Bonding, Structure and properties of matter

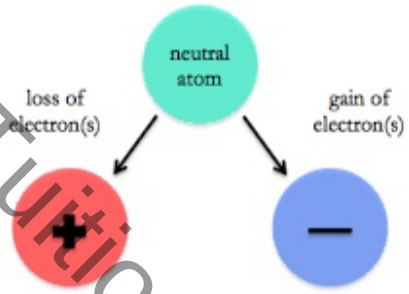
Content:

Ions

➤ **Definition:**

An ion is an atom or group of atoms with a positive or negative charge. Ions form when atoms lose or gain electrons to obtain a full outer shell

- Metal atoms lose electrons to form positively charged ions
- Non-metal atoms gain electrons to form negatively charged ions



➤ **Positively charged ions:**

a) Metal atoms lose electrons from their outer shell when they form ions:

- the ions are positive, because they have more protons than electrons
- the ions formed have full outer shells
- The ions have the electronic structure of a noble gas (group 0 element), with a full outer shell

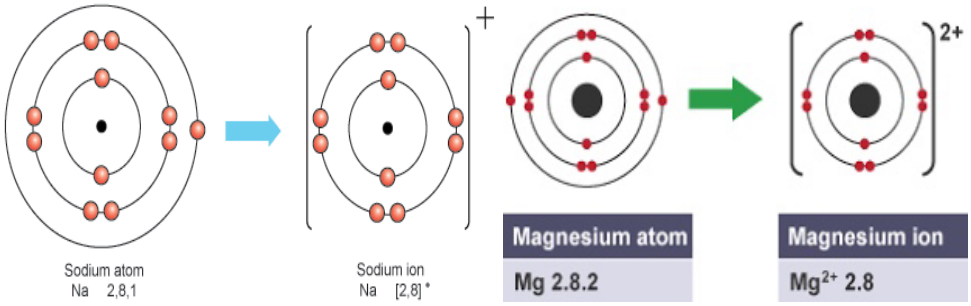
b) Elements in groups 1,and 2 , the number of electrons lost is the same as the group number.

c) From **Group 1** sodium atom(Na)there is only 1 electron in outer shell it loses its electron to form sodium ion Na+1 and has same electronic structure as Neon

Na —> Na+ + e-

d) From **Group 2** magnesium atom(Mg) has only 2 electrons in outer shell, so it loses 2 electron to form magnesium ion Mg+2 charge has same electronic structure as Neon

Mg —> Mg+2 + 2e-



➤ **Negatively charged ions:**

a) The outer shells of non-metal atoms gain electrons when they form ions:

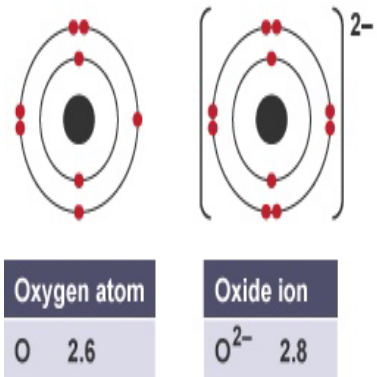
- the ions formed are negative, because they have more electrons than protons
- the ions have the electronic structure of a noble gas (group 0 element), with a full outer shell

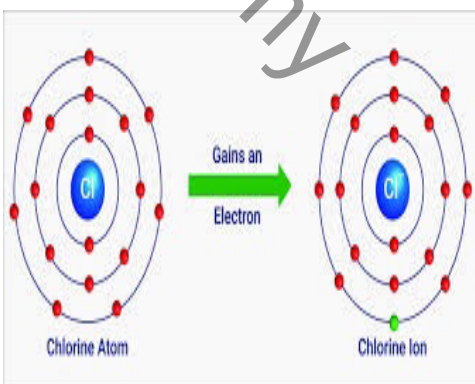
b) For elements in **groups 6** Oxygen has 6 electrons in outer most shell. To complete its outer shell it gains 2 more electron and form oxide ion with -2 charge with the same electronic no# as Neon

O + 2e- —> O2-

c) For element in **group 7** chlorine has 7 electron in outer shell. To complete its shell it gain 1 electron and form chloride ion with same electronic structure as Argon

Cl + e- —> Cl-





Ionic Bonding

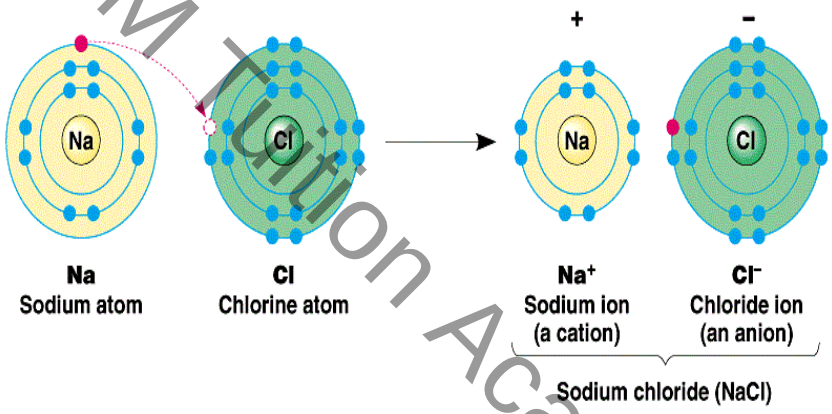
➢ Definition:

a) when a metal reacts with a non-metal, by transferring electrons.

b) Metal atom loses Electron and form +ve charge whereas Non metal gains Electrons and form -ve charge

c) The oppositely charged ions are strongly attracted to each other by Electrostatic Forces this attraction is called ionic bonds

d) For Example: in Sodium chloride (NaCl) there is ionic bind between sodium(Na) and Chloride(Cl)



