na, Ca, Mg and Al) are never found in free state.
- The moderately reactive metals are usually found as oxides, sulphides or carbonates.

## STEPS INVOLVED IN THE EXTRACTION OF METALS FROM ORES.



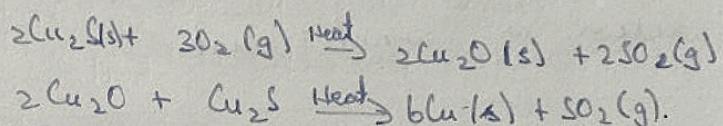
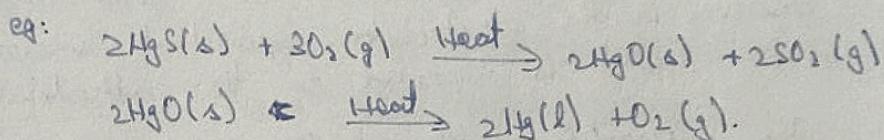
## SIMPLIFICATION OF ORES:

- Ores are contaminated with large amounts of impurities such as soil, sand... etc called gangue.
- Impurities are removed before extraction of ores.
- The process for removing gangue are based on differences between physical and chemical properties of the gangue and the ore. Different separation techniques are accordingly employed.

## EXTRACTING METALS:

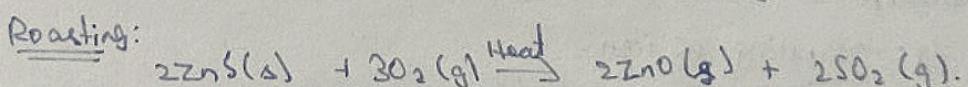
### LOW IN ACTIVITY SERIES:

- Reduced by heating alone.

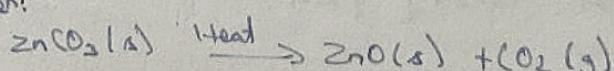


### MID IN ACTIVITY SERIES:

- Converted into metal oxides for extraction.

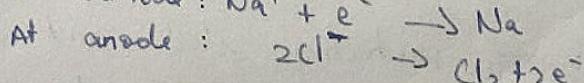
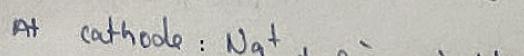


### Calcination:



### TOP IN ACTIVITY SERIES:

- Obtained by electrolytic reduction



## REFINING OF METALS:

(8)

- Even after reduction process they contain impurities. They are removed by electrolytic refining for making them pure.

### ELECTROLYTIC REFINING:

- Copper, Zinc, tin, nickel, silver, gold...etc are refined electrolytically.
- Impure metal is made anode and pure metal is made cathode.
- Solution of Metal salt is used as an electrolyte.
- Pass the current, the pure metal from anode dissolves in the electrolyte. Equivalent amount of pure metal is deposited on the cathode.
- The impurities settle at the bottom of the anode known as anode mud.

## CORROSION:

Slow process of eating away of metals by reaction of atmospheric air and moisture.

- Eg:
  - Rusting of iron
  - Silver becoming black.
  - Copper becoming green

## PREVENTION OF CORROSION:

Can be prevented by: Oiling, Greasing, Painting, galvanising, chrome plating, anodising etc....

Galvanising: Method of protecting steel and iron from rust by coating them with a thin layer of zinc.