Metals and Non Metals CBSE Class 10 Science Notes Chapter 3

Free Revision Notes for CBSE Class 10 Science Chapter 3 Metals and Non-Metals

Elements are classified as metals and non-metals based on different properties. The properties of metals and non-metals are given in the form of the table below-

Metals	Non-metals
Metals are lustrous, that is, they have a property to shine.	They are not lustrous, that is, they do not have a shining surface except, graphite and iodine.
All metals exist as solids except mercury which is liquid at room temperature.	They are generally soft, except for diamonds.
They can be drawn into wires, this is known as **Ductility**.	They are non-ductile.
Metals can be converted into sheets, this is known as **Malleability**, except mercury	They are non-malleable
They are good conductors of electricity and heat. Except for Lead and mercury.	They are poor conductors of electricity and heat. Exception-graphite is a good conductor of electricity
They have high density and high melting point. Exception-sodium and potassium have low melting points.	They have low density compared to metals and low melting point except for Diamond which has a high melting point.

Chemical Properties of Metals

- Metals react with air or oxygen to form metal oxide.

For Example, Copper reacts with oxygen to form copper oxide.

Metal + O_2 → Metal oxide

$2Cu + O_2 \rightarrow 2CuO$

$4Al + 3O_2 \rightarrow 2Al_2O_3$

- Oxides of metals can react with both acids and bases to produce salt and water. Such oxides are known as **Amphoteric Oxides**.

Al2O3 + 6HCl → 2AlCl3 + H2O

$$\underset{\text{Aluminium oxide}}{Al_2O_3} + \underset{\text{(Conc.)}}{2NaOH(aq.)} \rightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + H_2O$$

- Metals also react with water to form metal oxide. Metal oxide in turn can react with water to form metal hydroxide. **For Example**

2Na + 2H2O → 2NaOH + 1H2

2Al + 3H2O → Al2O3 + 3H2

- Metals also react with dilute acids to form salt and hydrogen. **For example**, magnesium reacts with dilute hydrochloric acid to form magnesium chloride and hydrogen.

Metal + Acid → Metal Salt + Hydrogen

Mg + 2HCl → MgCl2 + H2

Chemical Properties of Nonmetals

- Non-metals react with oxygen to form non-metal oxide.

Non-metal + Oxygen → Non-metal oxide

C + O2 → CO2

- Non-metals do not react with water and acids to evolve hydrogen gas.
- Non-metals can react with salt solution; the more reactive element will displace the less reactive non-metal.

2 NaBr (aq) + Cl2(aq) → 2NaCl (aq) + Br2 (aq)

- Non-metals can also react with hydrogen to form hydrides.
(/)

H2(g) + S(l) → H2S(g)

Reactivity Series

The series in which metals are arranged in the decreasing order of reactivity is known as the Reactivity **Series**.

