

**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

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| **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 + O2  MgO (Basic oxide)

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

MgO + H2O  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 + O2  SO2

SO2 + H2O  H2SO3 (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 + H2O  NaOH + H2

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  MgCl2 + H2

* 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  Na2AlO2 + H2

Zn + 2NaOH  Na2ZnO2 + H2

* 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

CuSO4 + Fe  FeSO4 + 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 ZnSO4 + Fe  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.