

CLASS X
CHAPTER 3
METALS AND NON-METALS-
METALLURGY and CORROSION
PART-II

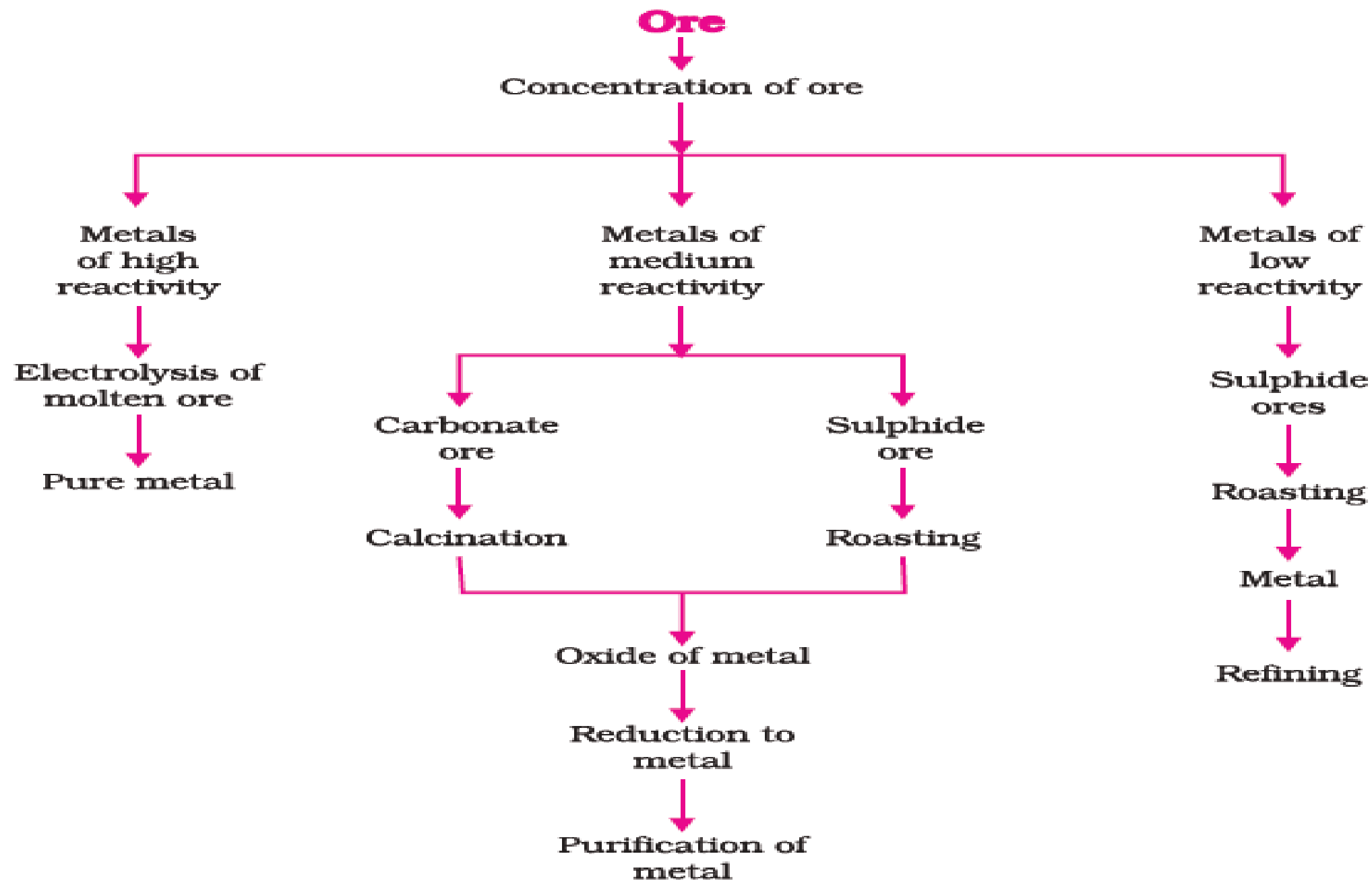


METALLURGY

- ▶ The earth's crust is the major source of metals.
- ▶ **Minerals**- The elements or compounds, which occur naturally in the earth's crust, are known as minerals.
- ▶ **Ores** - The minerals from which a metal can be profitably and conveniently extracted are called ores.
- ▶ **Gangue** - The impurities present in the ore like rock particles, sand particles, clay particles etc.

