

CHAPTER - 3 METALS AND NON-METALS

Metal

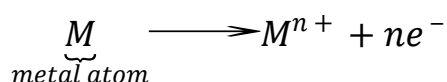
Element that are electropositive in nature are called metal, e.g., copper.

Physical Properties of Metal

- i. **Malleability** It is the property of metals due to which they can be beaten into thin sheets. Most of the metals are malleable.
- ii. **Ductility** It is the property due to which a metal can be drawn into wires. Metals are generally ductile. Gold is the most ductile metal.
- iii. **Hardness** Most of the metals are hard. But some alkali metals like sodium and potassium are so soft that they can be cut easily with knife.
- iv. **Metallic Luster** Metals in their pure state have bright shining surfaces. This property is called metallic luster.
- v. **Electrical Conductivity** Most of the metals are good conductors of electricity.
- vi. **Thermal Conductivity** Generally metals are good conductors of heat, except lead and mercury, which are poor conductors of heat. The best conductors of heat are copper and silver among all metals.
- vii. **Melting and Boiling Points** Metals generally have high melting and boiling point, except mercury, gallium and alkali metals. Tungsten has the highest melting point among metals while mercury has the lowest.
- viii. **Sonority** When metals are struck with a hard substance, they produce sound. This property is called sonority and the metals are said to be sonorous bells are made up of metal due to this property.

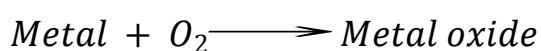
CHEMICAL PROPERTIES OF METALS

Most of the chemical properties of metals are due to their electropositive nature. It means metal atom loses electrons to form cation.

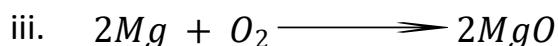
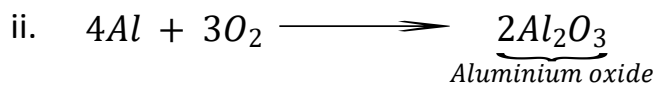
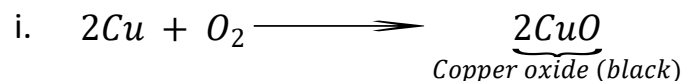


Reaction with Air:

Metals combine with oxygen to form metal oxide.



Examples:



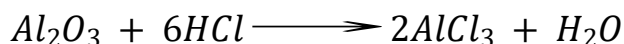
Different metals show different reactivity's towards oxygen.

- Na and K react so vigorously that they catch fire if kept in open so they are kept immersed in kerosene.
- Surfaces of Mg, Al, Zn, Pb are covered with a thin layer of oxide which prevent them from further oxidation.
- Fe does not burn on heating but iron fillings burn vigorously.
- Cu does not burn but is coated with black copper oxide.
- Au and Ag does not react with oxygen.

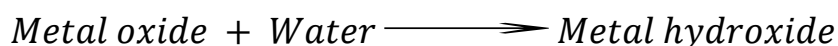
Amphoteric Oxides:

Metal oxides which react with both acids as well as bases to produce salts and water are called amphoteric oxides.

Examples

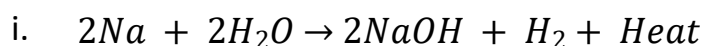


Reaction of Metals with Water:



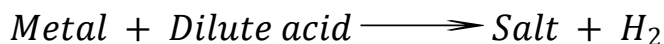
- React with cold water Na, K, Ca
- React with steam Al, Fe, Zn
- React with hot water Mg
- No reaction with water Pb, Cu, Au, Ag
- Ca and Mg float as bubbles of H₂ stick to their surface

Examples:



- ii. $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$
- iii. $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$
- iv. $2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$
- v. $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

Reaction of Metals with Acids (Dilute):

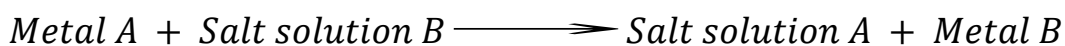


Cu, Ag, Hg do not react with dilute acids

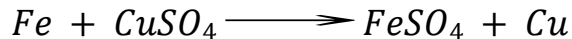
Examples:

- i. $Fe + 2HCl \rightarrow FeCl_2 + H_2$
- ii. $Mg + 2HCl \rightarrow MgCl_2 + H_2$
- iii. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
- iv. $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

Reaction of Metals with Solutions of other Metal Salts:



- Reactive metals can displace less reactive metals from their compounds in solution form.



REACTIVITY SERIES OR ELECTROCHEMICAL SERIES OF METALS

The reactivity series is a list of metals arranged in the order of their decreasing activities.

Non-metal

Element that are electronegative in nature are called non-metal. It means non-metals gain electrons to form negative ions, e.g., iodine

K	Potassium	Most reactive ↓ Least reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	
Fe	Iron	
Pb	Lead	
[H]	[Hydrogen]	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	

Physical Properties of Non-metals

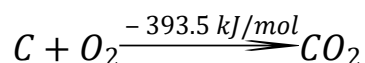
- i. **Brittleness** Non-metals are neither malleable nor ductile but they are brittle in nature.

- ii. **Physical State** Most of the non-metals are soft (if solid). Only diamond, a form of carbon is the hardest known substance. Other non-metals are gases except bromine which is a liquid.
- iii. **Metallic Luster** The non-metals do not have luster, i.e., shining surface. However, diamond, graphite (forms of carbon) and iodine have luster, even they are non-metals.
- iv. **Electrical and Thermal Conductivity** Non-metals are generally poor conductors of heat and electricity.
- v. **Melting and Boiling Points** Generally, non-metals have low melting and boiling points. But non-metals that are solids have comparatively higher boiling points (e.g., B, Si, C, etc.).

Chemical properties of non-metal

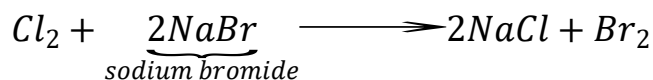
Reaction with oxygen

Nonmetal react with oxygen to form oxides. These oxides are generally acidic. Only some of the non-metallic oxides are neutral. Acidic oxides are CO_2 , SO_2 , P_2O_5 , etc.



Displacement reaction

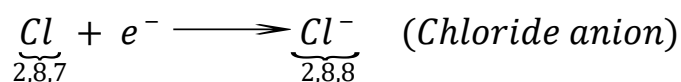
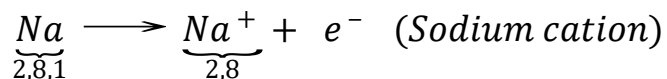
Nonmetal also show displacement reaction like metal.



Reaction of Metals with Non-metals

- Reactivity of elements is the tendency to attain a completely filled valence shell.
- Atoms of the metals lose electrons from their valence shell to form cation. Atom of the non-metals gains electrons in the valence shell to form anion.

Example - Formation of NaCl





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