

Ions

An ion is an atom or group of atoms which has obtained a charge by losing or gaining one or more electrons.

A positively charged ion is called a cation, and a negatively charged ion is an anion.

An ion consisting of one atom is a monatomic ion; ions with multiple atoms are called polyatomic ions.

Ions form ionic bonds with ions of opposite charge.

Valency

Every ion has a number which describes the way it reacts and forms bonds (its combining capacity). This number is called its valency, and tells us how many electrons the atom will gain or lose to form bonds. Ions formed by loss of electrons have a positive valence, and ions formed by gaining electrons have a negative valence.

For example a magnesium ion has a valency of II (two) and it loses electrons so we could also write its valency as 2+. We write the ion Mg^{2+} , where the 2+ indicates the charge on the ion. Ions which only lose or gain one electron (have a valency of I) we omit the "1" for: Na^+ , Cl^- .

Note that some elements have a valency of zero (noble gases) and some form multiple ions, for example iron can form Fe^{2+} or Fe^{3+} . In cases where the valency needs to be known, iron would be given as Fe(II) "iron two" or Fe(III) "iron three".

There are a number of monatomic ions which we may use but are in the transition metals and therefore we can't figure out their valency. Most are 2+, but there are some exceptions, which must be memorised:

Name	Symbol & charge
Chromium	Cr^{3+}
Silver	Ag^+

Any other monoatomic ions you can work out from the table, unless you are given the element in valence notation, e.g. mercury (I) which means Hg^+ .

Polyatomic ions you must memorise:

NH_4^+	Ammonium
SO_4^{2-}	Sulfate
NO_3^-	Nitrate
HCO_3^-	Bicarbonate
OH^-	Hydroxide
CO_3^{2-}	Carbonate
PO_4^{3-}	Phosphate

Nomenclature of ionic compounds

When naming an ionic compound:

- metal and metalloid ions are given as their name
- nonmetal ions end in "ide", for example oxygen's ion is called oxide (oxygen is O_2 , oxide is O^{2-} , so the standard name refers to the formula of the molecule whereas the -ide name refers to the ion)
- noble gases will never form ionic compounds
- polyatomic ions' names are used as-is.

Examples:

- CuO copper oxide
- NaCl sodium chloride
- CaI₂ calcium iodide
- AgNO₃ silver nitrate
- Mg(HCO₃)₂ magnesium bicarbonate

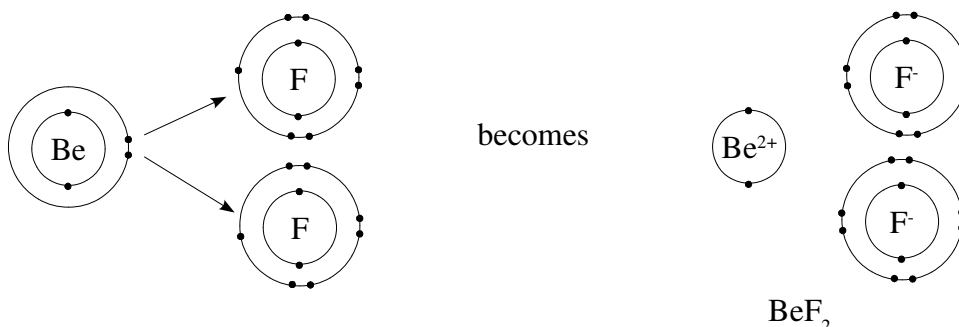
Writing Ionic Compound Formulae

Groups of atoms which do not have stable valence shells can react to form a compound made up of a pair of ions, each with stable valence shells.



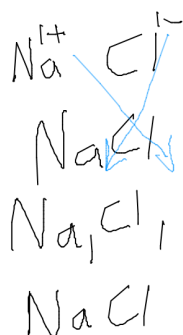
These ions are oppositely charged so they attract very strongly.

Ionic compounds will always have a net charge of zero. So if Mg reacts with Cl, there need to be two Cl ions to each Mg ion:

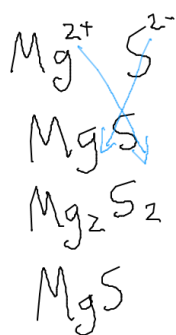


We can use the “Cross Over Method” to determine the formula of any ionic compound:

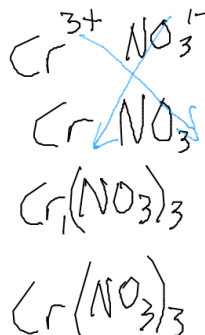
Sodium chloride



Magnesium sulphide



Chromium nitrate



Calcium carbonate