METALLURGICAL STEPS

- ▶ Metals are extracted from their ores. Main steps involved are :-
- ▶ Concentration of the ore (Ore -Enrichment)
- ▶ Conversion of concentrated ore into metal oxide (ROASTING/CALCINATION)
- ▶ Reduction to the metal oxide to metal
- ▶ Refining (Purification of the metal)



- **Extraction of metals low in the reactivity series**

Eg :- Mercury is obtained from its ore Cinnabar (HgS) by heating in the presence of oxygen.

When it is heated in the presence of oxygen it is first converted into mercuric oxide (HgO) and on further heating it is reduced to mercury.



- **Extraction of metals medium in the reactivity series**

- ▶ Metals in the middle of the activity series like Zn, Fe, Pb, are found as oxide, sulphide or carbonate ores. It is easier to obtain metals from their oxides than from their sulphides or carbonates.
- ▶ **Roasting** is heating of concentrated ore in the presence of excess oxygen. It is used to convert sulphide ore into metal oxide.



- ▶ **Calcination** is heating of concentrated ore in the limited supply of oxygen. It is used to convert carbonate ore into metal oxide.

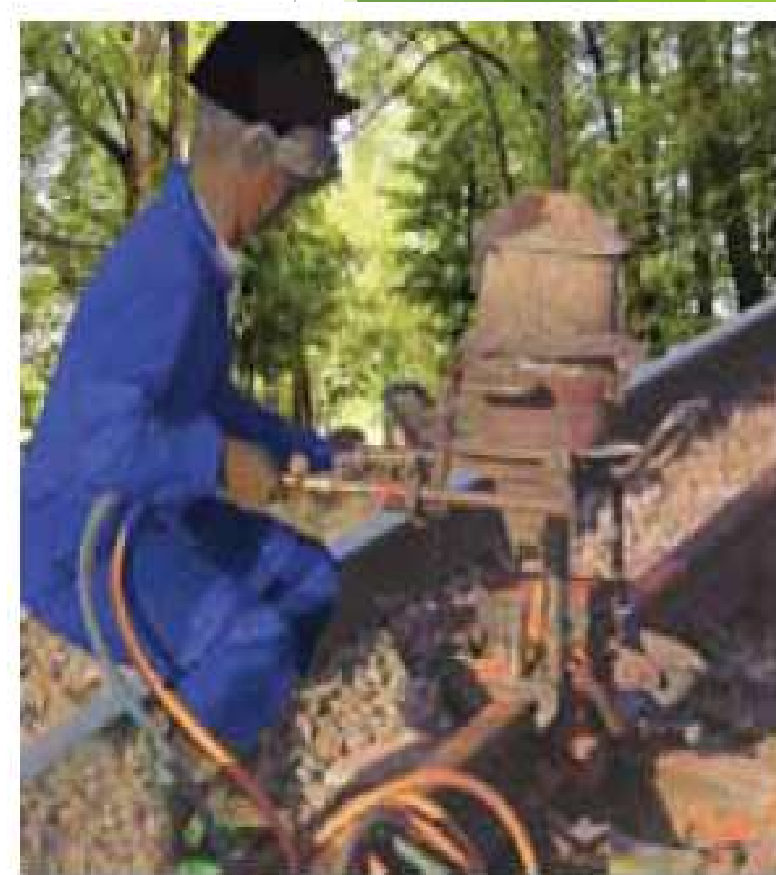


- ▶ The oxide ore is then reduced to the metal by heating with a reducing agent. The most common reducing agent is coke (carbon).



