

## Reaction of Metal and Non-metal

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

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

**Positive ion:** A positive ion is formed because of loss of electrons by an atom. Following are some examples of positive ions.

Sodium forms sodium ion because of loss of one electron. Because of loss of one electron; one positive charge comes over sodium.



Similarly; potassium gets one positive charge by loss of one electron.



Magnesium forms positive ion because of loss of two electrons. Two positive charges come over magnesium because of loss of two electrons.

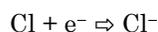


Similarly calcium gets two positive charges over it by loss of two electrons.

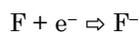


**Negative ion:** A negative ion is formed because of gain of electron. Some examples are given below.

Chlorine gains one electron in order to achieve stable configuration. After loss of one electron chlorine gets one negative charge over it forming chlorine ion.



Similarly, fluorine gets one negative charge over it by gain of one electron forming fluoride ion; in order to achieve stable configuration.



Oxygen gets two negative charge over it by gain of two electrons forming oxide ion; in order to obtain stable configuration.



## Ionic Bonds

Ionic bonds are formed because of transfer of electrons from metal to non-metal. In this course, metals get positive charge because of transfer of electrons and non-metal gets negative charge because of acceptance of electrons. In other words bond formed between positive and negative ion is called ionic bond.

Since, a compound is electrically neutral, so to form an ionic compound negative and positive both ions must be combined. Some examples are given below.

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

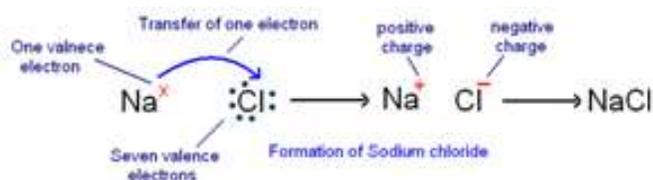
Valence electrons = Electrons in outermost orbit = 1

Atomic number of chlorine = 17

Electronic configuration of chlorine: 2, 8, 7

Electrons in outermost orbit = 7

Therefore, valence electrons = 7



Sodium has one valence electron and chlorine has seven valence electrons. Sodium requires losing 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 configuration sodium transfers one electron to chlorine.

After loss of one electron sodium gets one positive charge (+) and chlorine gets one negative charge 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 formed because of ionic bond, thus it is called ionic compound. In similar way; potassium chloride (KCl) is formed.

Formation of Magnesium Chloride (MgCl<sub>2</sub>):

The atomic number of magnesium is 12

Electronic configuration of magnesium: 2, 8, 2

Number of electrons in outermost orbit = 2

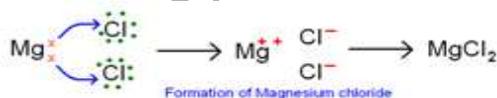
Valence electron = 2

Atomic number of chlorine = 17

Electronic configuration of chlorine: 2, 8, 7

Electrons in outermost orbit = 7

Therefore, valence electrons = 7



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

Formation of calcium chloride: (CaCl<sub>2</sub>):

Atomic number of calcium is 20.

Electronic configuration of calcium: 2, 8, 8, 2

Number of electrons in outermost orbit = 2

Valence electron = 2

Valence electrons of chlorine = 7

Calcium loses two electrons in order to achieve stable electronic configuration. Each of the two chlorine atoms on the other hand gains one electron losing from calcium to get stability. By losing of two electrons calcium gets two positive charges over it. Each of the chlorine atoms gets one positive charge over it.



The bonds formed in the calcium chloride are ionic bonds and compound (calcium chloride) is an ionic compound. In similar way; Barium chloride is formed.

Formation of Calcium oxide (CaO):

Valence electron = 2

Atomic number of oxygen is 8

Electronic configuration of oxygen is: 2, 6

Number of electrons in outermost orbit = 6

Valence electron = 6

Calcium loses two electrons and gets two positive charges over it in order to get stability. Oxygen gains two electrons; lost by calcium and thus gets two negative charges over it.



Bond formed between calcium oxide is ionic bond. Calcium oxide is an ionic compound. In similar way; magnesium oxide is formed.

### **Properties of Ionic compound:**

- Ionic compounds are solid. Ionic bond has greater force of attraction because of which ions attract each other strongly. This makes ionic compounds solid.
- Ionic compounds are brittle.
- Ionic compounds have high melting and boiling points because force of attraction between ions of ionic compounds is very strong.
- Ionic compounds generally dissolve in water.
- Ionic compounds are generally insoluble in organic solvents; like kerosene, petrol, etc.
- Ionic compounds do not conduct electricity in solid state.
- Solution of ionic compounds in water conduct electricity. This happens because ions present in the solution of ionic compound facilitate the passage of electricity by moving towards opposite electrodes.
- Ionic compounds conduct electricity in molten state.