Different elements have different properties. Elements can be classified into two broad categories: **Metals and Non- metals**. Aluminium and mercury are examples of metals. Diamond and oxygen are examples of non- metals.

But there are certain elements which have some properties of metals and some of non-metals. They are known as metalloids such as antimony, arsenic.

On the basis of chemical reaction, metals are elements which form positive ions by losing electrons. Non-metals are elements which form negative ions by gaining electrons. **Noble gases do not form ions, so they cannot be classified as metals or non-metals**. Example: Helium, argon.

Minerals & Ores:

A mineral is a naturally occurring inorganic substance found under the surface of the Earth. An ore is the mineral from which one or more metals can be extracted profitably. The process use to extract a metal in its pure form from its ore is called metallurgy. For example aluminum is extracted from bauxite ore. The extraction of metals involves the following process

1 Concentration of Ore: The impurities from the ore are removed. This process is known as concentration of ore.

2. Reduction: The process of reduction of metal ore to get the metal in its free state.

3. Refining of Metal: The metal obtained by reduction is impure. Refining is the process of purification of metal.

Physical properties of metals and non- metals:

Physical properties include physical state, luster, colour, hardness, malleability, ductility, thermal conductivity, electrical conductivity, and sonority.

Physical state:

Metals: almost all metals are solids at room temperature. Mercury, Gallium, Francium, Cesium, and Rubidium are the only metals known to occur in a liquid state at or near room temperature.

Non-metals: almost all non-metals are solids or gases at room temperature. Bromine is the only non-metals that exist as a liquid at room temperature.

Lustre:

The property of metals by virtue of which their surface has a shine.

Metals: 'Glitter' or a shiny surface is a property of most metals. This is because metals can be polished. This property is called luster. Because of their ability to shine and reflect light, metals like gold, silver and platinum are used for making jewellery and other decorative articles.

Non- metals: almost all non- metals have a dull surface. As most of them occur as powders and gases, they cannot be polished like metals. Graphite and iodine do show some luster.

Colour:

Metals: Most metals are white or silvery- grey. There are, however, a few exceptions. For example, Gold is yellow and Copper is reddish- brown.

Non- metals: some non- metals are colourless while some are coloured. For example, chlorine is a greenish- yellow gas, bromine is a brown liquid, iodine is a violet solid, and oxygen and nitrogen are colorless gases.

Hardness:

Metals: most metals are hard but some (e.g. sodium and potassium) are so soft that they can be cut with a knife.
Non- metals: non- metals are generally soft. Diamond is an exception. It is the hardest substance known.

Malleability:

Metals: most metals can be beaten into thin sheets or foils. The property by virtue of which metals can be beaten into thin sheets is called malleability. Gold and Silver are the most malleable metals known. Silver foils are used for decorating sweets. Aluminium foils are used for wrapping food and chocolates.
Non- metals: non- metals are brittle and cannot be beaten into sheets or foils. Hence they are non-malleable.

Ductility:

Metals: most metals can easily be drawn into thin wires, which have a wide range of applications. The property by virtue of which metals can be drawn into thin wires is called ductility.
Gold and silver are two of the best ductile metals known. Copper and Aluminium are also drawn into wire and used in electrical wiring.
Non- metals: non- metals are brittle and cannot be drawn into wires. Hence they are non-ductile.

Thermal conductivity:

Metals: metals are good conductors of heat and are, therefore, used for making cooking utensils. Silver is the best conductor of heat followed by copper.
Non- metals: non- metals are generally poor conductors of heat. Diamond, which is good conductor of heat, is an exception.

Electrical conductivity:

Metals: metals are good conductors of electricity and are, therefore, used for making electrical wires and cables.
Non- metals: non- metals are generally poor conductors of electricity. Graphite, which is a good conductor of electricity, is an exception.

Sonority:

Metals: when metals pipe strike each other, they produce a ringing sound, the property by virtue of which metal object produce a ringing sound when struck with a hard object is called **sonority**. Object like wind chimes and bells make use of this property of metals.
Non- metals: non- metals produce a dull sound when struck with a hard object.

Chemical properties of metals and non- metals:

Chemical properties of metals and non-metals can be divided into five categories: reaction with oxygen, reaction with water, reaction with acids, reaction with bases, and displacement reactions.

1. **Reaction with oxygen:**

Metals: most metals combine with oxygen to form metal oxides.

Metal + oxygen $\longrightarrow$ Metal oxide

Sodium reacts vigorously with the oxygen present in air to form sodium oxide. As a result, it catches fire if left in open. It is, therefore, kept immersed in kerosene.

$4Na + O_2 \longrightarrow 2Na_2O$

Sodium Oxygen Sodium oxide

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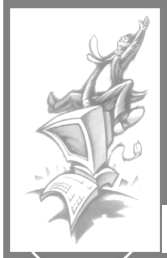

Magnesium, on heating, burns in air (oxygen) with a dazzling white light to form magnesium oxide.

$2Mg + O_2 \longrightarrow 2MgO$

Magnesium Oxygen Magnesium oxide

The metallic oxides formed are **basic** in nature and turn red litmus solution blue.

Non- metals: Non- metals like carbon, sulphur, and phosphorus react with oxygen to form non- metallic oxides. These oxides are also called **acidic** oxides as they form acids when dissolved in water.

Non-metal + oxygen $\longrightarrow$ Non- metallic oxide

Carbon burns in air (oxygen) to form carbon dioxide.

$C + O_2 \longrightarrow CO_2$

Carbon Oxygen Carbon dioxide

Sulphur burns in air (oxygen) to form a pungent (i.e. having a strong smell), suffocation gas called sulphur dioxide.

$S + O_2 \longrightarrow SO_2$

Sulphur Oxygen Sulphur dioxide

These oxides dissolve in water to form acids.

$CO_2 + H_2O \longrightarrow H_2CO_3$

Carbon dioxide water Carbon acid

$SO_2 + H_2O \longrightarrow H_2SO_3$

Sulphur dioxide water Sulphurous acid

2. Reaction with water:

Metals: most metals react with water to produce a metal hydroxide or metal oxide and hydrogen gas.

Metal + water $\longrightarrow$ Metal hydroxide + Hydrogen gas

Or

Metal + water $\longrightarrow$ Metal oxide + Hydrogen gas

Sodium reacts violently with cold water to form sodium hydroxide along with hydrogen gas. A large amount of heat is evolved in this reaction, which results in hydrogen catching fire.

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$

sodium water Sodium hydroxide Hydrogen gas

Calcium reacts with cold water but is not a violent reaction. Magnesium hardly reacts with cold water, it reacts faster with hot water, the reaction is even vigorous with steam. Metals like copper, silver, and gold do not react with water under any conditions.

Non- metals: Non- metals do not react with water.

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