Topic EX1 : Formulae

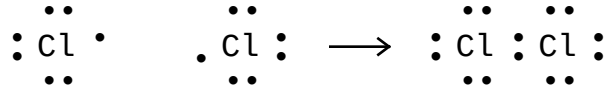
Revised July 1995

Chemical bonding between atoms is the result of the pairing of unpaired electrons. When atoms join to form compounds **ALL** the unpaired electrons must become paired.

This can be done in **two** ways :

¶ **Covalent Bonding** (bonding between two non-metals)

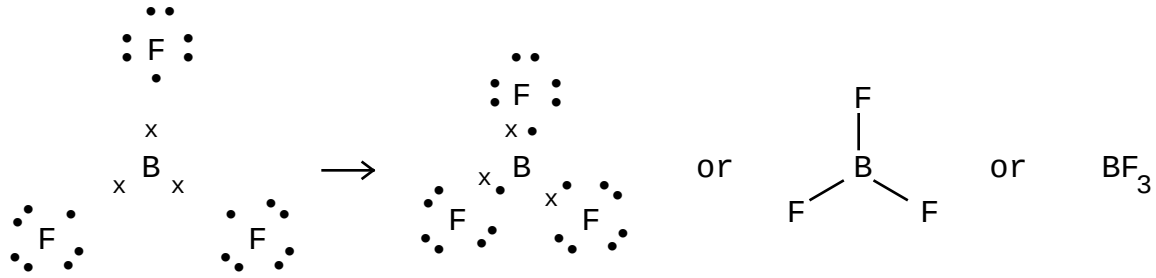
Example 1 : Chlorine gas Cl 2)8)7



or Cl-Cl or Cl_2

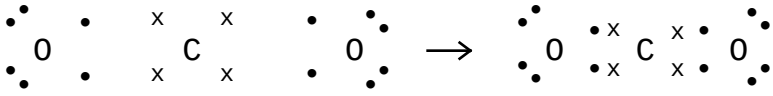
The bonding pair of electrons (-ve) attract the two nuclei (+ve) holding them together - a covalent bond.

Example 2 : Boron fluoride (or Boron trifluoride)
B 2)3 F 2)7



or BF_3

Example 3 : Carbon dioxide C 2)4 O 2)6

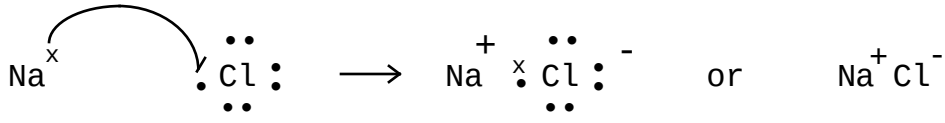


or O=C=O or CO_2

• **Electrovalent Bonding** (bonding between a metal (Low EAP) and a non-metal (High EAP)

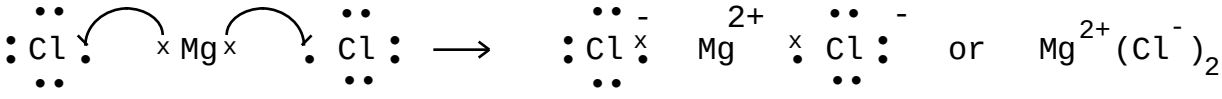
Example 1 : Sodium chloride

The metal, Sodium Na 2)8)1, loses all its outer electrons becoming a **positive ion** ; the non-metal, Chlorine Cl 2)8)7, gains these electrons becoming a **negative ion** :



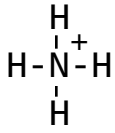
or Na^+Cl^-

Example 2 : Magnesium chloride Mg 2)8)2 Cl 2)8)7



Note : some ions contain more than one atom :

Examples :

Ammonium ion	NH_4^+	
Hydroxide ion	OH^-	
Nitrate ion	NO_3^-	
Carbonate ion	CO_3^{2-}	
Sulphate ion	SO_4^{2-}	

Where the atom has a **variable valency**, the number of electrons used in bonding will be indicated in the name of the compound :

Examples : Phosphorus(III) chloride PCl_3

Iron(III) chloride $Fe^{3+}(Cl^-)_3$

State symbols are often used to describe the physical state :

(s) : solid

(l) : liquid

(g) : gas

(aq) : dissolved in water

Examples :

$H_2O(g)$	means Water vapour
$H_2O(l)$	means ordinary liquid Water
$H_2O(s)$	means ice
$CH_3OH(aq)$	means a solution of Methanol in Water

Further Examples of formulae:

Potassium fluoride	K^+F^-
Calcium fluoride	$Ca^{2+}(F^-)_2$
Nitrogen fluoride	NF_3
Iron(II) chloride	$Fe^{2+}(Cl^-)_2$
Copper(II) carbonate	$Cu^{2+}CO_3^{2-}$
Sodium carbonate	$(Na^+)_2CO_3^{2-}$
Hydrogen sulphide	H_2S
Phosphorus hydride	PH_3
Magnesium oxide	$Mg^{2+}O^{2-}$
Sodium oxide	$(Na^+)_2O^{2-}$
Sodium nitrate	$Na^+NO_3^-$
Sodium nitride	$(Na^+)_3N^{3-}$
Ammonium sulphate	$(NH_4^+)_2SO_4^{2-}$
Oxygen chloride	OCl_2
Sodium hydroxide	Na^+OH^-
Carbon sulphide	CS_2
Iodine(V) fluoride	IF_5
Iodine(III) fluoride	IF_3
Lithium sulphate	$(Li^+)_2SO_4^{2-}$
Lithium sulphide	$(Li^+)_2S^{2-}$
Lithium sulphite	$(Li^+)_2SO_3^{2-}$
Calcium phosphate	$(Ca^{2+})_3(PO_4^{3-})_2$
Ammonium dichromate	$(NH_4^+)_2Cr_2O_7^{2-}$
Sulphur(VI) chloride	SCl_6
Silicon chloride	$SiCl_4$
Ammonium chloride	$NH_4^+Cl^-$