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Education that enlightens!

Materials: Metals and Non-Metals

Elements can be divided into metals and non-metals on the basis of their physical and chemical properties.

Physical Properties of Metals and Non-metals

Physical Property	Metals	Non-metals
Malleability	• Metals are malleable. • The property which allows metals to be hammered into thin sheets is called malleability. Example: Aluminium metal can be hammered into a thin aluminium foil.	• Non-metals are not malleable. Example: Carbon (i.e. coal) breaks into smaller pieces when hammered. • The property due to which non-metals break on hammering them is called brittleness.
Ductility	• Metals are ductile, i.e. they can be drawn into thin wires. • The property which allows the metals to be drawn into wires is called ductility.	• Non-metals are not ductile, i.e. they cannot be drawn into wires. • Sulphur and phosphorus break into pieces on stretching and do not form wires.
Conductivity	• Metals are good conductors of heat and electricity. • Copper, silver, gold, aluminium and iron are good conductors of heat and electricity.	• Non-metals are poor conductors of heat and electricity, i.e. they do not allow heat and electricity to pass through them.
Sonority	• Metals are sonorous, i.e. they produce a ringing sound when struck (sonorous means capable of producing a ringing sound).	• Solid non-metals do not make a ringing sound when we strike them. Thus, we can say that non-metals are not sonorous.

Lustre	• Metals have a shiny appearance. So, we can say that metals are lustrous or shiny.	• Non-metals are dull and not lustrous.

Chemical Properties of Metals and Non-metals

Reaction with Oxygen

- The metal oxides are basic in nature.
- The basic metal oxides turn red litmus blue.

  Example:

  Magnesium burns in air and combines with the oxygen of the air to form magnesium oxide.

  $Mg + O_2 \rightarrow MgO$

  (Basic oxide)

  Magnesium oxide dissolves partially in water to form magnesium hydroxide. It is a base and turns red litmus blue.

  $MgO + H_2O \rightarrow Mg(OH)_2$

  (Base)
- Non-metal oxides are acidic in nature.
- Acidic non-metal oxides turn blue litmus red.

  Example:

  Sulphur burns in air and combines with the oxygen of the air to form sulphur dioxide.

  $S + O_2 \rightarrow SO_2$

  $SO_2 + H_2O \rightarrow H_2SO_3$ (Sulphurous acid)

Reaction with Water

- Metals react with water to form metal hydroxide along with the evolution of hydrogen gas.

  Example: Sodium reacts violently with cold water to form sodium hydroxide solution along with the evolution of hydrogen gas.

  $Na + H_2O \rightarrow NaOH + H_2$

  Because sodium reacts vigorously with oxygen and water producing a lot of heat, it is stored in kerosene.
- Non-metals do not react with water though they may be very reactive in the air.

Reaction with Acids

- Most metals react with dilute acids to form salts and hydrogen gas.

  Example:

Magnesium reacts with dilute hydrochloric acid to form magnesium chloride and hydrogen gas.

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

- Hydrogen gas burns with a pop sound when a lighted matchstick is brought near the mouth of the test tube.
- Metals such as copper, silver and gold do not react with dilute acids.
- Non-metals do not react with dilute acids to form salts and hydrogen gas.

Reaction with Bases

- **Metals** react with bases to form salts and hydrogen gas.
- Aluminium and zinc are the two common metals which react with bases to produce hydrogen gas.

  $Al + 2NaOH \rightarrow Na_2AlO_2 + H_2$

  $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$
- Reactions of non-metals with bases are complex.

Displacement Reactions

- A more reactive metal displaces a less reactive metal from its salt solution.

  Example: Reaction of iron metal with copper sulphate solution

  $CuSO_4 + Fe \rightarrow FeSO_4 + Cu$

  In this reaction, a more reactive iron displaces a less reactive copper from its salt solution, i.e. copper sulphate. A less reactive metal cannot displace a more reactive metal from its salt solution.

  Example: Reaction of iron metal with zinc sulphate solution

  $ZnSO_4 + Fe \rightarrow$ No displacement reaction

  Iron metal is less reactive than zinc metal. So, a less reactive iron metal cannot displace a more reactive zinc metal from zinc sulphate solution.

Uses of Metals

- Aluminium metal in the form of alloys is used to make aeroplanes.
- Zinc metal is used for galvanising iron to protect it from rusting.
- Silver and gold metals are used to make jewellery.

Uses of Non-Metals

- Oxygen is a non-metal which is used by plants and animals for breathing.
- Nitrogen is a non-metal which is used in the manufacture of fertilisers to enhance the growth of plants.
- Chlorine is a non-metal which is used in the water purification process.
- Sulphur is a non-metal which is used in the vulcanisation of rubber.