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chapter NO: 3
Metals and Non metal

- All the elements and their large number of compound are very important in our every day life.

- At present about 118 chemical elements are known. on the basis of their properties all of them can be divided into two Main groups
  i] Metals
  ii] Non-metals

- Apart from these some element show property of boath metals and non metal There are called metalloids.

* Metals:
- Those element which form from positive ion by loosing electron are called metals.

- Physical property of metal
  - Metalic lusture
  - ductile
  - Malleable
  - Hard
  - good conductor of electricity
  - Sonorous.

Note
Mercury is exception it is in liquide state in room temp

* Chemical properties of metal:
different chemical property of metal are as follow:

i] Reaction of metal with oxygen:
[Burning in air in order to form oxide]

- metal react with oxygen to produce metal oxide
- almost all the metal forms their metal oxide.

metal + oxygen ⟶ metal oxide

Example:

i) $4Al_{(s)} + 3O_{2(g)} \xrightarrow{\Delta \text{ (heat)}} 2Al_2O_{3(s)}$

[aluminium] [oxygen] [Aluminium oxide]

ii) $2Cu_{(s)} + O_{2(g)} \xrightarrow{\Delta} 2CuO_{(s)}$

[copper] [oxygen] [copper oxide]

- Some Exception:

Some metal oxides such as Al_2O_3 and ZnO show both acidic and basic behaviour such metal oxide acid as well as bases to produce salt and water and are called atmospheric oxides.

Example:

$Al_2O_{3(s)} + 6HCl_{(aq)} \longrightarrow 2AlCl_{3(aq)} + 3H_2O_{(l)}$

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- metal oxides are insoluble in water but some these dissolve in water to form hydroxide known as alkali

Eg:

$$Na_2O + H_2O \longrightarrow 2NaOH$$

i) [Sodium Oxide] [water] [Sodium hydroxide]

$$K_2O + H_2O \longrightarrow 2KOH$$

ii) [potassium oxide] [water] [potassium Hydroxide]

- order of Reactivity of metals with oxygen.
- different metal react with oxygen at different rates as (Na) sodium and (K) potassium are reacting very vigorously with oxygen as they catch fire if left in open. hence these are most reactive metal.
- To prevent this the surfaces of magnesium and aluminium are covered with oxides which prevent metal from further oxidation
- Zn (Zinc) burns only on strong heating while iron (Fe) do not Copper (Cu) does not burns on heating but blister copper burns, silver and gold do not react with oxygen.
- we can conclude from above

Na > Mg > Zn > Fe > Cu > Ag

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ii] **Reaction of metals with water:**
Metal react with water to form/produce metal oxide and hydrogen gas. Metal oxide that are soluble in water dissolves in it further to form metal hydroxide (not all metals).

Metals + water → metal oxide + Hydrogen
Metal oxide + water → metal hydroxide
Example:

i) $2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_2\uparrow + Heat$

ii) $2Na + 2H_2O \longrightarrow 2NaOH + H_2 + Heat$

etc.

iii] **Reaction of metal with acids.**
Except a few less reactive metal such as [Cu, Hg, Ag, Au, Pt etc.] all acid react with acid to produce salt and hydrogen gas.

Metal + acid → salt + $H_2\uparrow$

Eg:

$$\underset{[\text{Zinc}]}{Zn} + \underset{[\text{hydrochloric acid}]}{2HCl} \longrightarrow \underset{[\text{zinc chloride}]}{ZnCl_2} + H_2\uparrow$$

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iv] Reaction of metal with solution of other metal salts:

- Reactive metal can displace a comparatively less reactive metal from its compounds in aqueous salt solution or in molten form general equation is,

Metal (A) + salt solution (B) → salt (A) + Metal (B)

$$Cu_{(s)} + 2AgNO_{3(aq)} \longrightarrow Cu(NO_3)_{2(aq)} + 2Ag_{(s)}$$

* Reactivity series *

The reactivity series of metal is a list of metal arranged in order of decreasing activity on the basis of their relative tendency to lose electron and their reactive nature

K
Na
Ca
Mg
Al
Zn
Fe
Sn
Pb
H
Cu
Hg
Ag

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* Non-metals *

those elements which forms negative ions by gaining electrons are called non-metal e.g. Iodine, Sulphur, Oxygen, hydrogen etc The non-metal are either solid or gas except Bromine which is liquid

- Physical properties :-
- non-malleable
- non-ductile
- non-lustrous
- non-sonorous.
- poor-conductor of heat and electricity
- have low melting and boiling.

* - chemical properties of Non-metal
- Non-metal do not react with water steam or dilute acids to evolve Hydrogen gas.

