METALS AND NON METALS

Class 10
Chapter 3

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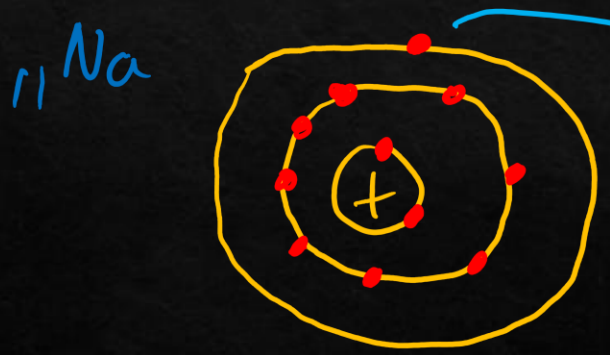
Element

Metal

↳ Readily lose $\bar{e}$ to form positive ions. (Cations)



$Na \longrightarrow \underbrace{Na^+ + \bar{e}}_{\text{Cation}}$

Eg - Al, Fe, Ca, K, Na, Mg etc.

Non-metal

↳ Readily gain $\bar{e}$ to form negative ions (anions)

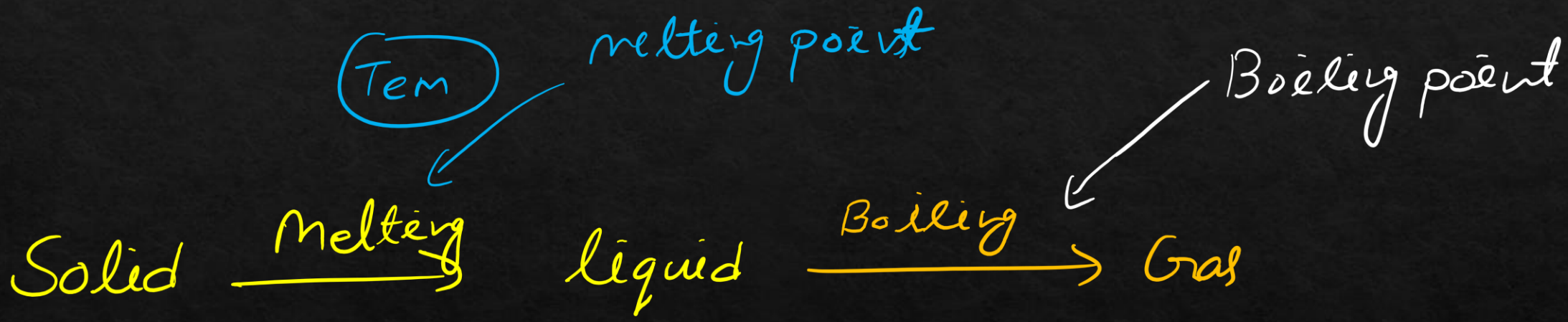
Eg - O, C, H, N etc.

$O + e \longrightarrow \bar{O}$

Physical properties of Metals -

1. Lustre → Shiny & Reflecting.
2. Malleability → Can be beaten into thin sheets.
3. Ductility → Can be drawn into chain and into wires.
4. Thermal conductivity - Ability to conduct heat.
5. Electric Conductivity → flow of electric current in metals.

⑥ - Melting point & Boiling point - ↑↑ MP, ↑↑ BP



⑦ Sonority - Metals produce ringing sound when struck.

Metals	Non-metals
• Metals are regarded as luster.	• Nonmetals are regarded as bright or radiant or lustrous.
• Metals are regarded as flexible or ductile	• Non-metals are regarded as non-ductile, i.e., they are not flexible.
• Metals are considered malleable or pliant.	• Non-metals are considered as non-malleable or non-tractable.
• Metals are recognized as good transmitters of heat as well as power/electricity.	• Non-metals are regarded as poor transmitters of heat as well as power/electricity.
• Metals are regarded as sonorous or resonant or vibrant.	• Non-metals are regarded as non-sonorous or non-resonant or non-vibrant.