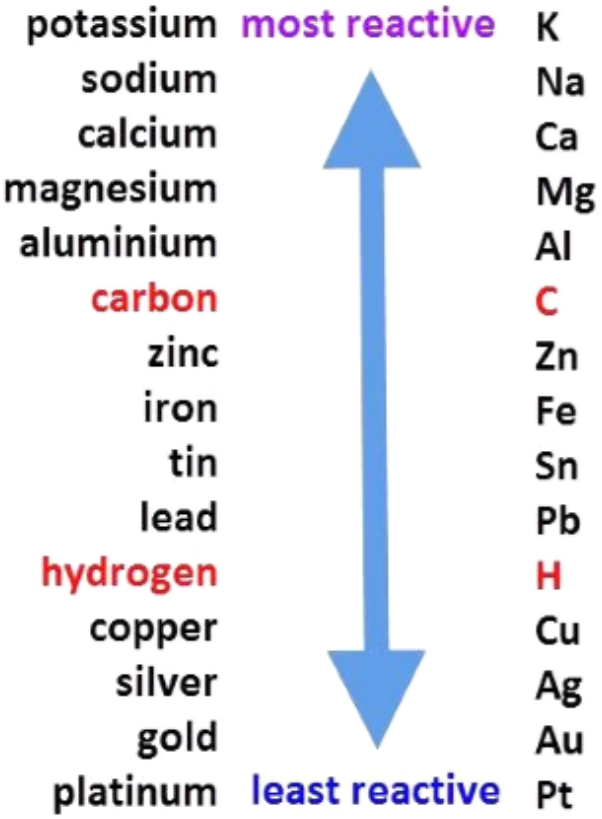
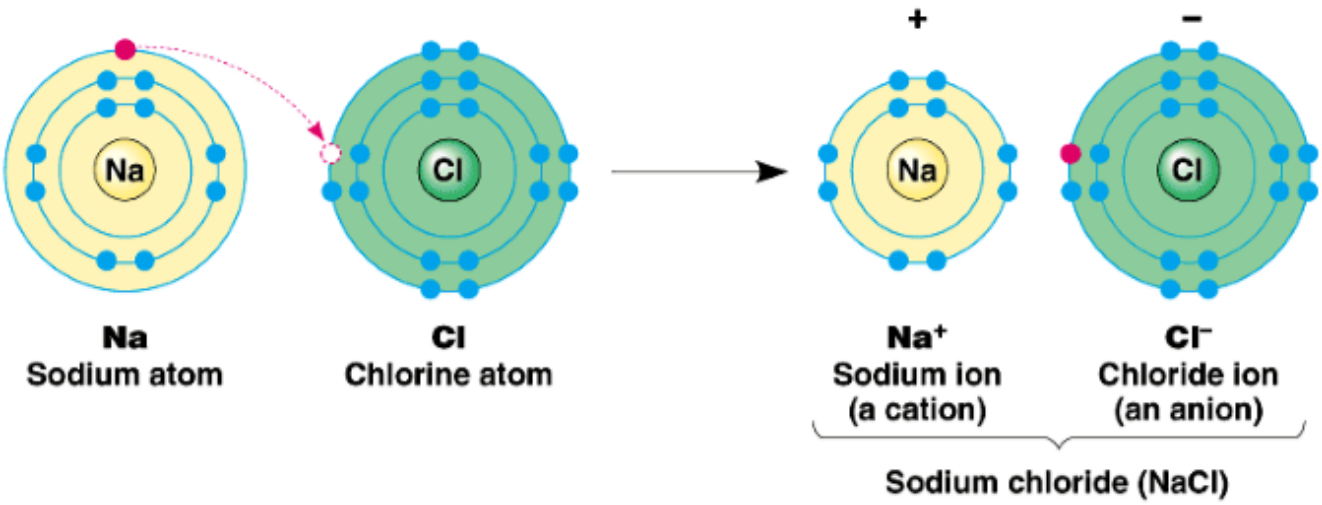


Fig.1. Reactivity Series

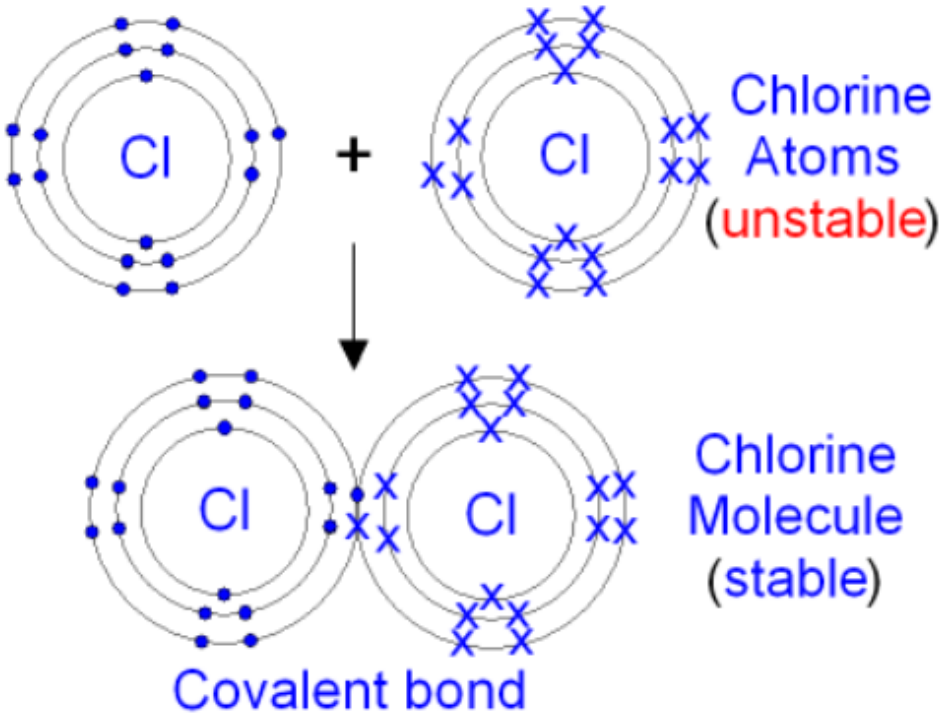
Ionic Compounds

Compounds formed due to the transfer of electrons from a metal to a non-metal are known as **Ionic Compounds**.