Reason

they act as an electron acceptor and cannot supply electrons of the H^+ ions of acid to reduce them to hydrogen gas

$$S + 2H_2SO_4 \xrightarrow{\Delta} 3SO_2 + 2H_2O(l)$$

- Non-metal show displacement reaction like metal.

$$Cl_2 + 2NaBr \longrightarrow 2NaCl + Br_2$$

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Note
most of the non-metal produce acidic oxide.

* Reaction between Metals and Non-metals (Formation of ionic Bonds) *

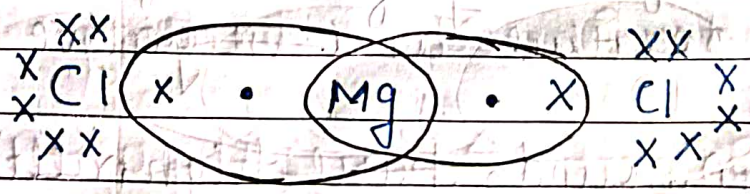
- for stability each electron need 8 electron in its outermost shell

- Metals have tendancy to loose electrone to form cations and non-metals have tendency to gain electron to form anion

- when metals and non-metals reacts with each other then both of them tries to acheive completly filled outermost shell by transfer of electron

* electrone-dot structure *

i] $MgCl_2$



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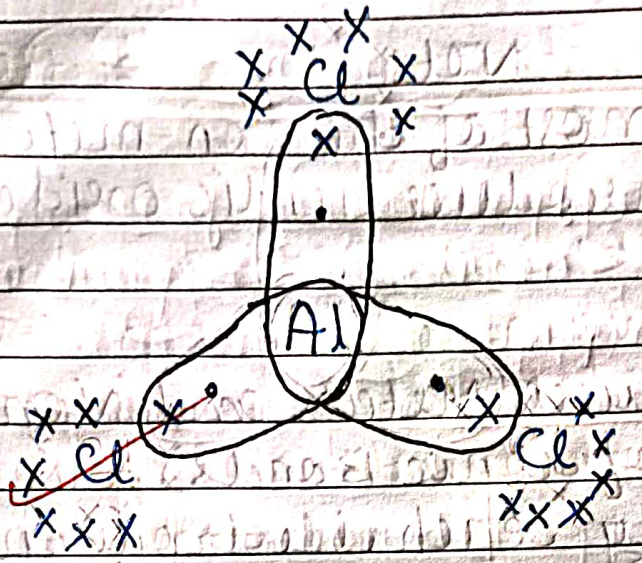
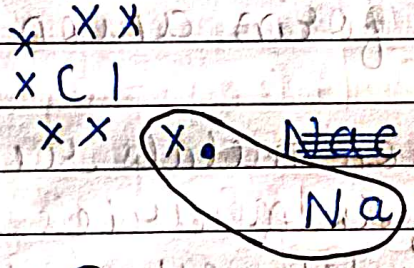
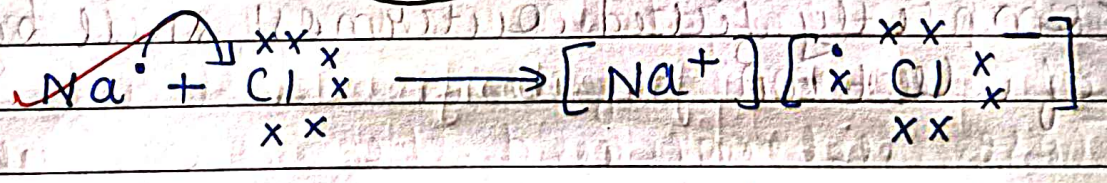
ii) $AlCl_3$



iii) NaCl





* Properties of ionic compounds.

- Ionic compounds are hard crystalline solid because of strong force of attraction between positive and negative ions.
- These compounds have high melting and boiling points as large amounts of energy is required to break strong inter-ionic attraction

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- The compounds are Soluble ~~have~~ ~~high~~ in water (polar-solvent) and insoluble in organic solvents (non-polar solvents) like Kerosene, benzene, ether petrol

- conduction of electricity through a solution involves movement of charged particle Ionic or electrovalent compound are good conductors of electricity. but the conduct electricity either in molten state or aqueous solution

* Occurance of Metal: *

- The earth's crust is the major source of metal sea water also contain salts like sodium chloride and Magnesium chloride.

- The elements or compound which occur naturally in the earth crust are known as mineral

* Extraction of Metals:

The process of obtaining the metal in their pure form from earth crust ~~are~~ is called Extraction of Metals

depends upon.