Chemical Properties -

① - Reaction with air / O_2 -

Metal + O_2 ⟶ Metal oxide $\xrightarrow{+ H_2O}$ Metal Hydroxide

Eg- $2Cu + O_2 \longrightarrow 2CuO$

Cuppor oxide (Basic)

$CuO + H_2O \longrightarrow Cu(OH)_2$ (Basic)

Cuppor hydroxide

Oxides

Metal oxide

Basic

Na_2O, MgO, CaO etc.

Amphoteric

Al_2O_3, BeO, PbO_2, ZnO etc.

Non-Metal oxide

Neutral

NO, CO, N_2O only

Acidic

Rest all are acidic - CO_2, SO_2, NO_2 etc.

$$Na_2O + H_2O \longrightarrow 2NaOH$$

(Base)

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

(Acid)

Oxides that can react with acids as well as bases are amphoteric in nature. (Amphoteric Oxide)

Ex -

→ $Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$

(Base) (Acid) (Salt)

→ $Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2\uparrow$

(Acid) (Base) (Salt)

② - Reaction of Metals with water -

Highly Reactive - ★ Metal + water ⟶ Metal hydroxide + Hydrogen gas

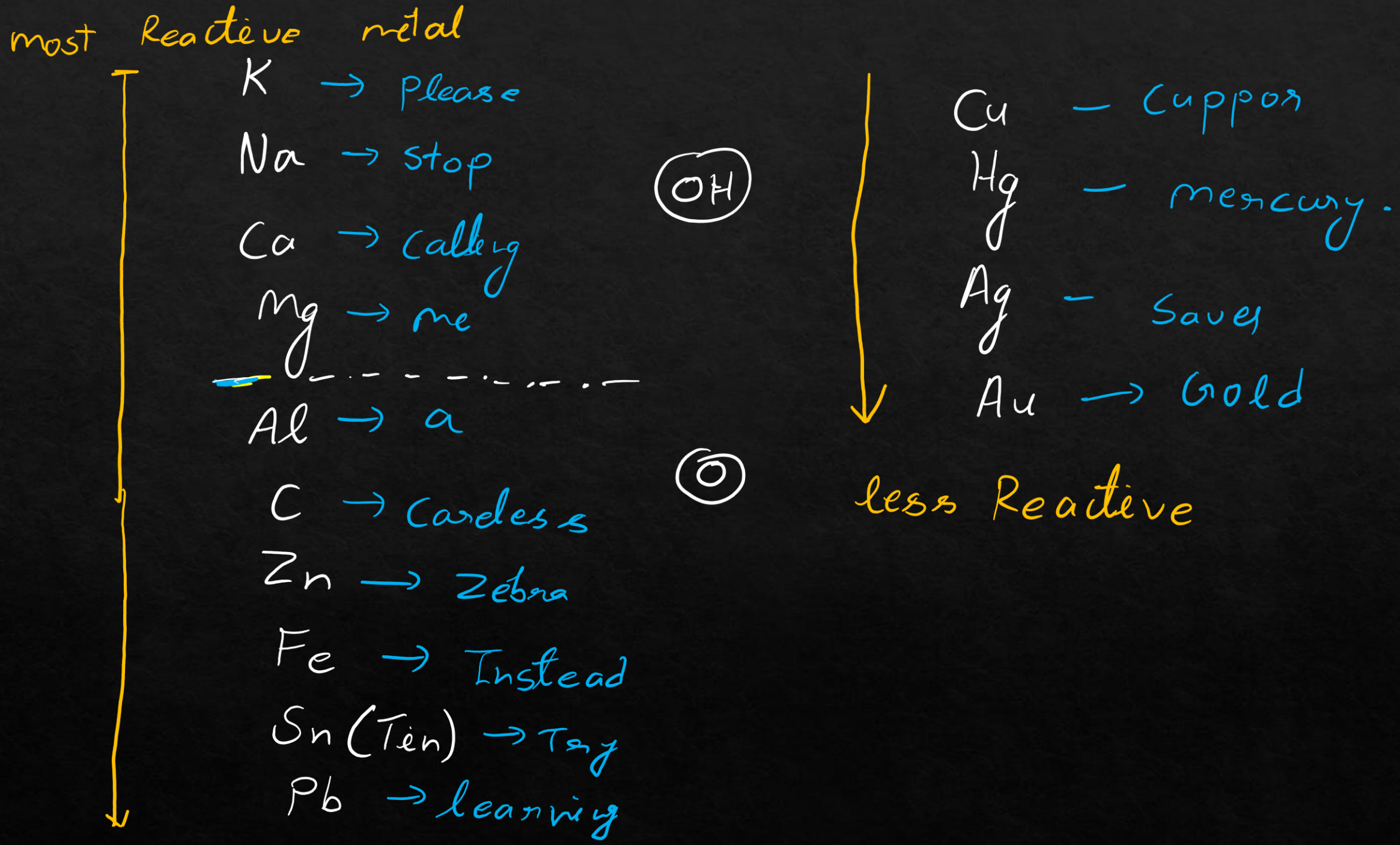
$$2K + 2H_2O \longrightarrow 2KOH + H_2 \uparrow\uparrow$$

