

## Materials – Metal and Non-metals

### Introduction of Metals and Non-metals

Materials are classified into two types – metals and non-metals; on the basis of their properties. For example – aluminium, copper, iron, silver, etc. are metals. Sulphur, carbon, nitrogen, oxygen, etc. are non-metals.

### Physical properties of Metals and Non-metals

#### Hardness

**Metals** – Metals are generally hard. For example; iron, copper, silver, gold, aluminium, etc. But some metals, such as mercury, sodium, calcium, etc. are not hard.

**Non-metals** – Non-metals are not hard. For example – phosphorous, sulphur, etc. Diamond is exception, which is a type of non-metal, coal. Diamond is the hardest naturally occurring material.

#### Appearance:

**Metals** – Metals are shiny in appearance. For example – iron, gold, silver, copper, etc.

**Non-metals** – Non-metals are dull in appearance. For example coal.

#### Sonorous:

**Metals** - Metals produce ringing sound when beaten, i.e. metals are sonorous. This is the reason that bells are made of metal.

**Non-metals** – Non-metals do not produce ringing sound when beaten. And thus, non-metals are non-sonorous.

#### Ductility:

**Metals** – Metals are ductile in nature. This means metals can be beaten into thin sheets. For example thin sheets of iron are used in making the body of vehicle, ship, roof of thatched house, etc.

**Non-metals** – Non metals are not ductile. When non-metal is beaten it broken into pieces, thus metals are called brittle. For example when a lump of coal is beaten using a hammer, it is broken into pieces.

#### Malleability:

**Metals:** Metals can be drawn into wire. This property of metal is called malleability and thus metals are malleable. For example – electric wires are made of metals, such as aluminium, copper, etc.

**Non-metals:** Non-metals are brittle and thus cannot be drawn into wire.

**Conductor:**

**Metals:** Metals are good conductor of electricity and heat. This is the cause that electric wire and kitchen utensils are made of metals.

**Non-metals:** Non-metals do not conduct electricity or heat and they are bad conductor. However, graphite; which is a non-metal; is an exception as it conducts electricity.

Thus, materials which are hard, sonorous, good conductors of electricity and heat, malleable, ductile and have shiny appearance are called metals.

And materials which are not hard, non-sonorous, bad conductors, brittle and dull in appearance are called non-metals.

## **Chemical Properties of Metals and Non-metals**

Reaction of metals with oxygen:

Metals form their oxides when react with oxygen.

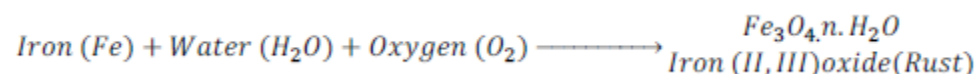


Metal oxides are basic in nature.

Example -

Reaction of Iron metal with oxygen

When iron reacts with moist air, it forms rust. Rust is iron oxide. Articles made of iron, such as grills, fencing, etc. are get rusted because of reaction with moist air.



Rust is reddish brown in colour and is iron oxide.

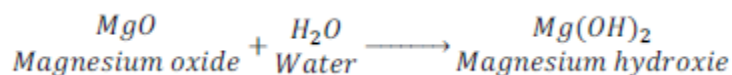
Iron oxide is basic in nature. It turns red litmus blue.

Reaction of Magnesium metal with oxygen:

When magnesium is burnt in air, it forms magnesium oxide. Burning in air means reaction with oxygen.



Magnesium oxide forms magnesium hydroxide with water. Solution of Magnesium oxide turns red litmus paper blue. This means magnesium oxide is basic in nature.



### Reaction of Non-metals with oxygen:

Non-metals form their oxides when they react with oxygen.



Thus,

Non-metal forms their oxide when they react with oxygen.

Non-metal oxides are acidic in nature.

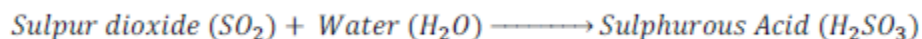
Example -

### Reaction of sulphur with oxygen

When sulphur is burnt in air, it forms sulphur dioxide.



Solution of sulphur dioxide turns blue litmus paper red. Sulphur dioxide forms sulphurous acid when dissolved in water. Thus, sulphur dioxide is acidic in nature.

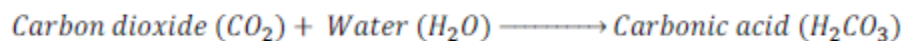


### Reaction of carbon with oxygen

When carbon is burnt in air, it forms carbon dioxide. You can observe that when coal (carbon) is burnt it forms smoke, which contains carbon dioxide.



