Ionic Bonding part 2

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Formulae of ionic compounds

You need to be able to work out the formula of any ionic compound quickly. Hopefully you will have done this at GCSE but we'll go over it again as it is very important for A-level.

To be good at working out formulae, you need to use the periodic table properly and follow a few rules.

The Rules

If the element is in:

Group 1, you will form a **1+** ion

Group 2, you will form a **2+** ion

Group 3, you will form a **3+** ion

Group **7**, you will form a **1-** ion

Group **6**, you will form a **2-** ion

Group **5**, you will form a **3-** ion

This accounts for *most* of the elements that you will see in ionic bonding. You can combine any combination of these ions.

Sodium Oxide

Sodium is in **group 1** → **1+** ion, Na^+

Oxygen is in **group 6** → **2-** ion, O^{2-}

We can see that there is a 'mismatch' in the charge of the 2 ions, 1+ versus 2-. We need to balance these charges, so we need 2 x Na to give us 2+ to balance the 2- from the oxygen.

Formula → $\mathbf{Na_2O}$

Sodium Nitrite

Sodium → **1+**

Nitrogen → **3-** ion

Again, there is a mismatch in charge, so we need 3 x sodium ions to balance the 3- charge.

Formula → **Na_3N**

If you can do these examples then you will be able to work out most ionic formulas. Try combining any ions from groups 1-3 (metals) with any from groups 5-7 (non-metals).

Other examples

The transition metals are a group of elements that can also change their state.

For example chromium can be Cr^{6+}, Cr^{4+}, Cr^{3+}, Cr^{2+}.

Iron is a very commonly used metal and exists as Fe^{3+} or Fe^{2+}.

So how do you know what ion you are dealing with?

They will tell you in the question, normally in the form of **roman numerals** e.g. Fe(II) means Fe^{2+} or $Mn(VII)O_4^-$ means Mn^{7+}.

Or going backwards

If they give you the formula of an ionic compound, you can work out the charge on the metal ion. For example: Fe_2O_3

We are saying we need two Fe ions and three O ions to balance the overall charge.

As we have an O^{2-} ion, and there are 3 of them, this gives a 6+ charge. To balance the 6+ charge, we must have the Fe^{3+} ion, as there are 2 of them, to give a 6+ charge overall.

Group Ions

There are ions that consist of more than one element, which are known as **group ions**. You can treat these group ions as a single ion.

The group ions that you need to know are:

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

A few examples:

Iron(II) Hydroxide

The ions: **Fe^{2+} and OH^{-} → $Fe(OH)_2$**

✓ We need the brackets around the OH as it is one of these group ions. If we wrote **$FeOH_2$** without the brackets it implies that we have 2 x H but only 1 x O.

Calcium Carbonate

The ions: **Ca^{2+} and CO_3^{2-} → $CaCO_3$**

We don't need the brackets this time as the 2+ and 2- cancel out.

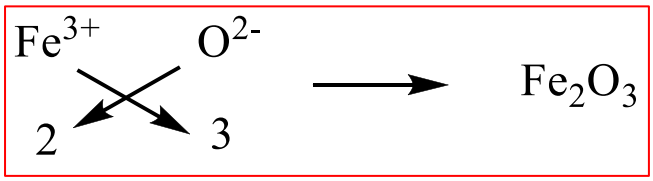
The cross over technique

This is not essential but it might help.

Once you know the charge on the positive and negative ions you can simply 'cross the charges over' to get the formula.

For example: Fe_2O_3, the charges are Fe^{3+} and O^{2-}.

Simply cross the 2 from the oxygen over to the iron 'side' and the 3 from the iron over to the oxygen 'side'. This instantly gives us the formula of the ionic compound.



When you are crossing over the numbers, you can simply forget about the charges. It all just magically balances.

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