Less Reactive - ★ Metal + water ⟶ metal oxide + $H_2 \uparrow$

$$Zn + H_2O \longrightarrow ZnO + H_2 \uparrow\uparrow$$

Mneumonic for learning reactivity Series -

Please stop calling me a careless Zebra,
Instead try learning Copper Saves gold.


most Reactive metal
K → Please
Na → Stop
Ca → Calling
Mg → me
Al → a
C → Careless
Zn → Zebra
Fe → Instead
Sn (Tin) → Toy
Pb → leaning
OH
O
Cu – Cuppor
Hg – mercury.
Ag – Saves
Au → Gold
less Reactive

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2$$

$$2K + 2H_2O \longrightarrow 2KOH + H_2$$

$$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2\uparrow$$

$$2Al + 3H_2O \longrightarrow Al_2O_3 + 3H_2\uparrow$$

$$2Fe + 4H_2O \longrightarrow Fe_2O_3 + 4H_2$$

③ Reaction with acids -

Metal + dilute acid ⟶ Salt + H_2

$Mg + 2HCl \longrightarrow MgCl_2 + H_2$

$2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2$

$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

$Fe + 2HCl \longrightarrow FeCl_3 + H_2$

$Mg > Al > Zn > Fe$

⇒ Copper, Silver and gold donot react with delute HCl.

Nitric acid:

✱ HNO_3 → Strong oxidizing agent

→ Reduced → to oxides of nitrogen.

$$3Cu + 8HNO_3 \longrightarrow 3\,Cu(NO_3)_2 + 4H_2O + 2NO_2$$

④ Reaction of Metals with Metal Salt Solution.

↳ (Displacement Reaction) → A more reactive metal displaces less reactive metal from its salt solution.

⇒ $Mg + CuSO_4 \longrightarrow MgSO_4 + Cu$

⇒ $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

⇒ $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$

How do metals & non metals Reacts -

Metal -

$_{11}Na \longrightarrow Na^{+} + 1e^{-}$

Cation

K L M N
2, 8, 1

Non metal -

$_{17}Cl + 1e^{-} \longrightarrow Cl^{-}$

Anion

K L M N
2, 8, 7

(A) Formation of Sodium Chloride Molecule (NaCl)

