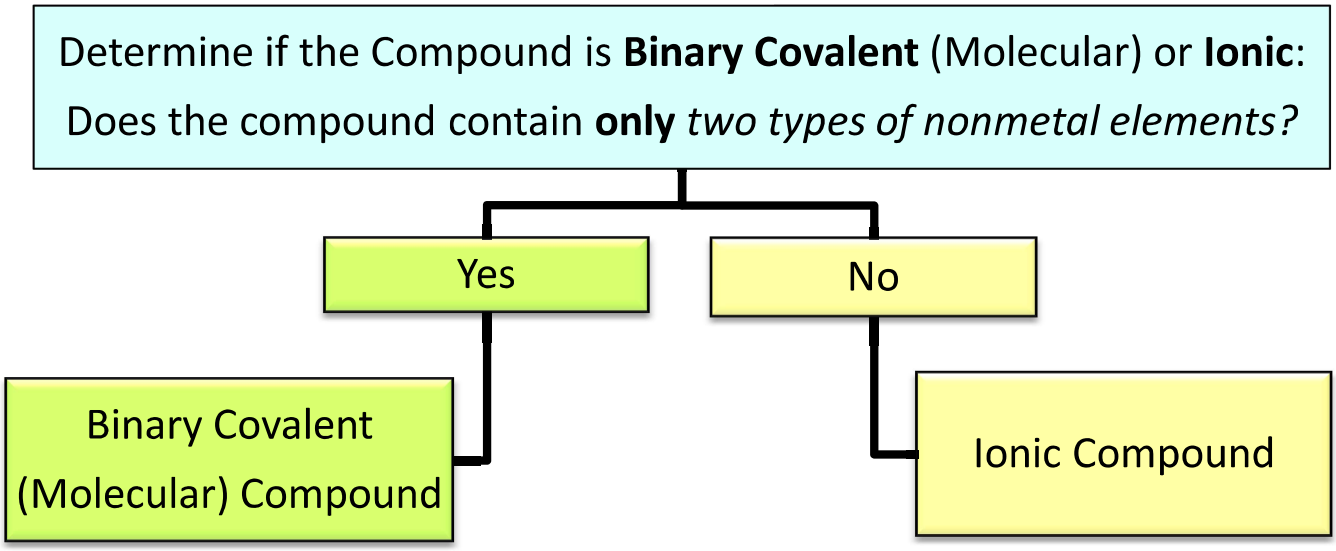
Naming Compounds Tutorial and Worksheet

Since we use different methods in naming binary covalent (molecular) compounds and ionic compounds, the **first step** in naming or writing the formula of a compound is to **determine which of the 2 compound classes it belongs**. This can be done as follows:



Binary covalent compounds will contain **only** *two types of non-metal elements*. There may be more than one of each element. For example CO_2 contains just two types of elements, carbon and oxygen. We will discuss naming covalent compounds that contain more than two types of elements, like glucose $C_6H_{12}O_6$, in later chapters.

Once it is determined that the compound is **ionic** or **covalent**, the student can be asked to do either of the following:

1) Given the **name** of the compound, write the **formula**.

Or

2) Given the **formula** of the compound, write the **name**.

In this tutorial we will review the process for achieving these 2 objectives and practice with some worksheet problems. First, we will review and practice how to write formulas for compounds when given the compound's name. Second, we will review and practice how to write the name of a compound when given the compound's formula.

Given the Name of the Compound, Writing Formulas for Compounds

Determine if the Compound is **Binary Covalent (Molecular)** or **Ionic**:

Does the compound contain **only *two*** types of ***nonmetal*** *elements*?

Yes

No

Binary Covalent (Molecular) Compound:

1) Write the symbol of the first element in the compound's name, then the symbol of the second element in the compound's name.
2) Indicate how many atoms of each element the molecule contains using subscripts after the atomic symbol.

- The numbers of atoms are given in the molecule's name in Greek prefixes
    - NOTE: If there is no Greek prefix in front of the first element in the name that implies the number is 1.

Ionic Compound:

1) Write the symbol/formula of the first ion in the compound's name, then the symbol/formula of the second ion in the compound's name.
2) Indicate the ratio of the ions in the compound using subscripts after each ion.
    - The ratio of the ions is deduced by balancing the charges of the ions.
    - *IMPORTANT: When there is more than one of a polyatomic ion in the formula unit we use parenthesis. Example* $Mg(NO_3)_2$

Writing the Formulas of Ionic Compounds

Example: Write the formula for **calcium bromide**.

1) Write the symbol/formula of the first ion in the compound's name, then the symbol/formula of the second ion in the compound's name.

