# Handout -4/6

**Class –X** **Subject – Science**

## CHAPTER – 3

## METALS AND NON-METALS

### REACTION OF METAL AND NON-METAL

**Table 3.3** Electronic configuration of some elements

| Type of element | Element | Atomic number | Number of electrons in shells | | | |
|---|---|---|---|---|---|---|
| | | | K | L | M | N |
| Noble gases | Helium (He) | 2 | 2 | | | |
| | Neon (Ne) | 10 | 2 | 8 | | |
| | Argon (Ar) | 18 | 2 | 8 | 8 | |
| Metals | Sodium (Na) | 11 | 2 | 8 | 1 | |
| | Magnesium (Mg) | 12 | 2 | 8 | 2 | |
| | Aluminium (Al) | 13 | 2 | 8 | 3 | |
| | Potassium (K) | 19 | 2 | 8 | 8 | 1 |
| | Calcium (Ca) | 20 | 2 | 8 | 8 | 2 |
| Non-metals | Nitrogen (N) | 7 | 2 | 5 | | |
| | Oxygen (O) | 8 | 2 | 6 | | |
| | Fluorine (F) | 9 | 2 | 7 | | |
| | Phosphorus (P) | 15 | 2 | 8 | 5 | |
| | Sulphur (S) | 16 | 2 | 8 | 6 | |
| | Chlorine (Cl) | 17 | 2 | 8 | 7 | |

Many metals form ionic bonds when they react with non-metals. Compounds so formed areknown as ionic compounds.

**Ions:** Positive or negative charged atoms are known as ions. Ions are formed because of loss orgain of electrons. Atoms form ion to obtain electronic configuration of nearest noble gas, this means to obtain stable configuration.

Metals will try to lose electrons the nearest noble gas configuration for example

$$Na \rightarrow Na^{+} + e-$$

$$K \rightarrow K^{+} + e-$$

$$Mg \rightarrow Mg^{2+} + 2e-$$

.

$$Ca \rightarrow Ca^{2+} + 2e-$$

Non-metals gain electrons to complete their octet.

$$Cl + e- \rightarrow Cl^{-}$$

$$F + e- \rightarrow F^{-}$$

$$O + 2e- \rightarrow O^{2-}$$

**IONIC BONDS**

The bond which is formed by loss and gain of electrons between the atoms is called ionic or electrovalent bond.

Ionic bonding is observed because metals have few electrons in their outer-most orbitals. Bylosing those electrons, these metals can achieve noble gas configuration and satisfy the octetrule. Similarly, non-metals that have close to 8 electrons in their valence shells tend to readilyaccept electrons to achieve noble gas configuration. In ionic bonding, more than 1 electron canbe donated or received to satisfy the octet rule. The charges on the anion and cation correspondto the number of electrons donated or received. In ionic bonds, the net charge of the compoundmust be zero.

**EXAMPLES**

**FORMATION OF SODIUM CHLORIDE (NaCl):**

In sodium chloride; sodium is a metal (alkali metal) and chlorine is non-metal.

Atomic number of sodium = 11

Electronic configuration of sodium: 2, 8, 1

Number of electrons in outermost orbit = 1

Valence electrons = Electrons in outermost orbit = 1

Atomic number of chlorine = 17

Electronic configuration of chlorine: 2, 8, 7

Electrons in outermost orbit = 7

Therefore, valence electrons = 7

$$Na \rightarrow Na^+ + e^-$$
$$2,8,1 \quad 2,8$$
(Sodium cation)

$$Cl + e^- \rightarrow Cl^-$$
$$2,8,7 \quad 2,8,8$$
(Chloride anion)

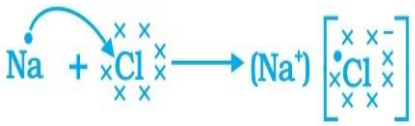


***Figure3.5*** *Formation of sodium chloride*

Sodium has one valence electron and chlorine has seven valence electrons. Sodium requireslosing one electron to obtain stable configuration and chlorine requires gaining one electron in order to obtain stable electronic configuration. Thus, in order to obtain stable configurationsodium transfers one electron to chlorine.After loss of one electron sodium gets one positive charge (+) and chlorine gets one negativecharge after gain of one electron. Sodium chloride is formed because of transfer of electrons.

Thus, ionic bond is formed between sodium and chlorine. Since, sodium chloride is formedbecause of ionic bond, thus it is called ionic compound.