Donate gain

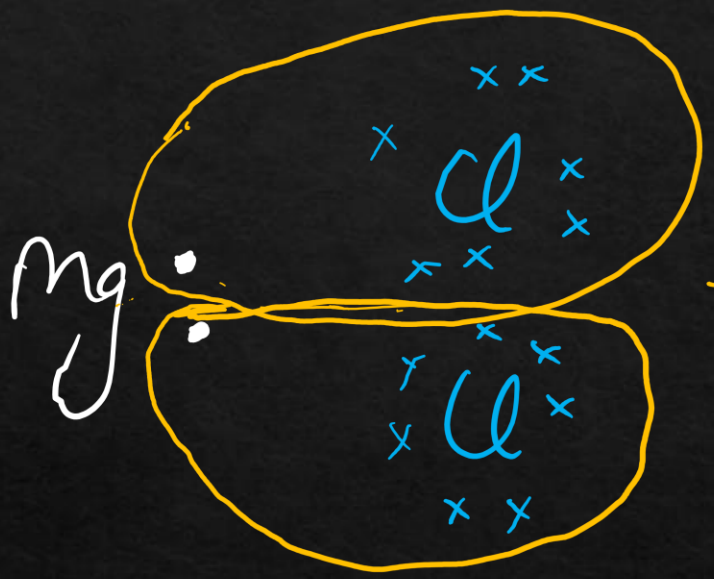
(B) - Formation of Magnesium Chloride molecule - ($MgCl_2$)

$$_{12}Mg \longrightarrow Mg^{+2} + 2e^-$$

2,8,2 → 2,8

$$Cl + 1e^- \longrightarrow Cl^-$$

2,8,7 → 2,8,8



$$[Mg]^{+2}[Cl]_2^{-1}$$

$$\boxed{MgCl_2}$$ salt

Ionic Compound
(Electrovalent Compound)

Ionic compound are Compounds formed by the transfer of electrons from metal to non-metals.

Properties -

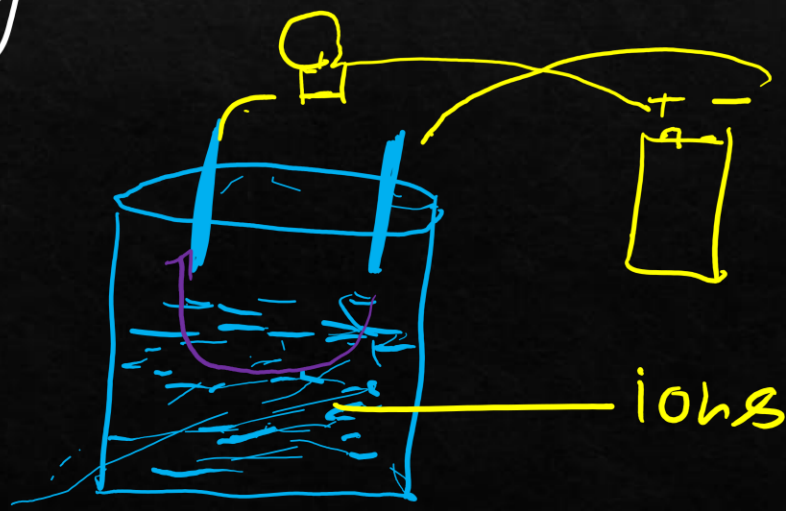
① - They are formed by transfer of $\bar{e}$ and are made up of ions.

② - They are crystalline Solids.

③ - They have high melting point ↑↑
& High Boiling point ↑↑

④ They are soluble in water but insoluble in Organic solvent. (Petrol , Kerosene).

⑤ - They conduct electricity in solution.



ions + water (electrolyte)

☆☆ Occurence of Metals -

- ↳ Au, Ag, Pt ⟶ earth crust
  (least reactive)
- Most metals are found as oxides, Carbonates, sulphides, halides etc.

- **Minerals** - elements / compound which occur naturally inside the earth's crust.

- **Ore** - is a minerals from which metal can be extracted Profitably.

Extraction of metals from their ores.

1. Concentration of the ore.
2. Reduction to the metal
3. Refining (Purification)

⇒ Steps involved in the extraction of metal from their ores.

