Other Ionic Compounds

How can we name other ionic compounds that are more complex than the simple ones we have studied?

Fe Ions

Some elements form more than one kind of cation. This occurs in the transition elements.
For example, iron can form into Fe^{2+} or Fe^{3+}.
At this point it is not important for you to know why this happens.

Iron Compounds

Now let's suppose that the iron ion combines with an anion such as F^-.
If Fe^{2+} combines with F^-, the result is FeF_2.
If Fe^{3+} combines with F^-, the result is FeF_3.
If we called both of these compounds iron fluoride, we would not be able to distinguish between them.
Therefore we must use a different naming system.

Alfred Stock

When we have compounds formed by metals that form ions of different charges, we can use the "Stock System."
This system was developed by Alfred Stock (1876-1946). It is the preferred system of the International Union of Pure and Applied Chemistry (IUPAC).

Roman Numerals

To use this system, the name of the ion includes the charge on the ion as a Roman numeral in parentheses.
Here is a quick review of the Roman Numerals.

Stock System for Fe Compounds

Now let's return to our two iron compounds.
If Fe^{2+} combines with F^-, the result is FeF_2. The name is iron (II) fluoride.
Please do not say iron fluoride(II). The II refers to the charge on the iron ion, not how many fluoride ions we have.
If Fe^{3+} combines with F^-, the result is FeF_3. The name is iron (III) fluoride.

Stock System Not for all Cations

Note that the Stock System is not used for cations that have only one possible charge. For example, the calcium cation is written as Ca^{2+}. There is no other possible charge for this ion. When it combines with F^-, the compound is CaF_2.
The correct name is calcium fluoride, not calcium (II) fluoride.

Copper Ions

Here is another example. Copper can form into Cu^+ or Cu^{2+}.
What would be the formula and name of the compound formed when these ions combine with the oxide ion?
Cu^+ and O^{2-} result in Cu_2O.
The name is copper (I) oxide.
Cu^{2+} and O^{2-} result in CuO.
The name is copper (II) oxide.

Symbol from Name

We can also work in reverse. If we know the name of the compound, we can derive its formula.
For example in the name uranium (VI) fluoride, the VI tells us that the charge on the uranium ion is U^{6+}. We already know that the charge on the fluoride is F^-. Therefore the formula of the compound is UF_6.

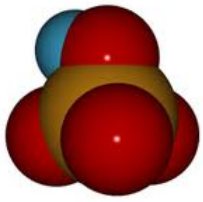
Checklist

1. Use the Stock system in naming appropriate ionic compounds.

Polyatomic Compounds

What are polyatomic compounds and how do they compare to other compounds we have studied?

Ionic Compounds Till Now



We have already studied simple binary ionic compounds such as NaCl (sodium chloride), CaF_2 (calcium fluoride), and so on.
We have also studied compounds whose positive ions have more than one charge, so we need to use Roman numerals. Examples are $FeCl_2$ (iron II chloride) and $FeCl_3$ (iron III chloride).
Now we will study other compound such as $CaCO_3$ and $Mg(OH)_2$.
These are called polyatomic compounds.

Polyatomic Ions

Polyatomic ions are groups of atoms that tend to stay together and carry an overall ionic charge.
Here are a few that you need to learn:
Nitrate: NO_3^-
Hydroxide: OH^-
Carbonate: CO_3^{2-}
Sulfate: SO_4^{2-}
Phosphate: PO_4^{3-}

Polyatomic Compound Formulas

When a polyatomic ion combines with other elements, we use the same rules for writing formulas that we learned before.
Example 1: Combine Na^+ and NO_3^-.
Both of these have a charge of 1.
The simple negative Na^+ balances the single negative NO_3^-.
The result is $NaNO_3$.
The name is sodium nitrate.

Polyatomic Compound Naming

In example the compound $NaNO_3$ was formed.
To name the compound, use the name of the metal and the name of the polyatomic ion.
The name of the metal for $NaNO_3$ is sodium.
The name of the polyatomic ion for $NaNO_3$ is nitrate.
The name of $NaNO_3$ is sodium nitrate.

Ca^{2+} and SO_4^{2-}

What is the formula of the ionic compound formed when we combine the calcium ion Ca^{2+} with the sulfate ion SO_4^{2-}?
They each have a charge of 2.
$CaSO_4$.
The name is calcium sulfate.

Checklist

1. Write chemical formulas and name compounds formed with polyatomic ions.