**FORMATION OF MAGNESIUM CHLORIDE ($MgCl_2$):**

The atomic number of magnesium is 12

Electronic configuration of magnesium: 2, 8, 2

Number of electrons in outermost orbit = 2

Valence electron = 2

Atomic number of chlorine = 17

Electronic configuration of chlorine: 2, 8, 7

Electrons in outermost orbit = 7

Therefore, valence electrons = 7

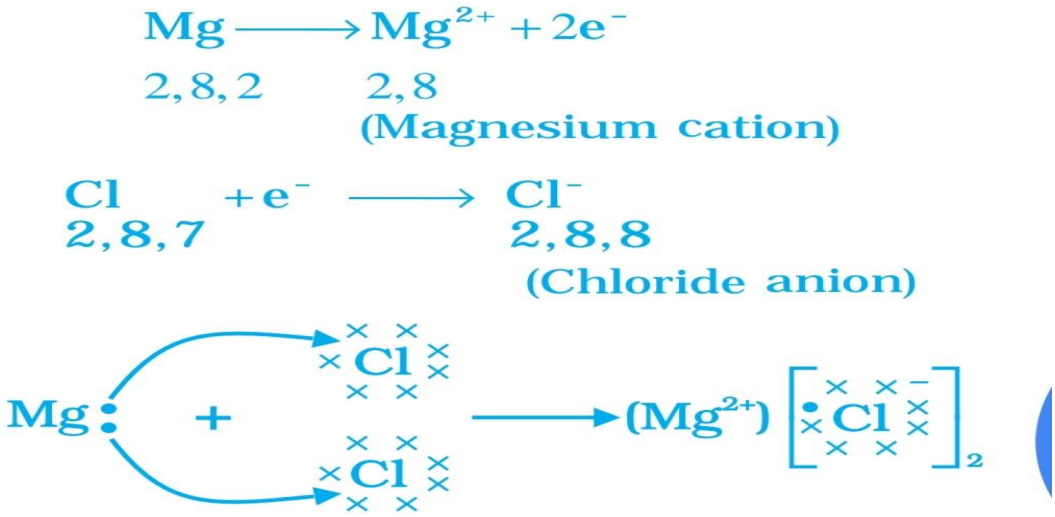


***Figure3.6** Formation of magnesium chloride*

Magnesium loses two electrons in order to obtain stable electronic configuration. Each of thetwo chlorine atoms gains one electron lost by magnesium to obtain stable electronicconfiguration. The bonds so formed between magnesium and chlorine are ionic bonds andcompound (magnesium chloride) is an ionic compound.

**PROPERTIES OF IONIC COMPOUND:**

**FLAME TEST**

**ACTIVITY-**

Take samples of **sodium chloride, potassium iodide, barium**

**chloride** or any other salt from the science laboratory.
Take a small amount of a sample on a metal spatula and heat directly on the flame.
Repeat with other samples.

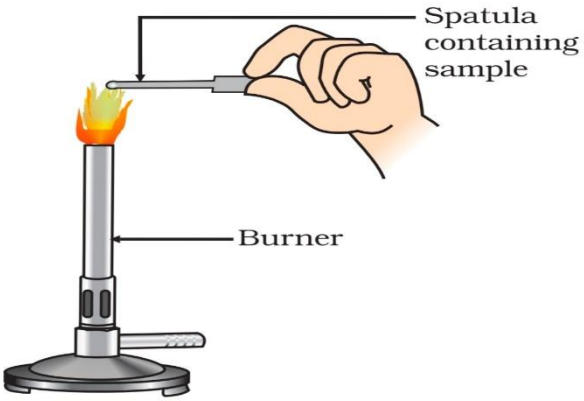


***Figure 3.7***
*Heating a salt sample on a spatula*

What did you observe?
Did the samples impart any colourto the flame?

1) ***Physical nature*****:** Ionic compounds are solids and are somewhat hard because of the strongforce of attraction between the positive and negative ions. These compounds are generallybrittle and break into pieces when pressure is applied.

2) ***Melting and Boiling points*****:** Ionic compounds have high melting and boiling points. This isbecause a considerable amount of energy is required to break the strong inter-ionicattraction.

3) ***Solubility*****:** Electrovalent compounds are generally soluble in water and insoluble insolvents such as kerosene, petrol, etc.

4) ***Conduction of Electricity*****:** The conduction of electricity through a solution involves themovement of charged particles. A solution of an ionic compound in water contains ions,which move to the opposite electrodes when electricity is passed through the solution. Ioniccompounds in the solid state do not conduct electricity because

movement of ions in thesolid is not possible due to their rigid structure. But ionic compounds conduct electricity inthe molten state. This is possible in the molten state since the electrostatic forces ofattraction between the oppositely charged ions are overcome due to the heat. Thus, the ionsmove freely and conduct electricity.