☆ Extraction of metals low in the activity Series -

Metals which are low in activity series can be reduced to metals by heating in presence of oxygen. (Roasting)

Eg- ① Hg is obtained from its ore Cinnabar (HgS)

$\downarrow \Delta$

HgO

$\downarrow \Delta$

$Hg + O_2$

(2) - Copper ⟶ its sulphide or (CuS)

(Roasting) Δ ↓

Cu_2O

Δ ↓

$Cu + O_2$

(ii) - Extraction of Metal in Middle of activity series -

like Zn, Fe, Pb are found as oxide, sulphide Carbonates ores.

Roasting - is heating of an ore in the presence of Oxygen. It is used to convert sulphide ore in to oxide ore.

$$2ZnS + 3O_2 \xrightarrow{Heat} 2ZnO + 2SO_2$$

Calcination – is heating of an ore in the absence of oxygen. It is used to convert carbonate ore into oxide ore.

Eg- $ZnCO_3 \xrightarrow{Heat} ZnO + CO_2$

$ZnO + C \xrightarrow{Heat} Zn + CO$

Oxide ore

Reducing agent (Coke/Carbon)

Thermit Reaction -

Sometimes, reactive metals like Na, Ca, Al etc are used as reducing agent to obtain metal from their oxide.

Eg- $MnO_2 + Al \xrightarrow{\Delta} Mn + Al_2O_3 +$ Heat ↑

The reaction b/w metal oxide and almunium is highly exothermic and the metal are obtained in moltain state.
Such reaction are called Thermit reaction.

$$Fe_2O_3 + 2Al \longrightarrow 2Fe + Al_2O_3 + Heat$$

(Iron oxide) (molten iron)

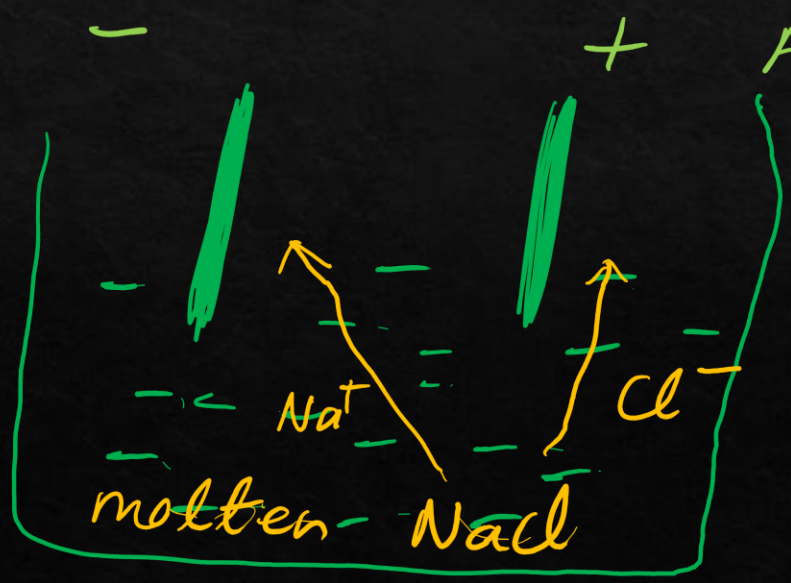
This reaction is use to join rail tracks, broken machine parts.

③ - Extraction of metals at top of activity series

Series - (K, Na, Ca, Al)

⇒ They are obtain by Electrolytic reduction of their molten chlorides.

