

# WRITING CHEMICAL FORMULAE

## Writing Formulae of Ionic Compounds

When writing a chemical formulae from the name of an ionic compound, one must consider the ions contained in the compound. You must recognize the ions which are a part of the compound. These include the cations, as well as the monatomic anions and polyatomic anions. The inability to recognize these ions are the main reason for difficulty in writing chemical formulae of inorganic compounds. If you haven't memorized the ions, it is essential you do so immediately.

Recall that some cations will only form one ion (Group IA, IIA, and IIIA, except T1). Cations which can form more than one ion will have a Stock number shown as a Roman numeral in parenthesis. For the monatomic anions, the charge is equivalent to the Group number - 8. The polyatomic anions must be memorized.

Let's look at a few examples, and try to come up with the chemical formulae.

What is the chemical formula for the compound magnesium oxide?

First, consider the ions involved. Magnesium, found in Group IIA, can only form a +2 ion. Oxide ion must have a charge of -2, because oxygen is found in Group VIA. Since the magnitude of the charges are the same, the ions will combine in a 1:1 ratio, and the formula for magnesium oxide is MgO.

What happens when the magnitude of the charges are not the same? For instance, what will be the formula of the compound aluminum chloride?

As before, consider the ions involved. Aluminum, found in Group IIIA, can only form a +3 ion. Chloride ion must have a -1 charge, because it is found in Group VIIA. The magnitude of the aluminum ion is greater than the magnitude of the chloride ion. In fact, three chloride ions at -1 apiece are needed to cancel the +3 on the aluminum ion. To show three chloride ions in the formula a subscript of three is used. Incidentally, by convention, the cation is always written first: AlCl<sub>3</sub>.

Let's consider a compound containing a polyatomic anion. Polyatomic anions, with few exceptions, will have names ending in -ite or -ate, so they should be easy to recognize. What is the formula for the compound sodium sulfate?

Consider the ions. Sodium, found in Group IA, can only form a +1 ion. Sulfate ion is SO<sub>4</sub><sup>2-</sup>, and has a -2 charge. The magnitude of the sulfate ion is greater than the magnitude of the sodium ion. One can see that more than one sodium ion will be needed to cancel the -2 charge on the sulfate ion. Since two sodium ions are needed, a subscript of 2 will be found in the formula: Na<sub>2</sub>SO<sub>4</sub>.

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Let's consider a compound involving a Stock number. What is the formula for the compound chromium(III) nitrate?

Consider the ions. The Roman numeral, III, for chromium(III), indicates the charge of the chromium ion is +3. Nitrate ion you have memorized to be  $\text{NO}_3^-$ , and has a -1 charge. The magnitude of the chromium(III) ion is greater than the magnitude of the nitrate ion. Three nitrate ions at -1 apiece are needed to cancel the +3 on the chromium ion. In order to show three nitrate ions in the formula, one must use parenthesis around the nitrate ion and a subscript of 3 outside the parenthesis:  $\text{Cr}(\text{NO}_3)_3$ .

Here is a compound which is a little more difficult. What is the formula for iron(III) carbonate?

Consider the ions. Iron(III) has a +3 charge, as indicated by its Stock number. Carbonate ions has the formula,  $\text{CO}_3^{2-}$ , and thus has a -2 charge. The magnitudes of the charges are not equal, and they are not multiples of each other. One needs to consider a common multiple, in this case 6, and adjust the number of each ion to this multiple. This means that two iron(III) ions, totaling +6, and three carbonate ions, totaling -6 are needed to write the formula:  $\text{Fe}_2(\text{CO}_3)_3$ .

### **Writing Formulae of Binary Molecular Compounds**

Writing the formula of a binary molecular compound is actually quite easy. The number of each element in the compound is indicated by a prefix. Apply the prefix when writing the formula. Thus, the formula for carbon dioxide is  $\text{CO}_2$ , since the name indicates one carbon (no prefix), and two oxygens (prefix di- means 2).

The compound, disulfur tetrafluoride, would have the formula  $\text{S}_2\text{F}_4$ , since the di- prefix indicates two sulfurs and the tetra- prefix indicates four fluorines.

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