Explanation of the Diagram:

I. The atomic Number of **sodium is 11** and its electronic structure is 2,8,1. To achieve the noble gas configuration it needs to lose 1 electron from its outer shell and form +ve ion **Na+.**

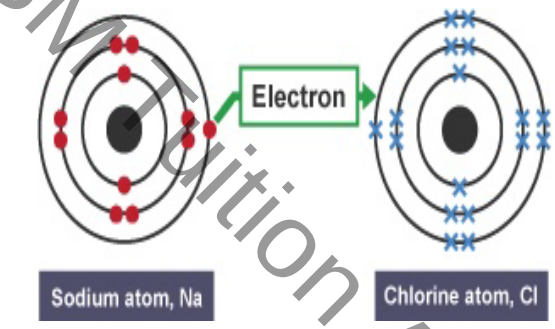
II. The atomic number of **chlorine is 17** and it's electronic structure is 2,8,7. To achieve the noble gas configuration it needs to gain 1 electron from near by atom and form -ve charge **(Cl -).**

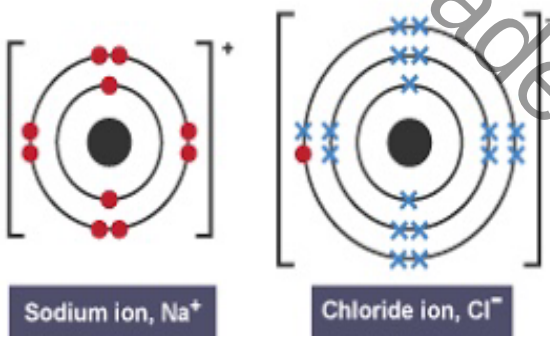
III. As we know, Opposite charges attract each other so Na+ and Cl- attract each other by losing and gaining Electrons and form **Ionic bond.**

Dot and cross Diagram for ionic bonding

- **A dot and cross diagram models** the transfer of electrons from metal atoms to non-metal atoms.
- The electrons from one atom are shown as dots, and the electrons from the other atom are shown as cross.
- **For example**,

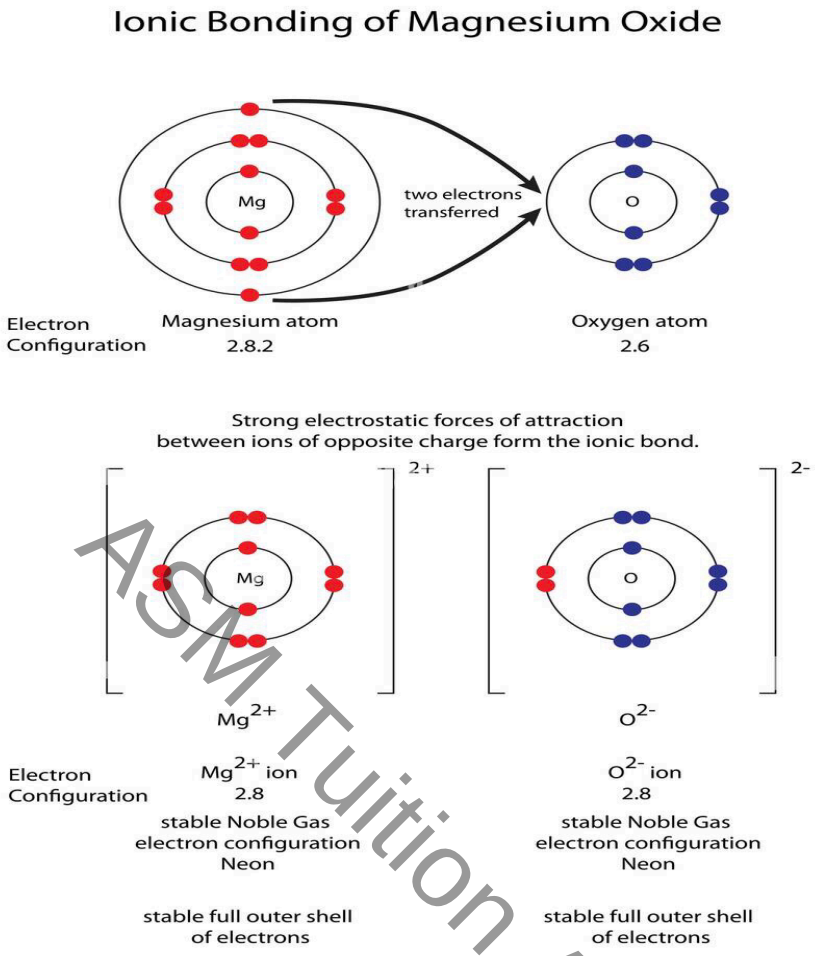
1- when sodium reacts with chlorine, electrons transfer from sodium atoms (electron shown in Dots) to chlorine atoms (electrons shown in cross).





2- Magnesium oxide (MgO)

- Magnesium has electronic structure (2,8,2) to achieve noble gas configuration it needs to lose its 2 electron and form (Mg+2)
- Oxide has 6 electrons in outer shell to complete its shell it need to gain 2 electron from nearby atom (O-2)
- Here is the diagram



3- Magnesium chloride (MgCl2)

- Magnesium holds an atomic number of 12, and its electronic configuration is 2,8,2. To achieve the noble gas configuration **magnesium needs** to **lose two electrons** from its outermost shell and form **magnesium cation** (Mg2+).
- **Ionic bond formation in Magnesium chloride:**

When a **magnesium** atom **joins two chlorine atoms**, **two electrons** are transferred from the magnesium to the chlorine, resulting in a **magnesium chloride(MgCl2)** molecule. Thus, both atoms have a stable octet electronic configuration.