Eg -



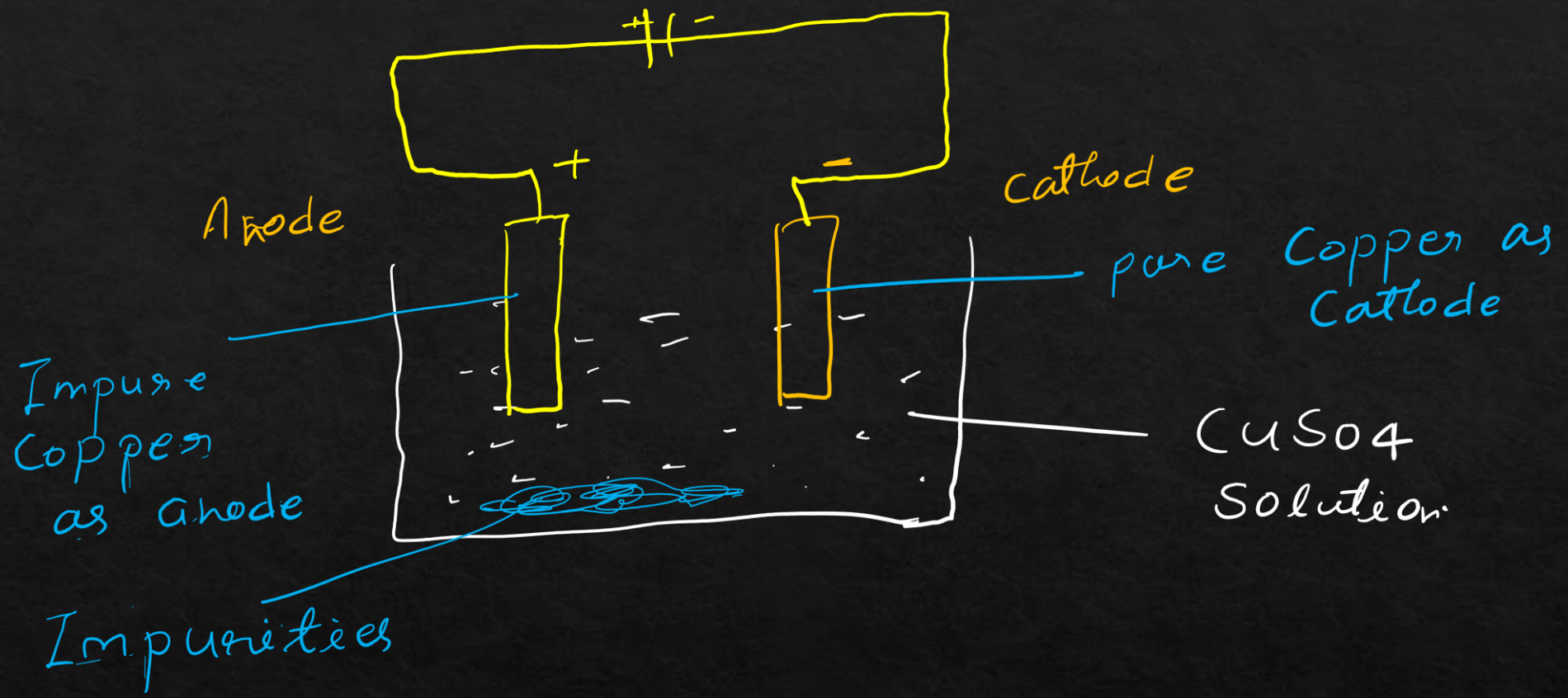
☆ Refining of metal -

The removal of impurities from the metal to obtain the pure metal is called Refining of metal.

Most common method of refining ⟶ Electrolytic Refining.

☆ In this method a block of impure metal is made the anode and a thin sheet of pure metal made cathode.

Eg -



Experimental set up for electrolytic Refining of Copper.

☆ Corrosion -

Corrosion is the damage caused to metal due to the reaction of metal with oxygen, moisture, CO_2 etc.

Eg - ① formation of brown coating of rust over iron.

② Cu

green (copper carbonate)

③ Ag

black

(Silver sulphide)

⇒ Prevention of Corrosion -

① - Applying oil / grease.

② - Paint.

③ - By galvanisation (coating with Zn)

④ - By tinning (coating with tin)

⑤ - By electroplating (coating with Cr)

⑥ - By alloying (Making alloys)

⁂ Alloy -

An alloy is a homogenous mixture of metal with other metal or non metal.

Eg- Steel - Iron, carbon

Stainless steel - iron, carbon, Cobalt, nickel

Brass - Copper, zinc

Bronze - Copper, tin

Solder - Lead, tin

Amalgam

↳ metal + mercury

↓

Alloy