- Metal of low reactivity
- Metal of medium reactivity
- Metal of high reactivity

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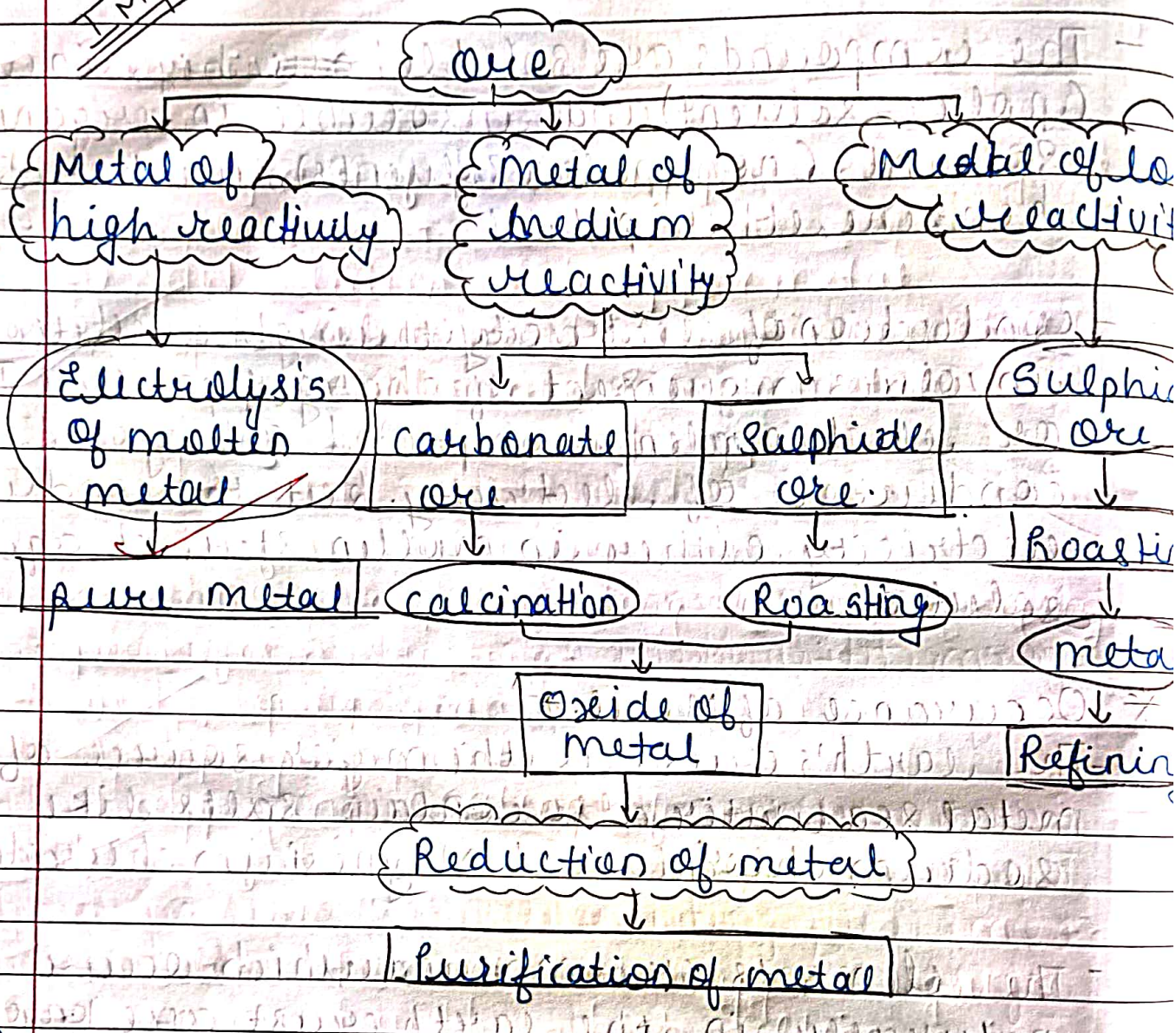

i) Extraction lower reactive Metal

- Cinnabar: it is an ore of mercury when heated in air it first change into its oxide i.e. HgO and then reduce to mercury metal after further heating

$$2HgS + 3O_2 \xrightarrow{\Delta} 2HgO + 2SO_2\uparrow$$

$$2HgO \xrightarrow{\Delta} 2Hg(l) + O_2(g)\uparrow$$

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- copper glance : when heated in air partially get oxidised and then the oxidised product react with remaining copper glance to give copper metal

$$2Cu_2S + 3O_2 \xrightarrow{\Delta} 2Cu_2O + 2SO_2\uparrow$$

$$2Cu_2O + Cu_2S \xrightarrow{\Delta} 6Cu + SO_2(g)$$

ii) Extraction of medium reactive metal
- Roasting
- calcination
- reduction of oxide ore.

iii) Extraction of high reactive metals
- electrolysis of their molten state

* corrosion:
it is the slow process of eating away of metals by the reaction of atmospheric air and pressure and moisture
eg: rusting of iron

- Prevention of corrosion.
- galvanisation
- alloying
- Painting
- Greasing or oiling
- Tin or Chromium plating