Chemical Formulas (Binary Ionic Compounds)

These compounds are usually the combination of a metal with a nonmetal.

Let's look at how to write the chemical formulas for some simple compounds. The rules are quite simple: but you must know some things about how compounds are put together.

Some compounds are made from what we call ions. Ions are simply atoms, or groups of atoms, that have picked up a positive or negative charge by gaining or losing electrons. Different ions have different charges, however most ions have a charge that ranges from +4 down to -3. You can find many of these ions on the Common Ion Table handout.

The most important rule is that there must be equal number of positive and negative charges when you write the formula for a compound.

Rules for writing the formulas for binary (2) ionic compounds:

Rule 1. Write the symbols for the two elements in the compound, placing the symbol for the cation (the positive ion) first and the anion (the negative ion) second. **[Don't change the symbol for an ion]**

Rule 2. Determine the charge on the atoms of each element. There are two sources of information for this:

a) they can be obtained from a table like ones in the handout or from tables in a textbook.

b) You can infer the charge on an ion from the position of the element in the periodic table. Some generalizations are:

1) Ions from elements in Column (1) have a charge of 1^+

2) Ions from elements in Column (2) have a charge of 2^+

3) Ions from elements in Column (17) have a charge of 1^-

4) Ions from elements in Column (16) have a charge of 2^-

5) Ions from elements in Column (15) have a charge of 3^-

Rule 3. From the known charges on the ions, select subscripts that will make the total positive charge equal the total negative charge so that the compound as a whole is electrically neutral.

EXAMPLE 1

What is the formula for lithium chloride?

SOLUTION

When you look in a Common Ion Table you can see that lithium ions have a +1 charge and that chloride ions have a -1 charge. The +l and -1 cancel each other out.

Thus the formula is LiCl. ***(We always write the positive part (ion) of the compound first in the formula.)***

EXAMPLE 2

What is the formula for calcium fluoride?

SOLUTION

You can see that Ca ions have a +2 charge and fluoride ions have a -1 charge. These charges do not balance when simply added together. In this case we will need one Ca^{+2} ion and two F^{-l} ions. In this proportion the charges will balance.

The formula will then be CaF_2.

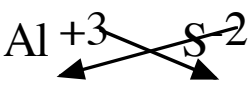
EXAMPLE 3

What is the formula for aluminum sulfide?

SOLUTION

Al is +3 and S is -2 in your table. The only way to balance the charges is to have two Al^{+3} ions and three S^{-2} ions. This will give six (+) charges and six (-) charges. The formula then would be Al_2S_3.

The Simple Crisscross Method



In the crisscross method the 3 from aluminum's charge becomes the subscript for sulfur and the 2 from sulfur's charge becomes the subscript for aluminum. This gives the formula: Al_2S_3

Things to remember:

1. Subscripts of (1) are not written.

EXAMPLE 4

Write the formula for sodium chloride using the crisscross method.

SOLUTION

$$NaCl$$

We do not write the ones(1), The symbol for sodium and chlorine already indicate 1. We only need to use a subscript if there is more than one needed to assure equal amount of positive and negative charge.

2. Subscripts are reduced to the smallest whole number ratio.

EXAMPLE 5

Write the formula for Barium Oxide using the crisscross method.

SOLUTION

$$Ba_{2/2}O_{2/2}$$

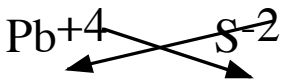
Since each subscript is divisible by 2, doing so, would give the answer for Barium Oxide as:

$$BaO$$

This procedure reduces the subscripts to the smallest whole number ratio in the combination of the barium ion with the oxide ion.

EXAMPLE 6

Write the formula for Lead IV Sulfide using the crisscross method.



SOLUTION

$$Pb_{2/2}S_{4/2}$$

Since each subscript is divisible by 2, doing so, would give the answer for Lead IV Sulfide as:

$$PbS_2$$

This procedure reduces the subscripts to the smallest whole number ratio in the combination of the lead IV ion with the sulfide ion.

Teacher Assisted Practice

1. Write the formulas for each of the following compounds:

silver sulfide

lead II bromide

calcium iodide

calcium oxide

lithium sulfide

Barium Nitride

Strontium Sulfide

Student Practice

Write the formulas for each of the following compounds:

1. Aluminum Fluoride
2. Zinc Bromide
3. Barium Iodide
4. Calcium Chloride
5. Silver Oxide
6. Lead II Sulfide
7. Magnesium Chloride
8. Copper II Iodide
9. Barium Peroxide
10. Iron III Oxide
11. Potassium Iodide
12. Strontium Chloride
13. Mercury I Fluoride
14. Copper I Sulfide
15. Cobalt II Chloride
16. Zinc Sulfide
17. Aluminum Oxide
18. Sodium Peroxide
19. Lead II Chloride
20. Copper II Oxide
21. Mercury I Chloride
22. Nickle II Oxide
23. Chromium III Oxide
24. Zinc Bromide
25. Potassium Oxide
26. Copper II Chloride
27. Iron III Bromide
28. Cadmium Chloride
29. Barium Oxide
30. Magnesium Oxide