

How Atoms Combine

WORD BANK

gained	lose	positive	non-metal	negative	lose
equals	zero	positive	gain	metals	gain

Remember that electrons have a _____ charge and protons have a _____ charge.

In a normal atom, the number of electrons _____ the number of protons, so there is _____ charge.

If electrons are lost, the charge on the atom will become _____.

If electrons are _____, the charge on the atom will become negative.

Atoms become more stable if they have a full outer shell of electrons.

Atoms of groups I, II and III and of V, VI and VII tend to react by gaining or losing electrons until they are like the closest element in Group VIII. Group VIII elements have 8 outer orbit electrons (except for helium since the first orbit only holds 2 electrons).

The elements of groups I, II and III _____ electrons.

These elements are called _____.

Metals tend to _____ electrons.

The elements of groups V, VI and VII _____ electrons.

These elements are called _____.

Non-metals tend to _____ electrons.

Atoms that have gained or lost electrons so that they are positively or negatively charged are called ions.

Examples:

$\text{Na} \rightarrow \text{Na}^{+1} + 1\text{e}^{-}$ Sodium, a metal, loses one electron to form a +1 ion.

$\text{S} + 2\text{e}^{-} \rightarrow \text{S}^{-2}$ Sulphur, a non-metal, gains two electrons to form a -2 ion.

Notice that adding two negative electrons to S is like adding -2 to zero. $0 + (-2) = -2$

Taking a negative electron away from Na is like subtracting -1 from zero. $0 - (-1) = +1$

The Rule of Eight (The Octet Rule)

Many metal atoms **lose** their outer orbit electrons and non-metal atoms **gain** outer orbit electrons until they have **eight** like a Group VIII element (or two if they are close to helium). Complete the table below.

Element	Group	Metal or Non-metal	Gains or Loses Electrons?	# of outer orbit electrons	# of e ⁻ 's gained or lost	Ion formed and its charge
Li	I	metal	loses	1	1	Li ⁺¹
Be						
B						
N	V	non-metal	gains	5	3	N ⁻³
O						
F						
Na						
Mg						
Al						
P						
S						
Cl						
K						
Ca						

Ionic Compounds

Positive metal ions attract negative non-metal ions. They join to form neutral ionic compounds.

The total positive and negative charges **must cancel out** to have a neutral formula.

To name the compound, name the metal element first and the non-metal second with the ending of the non-metal changed to **ide**.

Complete the charts following the examples in the first two rows.

Elements				Chemical Formula	Ionic Compound Name
	Ionic Charge		Ionic Charge		
Na	Na^{+1}	F	F^{-1}	NaF	sodium fluoride
Mg	Mg^{+2}	O	O^{-2}	MgO	magnesium oxide
Na	Na^{+1}	Cl	Cl^{-1}		sodium _____ ide
Li	Li^{+1}	F	F^{-1}		
Al	Al^{+3}	P	P^{-3}		
Ca	Ca^{+2}	S	S^{-2}		
Li		Cl			
Ca		O			

Oppositely charged ions can also react even if the size of the charges are not the same.



Since each fluoride ion has a charge of only -1 while the magnesium is +2, two fluoride atoms are needed for each one magnesium atom.

When writing the chemical formula, the number of atoms is written as a subscript.

Complete the following and name the compounds formed. Follow the examples above. Fill all blanks.

Ions	Chemical Formula	Ionic Compound Name
$\text{Mg}^{+2} + 2\text{F}^{-}$	MgF_2	magnesium fluoride
$2\text{Na}^{+1} + \text{S}^{-2}$	Na_2S	sodium sulfide
$\text{Ca}^{+2} + 2\text{F}^{-1}$		
$\text{Mg}^{+2} + \underline{\quad} \text{F}^{-1}$		
$\underline{\quad} \text{Na}^{+1} + \text{O}^{-2}$		
$\text{Be}^{+2} + \underline{\quad} \text{Cl}^{-1}$		
$\text{Ca}^{+2} + \text{O}^{-2}$		
$\text{Al}^{+3} + \underline{\quad} \text{Cl}^{-1}$		
$\underline{\quad} \text{Na}^{+1} + \text{N}^{-3}$		
$\text{B}^{+3} + \underline{\quad} \text{Br}^{-1}$		

Extra Challenge

Use the format above to name and show the formation of an ionic compound from ions of:

- aluminum and oxygen
- calcium and nitrogen
- Fe^{+3} and oxygen
- Sn^{+4} and fluorine