Carbon dioxide is acidic in nature. The solution of carbon dioxide in water turns blue litmus paper red.



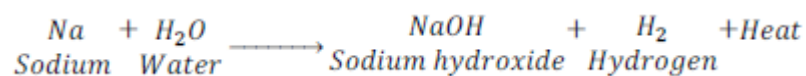
### Reaction of Metals and Non-metals with water:

Generally, metals form respective hydroxides when they react with water.



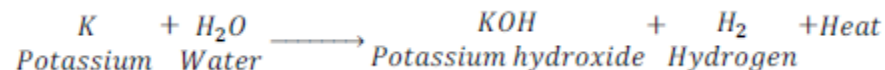
### Reaction of sodium metal with water:

Sodium metal vigorously reacts with water and forms sodium hydroxide along with lot of heat.



### Reaction of potassium with water:

Potassium metal vigorously reacts with water and forms potassium hydroxide along with lot of heat.



Non-metals generally do not react with water. Rather some non-metals which react with air vigorously are stored in water.

## Chemical Properties of Metals and Non-metals - part 2

### Reaction of metals and non-metals with dilute acid

Metals give hydrogen gas when they react with dilute acid.

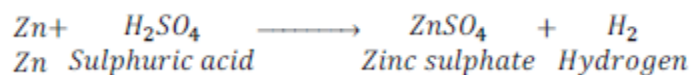


### Reaction of zinc with dilute acid:

Zinc gives hydrogen gas along with zinc chloride when it reacts with hydrochloric acid.



Similarly, zinc gives hydrogen gas along with zinc sulphate when it reacts with sulphuric acid.



This method is used to produce hydrogen gas in laboratory.

#### Reaction of sodium metal with dilute acid:

Sodium gives hydrogen gas and sodium chloride when reacts with dilute hydrochloric acid (HCl).



#### Reaction of Aluminium with dilute acid:

Aluminium gives hydrogen gas along with aluminium chloride when it reacts with dilute hydrochloric acid.



Copper does not react with dilute sulphuric acid even on heating, but it reacts with concentrated sulphuric acid. Copper, silver and gold are considered as noble metals as do not react with dilute acid.

Generally, non-metals do not react with dilute acid.

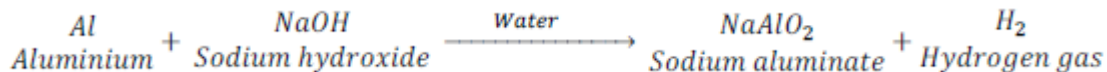
#### Reaction of metals and non-metals with base:

Metals give hydrogen gas when they react with a base.



#### Reaction of aluminium metal with sodium hydroxide

Aluminium metal forms hydrogen gas and sodium aluminate when it reacts with sodium hydroxide.



Similarly; zinc gives sodium zincate and hydrogen gas when it reacts with sodium hydroxide.

#### Displacement Reaction

When a more reactive metal reacts with the salt solution of less reactive metal, more reactive metal displaces the less reactive metal from its solution.



In the above equation, metal A is more reactive than metal B.

### Example –

When aluminium metal is dipped in the solution of copper sulphate, it forms aluminium sulphate and copper.

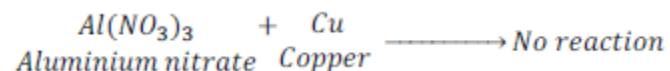


When iron reacts with solution of copper sulphate, it gives iron sulphate and copper.



In the above two reactions, aluminium and iron are more reactive than copper, that's why they replace copper from the solution of copper sulphate.

When copper metal is dipped in the solution of aluminium nitrate, no reaction takes place. Because copper is less reactive than aluminium.



## Use of Metals and Non-metals

### Use of metals

- Iron is used in making machinery, buildings, car, motorcycle, ships, bridge, etc.
- Copper is used in making electric wires, statue, etc.
- Aluminium is used in making kitchen utensils, electric wire, etc.
- Gold is used in making ornaments.
- Silver is used in making ornaments.

### Use of Non-metals

- The number of non-metals is very less in comparison to metals but non-metals are more useful for us. So far only 22 non-metals are discovered.
- We breathe oxygen which is a non-metal. Without oxygen no one can live.
- Sodium chloride (common salt) cannot be formed without chlorine (a non-metal) which we use to enhance the taste of food. Without using common salt, food is tasteless.

- Nitrogen is used in making fertilizers.
- Coal, which carbon, is used as fuel.