Covalent Bond

A bond is formed by the sharing of electrons between the two atoms. They share their valence electrons to gain stability.

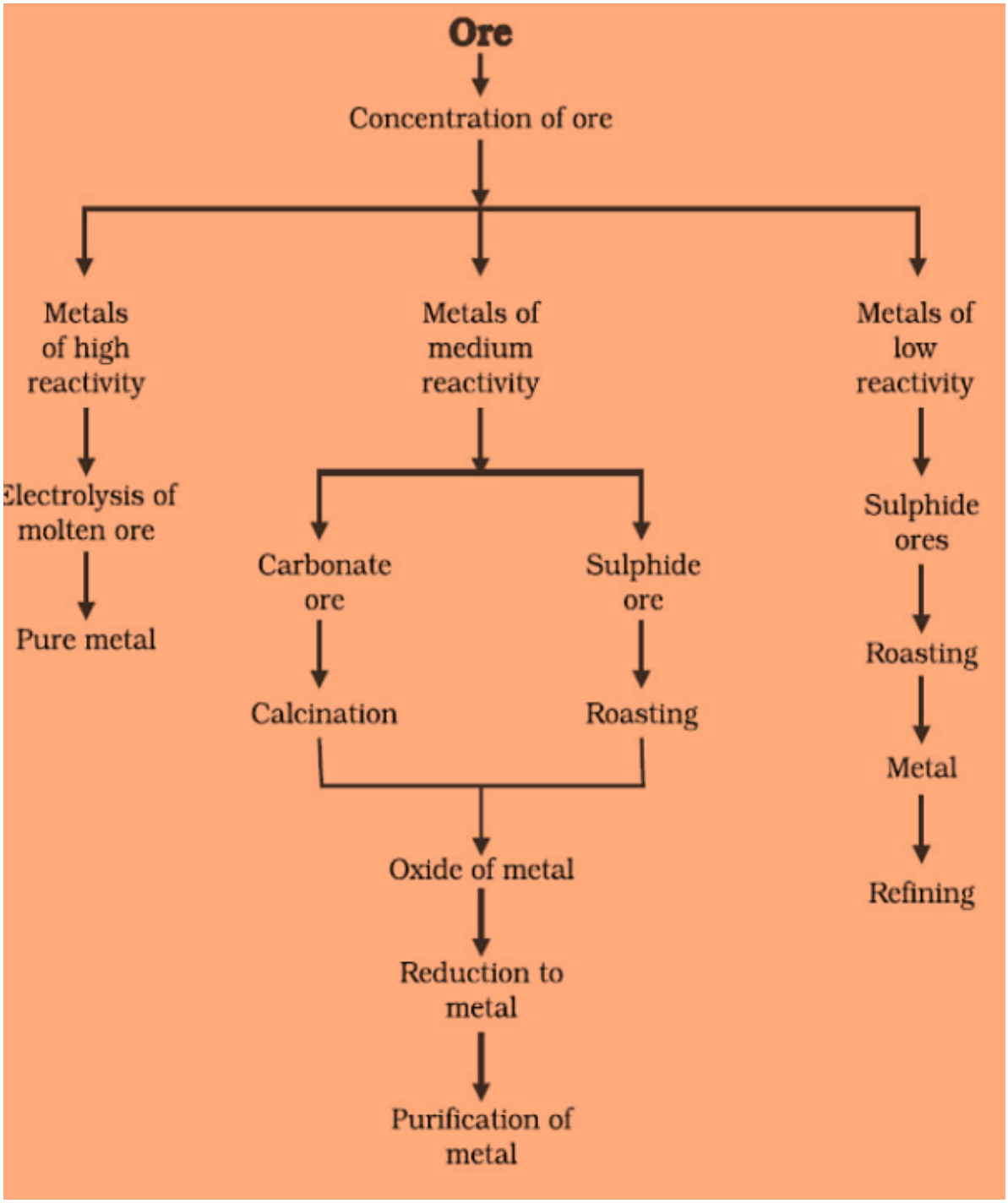


Properties of Ionic Compounds

- They are generally hard and solid.
- They have a high melting and boiling point.
- They are soluble in water but insoluble in inorganic solvents such as ether etc.
- They are conductors of electricity in molten and solution states.

