Chap 3. Metals and Non-metals

1. What is ductility?

The ability of a metal to be drawn into thin wires without breaking is called ductility. eg: Copper is used to make electrical wires.

1 g of gold can be drawn into a 2 km long wire.

2. What is malleability?

The ability of a metal to be beaten into thin sheets without cracking is called malleability. eg: Gold and aluminium can be beaten into thin foils.

Most non-metals are neither ductile nor malleable. They are brittle and crumble on hammering.

3. Being a non-metal, how graphite conduct electricity?

In graphite, each carbon atom is covalently bonded to 3 other carbon atoms, leaving one free (delocalised) electron per atom. These free electrons move freely through the structure and make them conductors.

Graphite is the only non-metal that conducts electricity. It is used as electrodes in electrolysis and in dry cell batteries.

4. What is the reactivity series?

The reactivity series is an arrangement of metals in decreasing order of reactivity based on their ability to react with water, steam, or acids.

K > Na > Mg > Al > Zn > Fe > Cu > Ag > Au

A metal higher in the series displaces a metal lower in the series from its salt solution.

$Fe + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu$

As iron is more reactive than copper, it displaces copper.

5. What is an amphoteric oxide?

An amphoteric oxide reacts with both acids and bases, showing dual character. eg: aluminium oxide, zinc oxide

$Al_2O_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2O$

$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

$ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$

6. What is thermite reaction?

It is a highly exothermic chemical reaction where a metal powder reacts with a metal oxide to produce intense heat and molten metal. It is used in welding of railway tracks.

$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

Aluminium is more reactive than iron and displaces iron from iron oxide. The reaction generates extreme heat (2500°C), melting the iron, which flows into gaps between railway tracks and solidifies — joining them without bolts.

7. How are ionic compounds formed?

Ionic compounds are formed by transfer of electrons from a metal to a non-metal, resulting in oppositely charged ions that attract each other.

In NaCl, sodium loses 1 electron, and chlorine gains 1 electron.

$Na \rightarrow Na^+ + e^-$

$Cl + e^- \rightarrow Cl^-$

Ionic compounds have high melting point due to strong electrostatic forces.

They are soluble in water.

The conduct electricity in molten/aqueous state.

8. Why do ionic compounds conduct electricity in molten or aqueous state but not in solid state?

In solid state, ions are in fixed position in the crystal lattice, and they cannot move.

When melted or dissolved in water, the lattice breaks down and ions become free to move carrying electric current.

9. What is the difference between mineral and ore?

A mineral is any naturally occurring substance in the Earth's crust that contains a metal element.

An ore is a mineral from which a metal can be profitably and economically extracted.

All ores are minerals, but not all minerals are ores.

10. What are calcination and roasting? How they differ?

Calcination and roasting are thermal metallurgical processes used to convert raw ores into metal oxides, making them easier to reduce into pure metals. The primary difference lies in the presence or absence of air during heating.

Calcination involves heating an ore to a high temperature below its melting point, either in the absence of air or with a limited supply of air.

$CaCO_3$ -----> $CaO + CO_2$

Roasting involves heating an ore to a high temperature below its melting point in the regular presence of excess air.

$2ZnS + 3O_2$ -----> $2ZnO + 2SO_2$

11. What is an alloy?

An alloy is a **homogeneous mixture of a metal with one or more other elements** to improve its properties.

12. Why pure gold is not used in jewellery?

Pure gold (24 carat) is too soft and malleable. It easily bends and deforms, making it unsuitable for jewellery. Gold is alloyed with copper or silver to make it harder, more durable, and retain shape, while still being attractive.

Jewelleries are usually made with 22 carat gold (22 parts gold + 2 parts other metals)

13. What is corrosion?

Corrosion is the slow destruction of metals by chemical reactions with substances in the environment (oxygen, moisture, acids, etc). eg:

1. rusting of iron in the presence of oxygen and moisure
2. green coating on copper in the presence of CO_2, O_2 and moisure
3. blackening of silver in the presence of H_2S