- **Extraction of metals medium in the reactivity series (THERMITE REACTION)**

- Aluminium as a reducing agent
- The reaction between metal oxides and aluminium is highly exothermic and the metals are obtained in the molten state. Such reactions are called thermite reactions.
- $3\text{MnO}_2 + 4\text{Al} \rightarrow 3\text{Mn} + 2\text{Al}_2\text{O}_3 + \text{Heat}$
- The reaction between iron oxide and aluminium produces molten iron. This reaction is used to join rail tracks, broken machine parts etc.
- $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe} + \text{Heat}$



- **Extraction of metals high in the reactivity series**

- ▶ Metals at the top of the activity series like K, Na, Ca, Al etc. cannot be obtained from their ores by simple heating or by heating with reducing agents. They are obtained by **Electrolytic Reduction** of their molten chlorides.

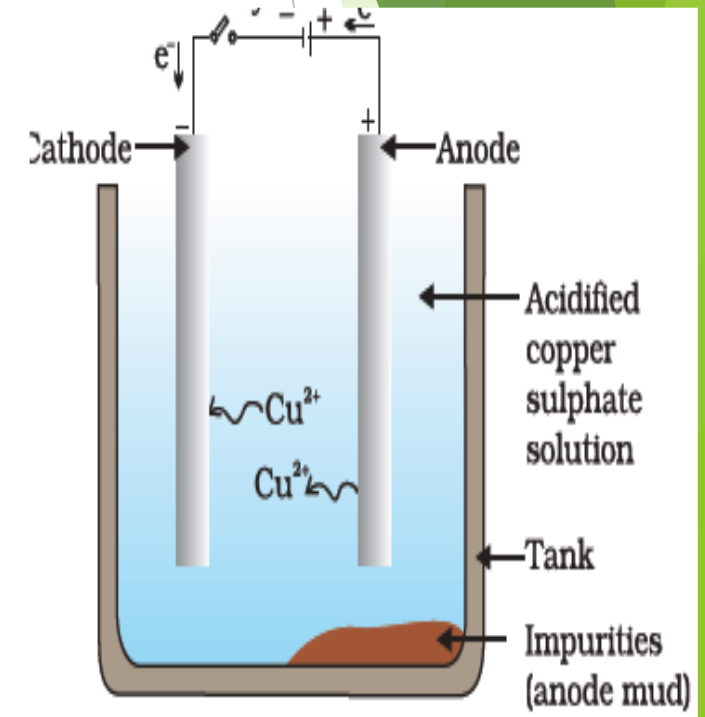
- ▶ Eg :- When electric current is passed through molten sodium chloride, sodium metal is deposited at the cathode and chlorine gas is deposited at the anode.

- ▶ **At Cathode** : $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$ (Sodium metal)

- ▶ **At Anode** : $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ (Chlorine gas)

ELECTROLYTIC REFINING OF COPPER

- ▶ The removal of impurities from the metal to obtain the pure metal is called refining of metals. The most common method for refining of metals is **Electrolytic Refining**.
- ▶ A thick block of impure copper is made the anode and a thin sheet of pure copper is made the cathode. The electrolyte is acidified copper sulphate solution.
- ▶ When electric current is passed through the electrolyte, pure copper from the anode is deposited at the cathode and the impurities settle down as **anode mud**.