Occurrence of Metals

Elements or compounds which occur naturally in earth crust are known as **Minerals**. Minerals from which pure metals can be extracted are known as **Mineral Ores**.



Extraction of pure metals from its ores/steps for extraction of metals from its ore

- The first step is the enrichment of the ore
- The second step includes extraction of metals
- Third steps involve refining of metal

Gangue - Ores contain different impurities in it such as sand, soil etc. These impurities are known as **Gangue**.

Extracting Metals which are low in activity series

Metals which are low in the activity series are unreactive. The oxides of such metals can be reduced to metals by heating alone. **For Example**, Cinnabar (HgS)

$$2HgS(s) + 3O_2(g) \xrightarrow{\text{Heat}} 2HgO(s) + 2SO_2(g)$$

(/)

$$2HgO(s) \xrightarrow{\text{Heat}} 2Hg(l) + O_2(g)$$

Extracting Metals in the middle of the Activity Series

These metals are moderately reactive. They exist as sulphides or carbonates in nature. Before reduction, metal sulphides and carbonates must be converted into metal oxides. Sulphide ores are converted into oxides by heating strongly in the presence of excess air, this is known as **Roasting**. Carbonate ores are converted into oxides by heating in limited air. This is known as **Calcination**.

Roasting

$$2ZnS(s) + 3O_2(g) \xrightarrow{\text{Heat}} 2ZnO(s) + 2SO_2(g)$$

Calcination

$$ZnCO_3(s) \xrightarrow{\text{Heat}} ZnO(s) + CO_2(g)$$

Reduction-metal oxides can be reduced to metals using a reducing agent such as **Carbon**.

Extracting metals towards the top of the activity series

The metals are highly reactive. They cannot be obtained by heating. **For Example**, Sodium, magnesium and calcium are obtained by the electrolysis of their molten chlorides.

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

At anode $2Cl^- \rightarrow Cl_2 + 2e^-$

Refining of Metals

Refining of impure metal is done using electrolytic refining. Impure copper is used as anode and a strip of pure copper is used as **Cathode**. Acidified copper sulphate is used as an electrolyte. When an electric current is passed through this, impure metal from the anode gets deposited in the electrolyte solution, whereas pure metal from the electrolyte is deposited at the cathode.

Deposition of insoluble residue formed from the dissolution of the anode during commercial electrolysis.

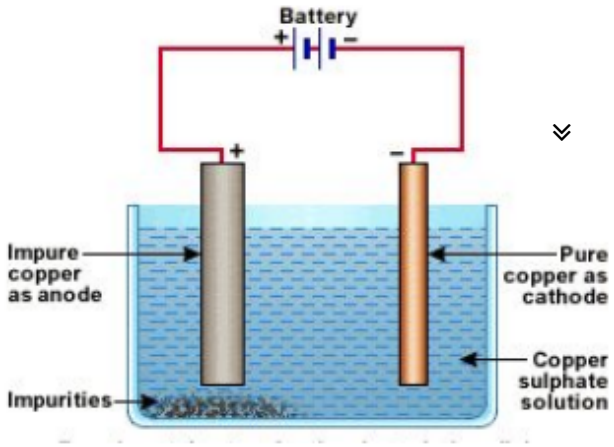


Fig.2. Electrolytic refining

Corrosion

When exposed to moist air for a long period of time, metals become corroded. This is known as **Corrosion**. **For Example**, Silver reacts with moist air and becomes black in colour due to silver sulphide coating.

Iron + oxygen → Iron (III) oxide

Fe + O 2 → Fe2O3

Prevention of Corrosion

- Rusting of iron can be prevented by oiling, galvanising, painting, greasing etc.
- To protect steel and iron from rusting, a thin layer of zinc is coated on them, this is known as **Galvanization**.

Alloy

Mixture of two or more metals or metal and non-metal is known as **Alloy**. **For Example**,

- Brass is an alloy of copper and zinc.
- Bronze is an alloy of copper and tin.
- Solder is an alloy of lead and tin.