CORROSION OF METALS

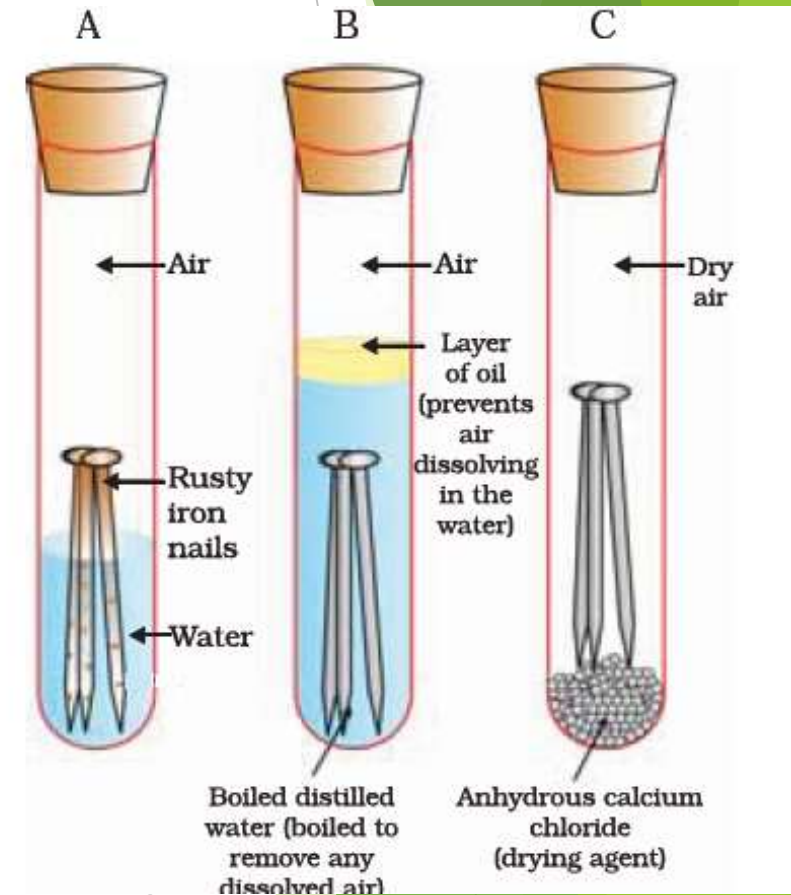
- ▶ **CORROSION**- The slow attack of atmospheric gases, moisture and acids on the surface of metals which results in the formation of a new layer of sulphide, carbonate, oxide etc to be formed on the surface.

Corrosion of metals can be prevented by :

- ▶ Applying oil or grease.
- ▶ Applying paint.
- ▶ By galvanization. (Coating with zinc)
- ▶ By tinning. (Coating with tin)
- ▶ By electroplating. (Coating a less reactive metal like chromium)
- ▶ By alloying. (Making alloys)

To show that both air and moisture are necessary for the RUSTING OF IRON

- **PROCEDURE:** Take three dry test tubes marked 1,2,3 and put iron nails in each of them. Put some anhydrous calcium chloride in test tube 1 to absorb moisture. Pour some boiled distilled water in test tube 2 and pour some oil over it to prevent air into the test tube. Pour some water in test tube 3. Cork the test tubes and leave them aside for a few days.
- **OBSERVATIONS:** The nails in test tube 1 does not rust because it had only air and no water. The nails in test tube 2 does not rust because it had only water and no air. The nails in test tube 3 gets rusted because it had air and water.



ALLOYS

- ▶ An alloy is a homogeneous mixture of two or more metals or a metal and a non metal.
- ▶ The electrical conductivity and melting point of an alloy is less than pure metals.

EXAMPLES:

- ▶ **Steel** -Iron, Carbon (hard, tough and strong)
- ▶ **Stainless steel** - Iron, Chromium, Nickel(hard, does not rust)
- ▶ **Brass** - Copper, Zinc (malleable, strong, resistant to corrosion)
- ▶ **Bronze** - Copper, Tin (very strong, highly resistant to corrosion)
- ▶ **Solder** - Lead, Tin (low melting point ,used for welding electrical wires together)
- ▶ If one of the metals in an alloy is mercury, it is called an **amalgam**.