   Ca Br

2) Indicate the ratio of the ions in the compound using subscripts after each ion.
   - This step involves filling in the subscripts boxes as we did in the lecture:

     $Ca_{\square}Br_{\square}$
   - The ratio of the ions is deduced by **balancing the charges** of the ions.
     - This is done so that the **total charge** in the crystal, when large numbers of cations and anions combine, is **equal to zero**.
     - We find the ion's charge from its position on the periodic table **or** we look it up in a table in the case of polyatomic ions.
     - Transition metal with varying charges will be written in the compound name in Roman numerals.

   - First, temporarily write the charge of each ion above the ion's symbol.

     2+ 1-

     $Ca_{\square}Br_{\square}$

   - Next, place numbers in the subscripts such that the total charge of the compound is zero. Note that in this example, we need **two** bromide ions, each has a charge of (1-) to cancel the (2+) charge of the calcium ion:
     - 2(-1) + (+2) = 0 zero total charge.

     2+ 1-

     $Ca_{\boxed{1}}Br_{\boxed{2}} = CaBr_2$

   - We saw a shortcut way to do this called the Criss-Cross Method (see your chapter 3 notes)

     2+ 1-

     $Ca_{\boxed{1}}Br_{\boxed{2}} = CaBr_2$

   - Note, we do not leave the charges written above the symbols in the completed formula.

IMPORTANT: When there is more than one of a polyatomic ion in the formula, we use parenthesis.

- Not applicable in this example since there are no polyatomic ions in calcium bromide.

Examples: Writing the Formulas of Ionic Compounds

Write the formula for **magnesium nitrate**.

1) Write the symbol/formula of the first ion in the compound's name, then the symbol/formula of the second ion in the compound's name.
    - When you see a polyatomic ion (nitrate), look up the formula and charge in the table of polyatomic ions.

$$Mg\ \ NO_3$$

2) Indicate the ratio of the ions in the compound using subscripts after each ion.
    a. This step involves filling in the subscripts boxes as we did in the lecture:

$$Mg_{\square}NO_{3\square}$$

- The ratio of the ions is deduced by **balancing the charges** of the ions.
    - This is done so that the **total charge** in the crystal, when large numbers of cations and anions combine, is **equal to zero**.
    - We find the ion's charge from its position on the periodic table **or** we look it up in a table in the case of polyatomic ions.
    - Transition metal with varying charges will be written in the compound name in Roman numerals.

- First, temporarily write the charge of each ion above the ion's symbol.

$$\overset{2+}{Mg}_{\square}\overset{1-}{NO_3}_{\square}$$

- Next, place numbers in the subscripts such that the total charge of the compound is zero. Note that in this example, we need **two** nitrate ions, each has a charge of (1-) to cancel the (2+) charge of the magnesium ion:
    - 2(-1) + (+2) = 0 zero total charge.

$$\overset{2+}{Mg}_{\boxed{1}}\overset{1-}{NO_3}_{\boxed{2}}$$

- We saw a shortcut way to do this called the Criss-Cross Method (see your chapter 3 notes)

$$\overset{2+}{Mg}\ \overset{1-}{NO_3}\ \begin{matrix}\boxed{1}\\ \boxed{2}\end{matrix}$$

*IMPORTANT: When there is more than one of a polyatomic ion in the formula unit we use parenthesis. There are **2 ions** of nitrate in magnesium nitrate*

$$Mg_{\boxed{1}}NO_{3\boxed{2}} = Mg(NO_3)_2$$

In compound where there is just **one formula unit** of a polyatomic ion, no parenthesis are needed. An example of this is **sodium nitrate: $NaNO_3$**

Examples: Writing the Formulas of Ionic Compounds

Write the formula for **iron(II) phosphate**.

1) Write the symbol/formula of the first ion in the compound's name, then the symbol/formula of the second ion in the compound's name.
    - When you see a polyatomic ion (phosphate in this case), look up the formula and charge in the table of polyatomic ions.

$Fe\ \ PO_4$

2) Indicate the ratio of the ions in the compound using subscripts after each ion.
    b. This step involves filling in the subscripts boxes as we did in the lecture:

$Fe_{\square}\ PO_{4\square}$

- The ratio of the ions is deduced by **balancing the charges** of the ions.
    - This is done so that the **total charge** in the crystal, when large numbers of cations and anions combine, is **equal to zero**.
    - We find the ion's charge from its position on the periodic table **<u>or</u>** we look it up in a table in the case of polyatomic ions.
    - **Transition metal with varying charges will be written in the compound name in Roman numerals.**
        - In this example, now we know the charge on **the Fe ion is 2+**

- First, temporarily write the charge of each ion above the ion's symbol.

2+ 3-

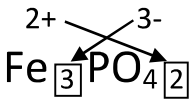
$Fe_{\square}\ PO_{4\square}$

- Next, place numbers in the subscripts such that the total charge of the compound is zero. Note that in this example, we need **two** phosphate ions, each has a charge of (3-) and three Fe^{2+} ions to balance the charge:
    - 2(-3) + 3(-2) = 0 zero total charge.

2+ 3-

$Fe_{\boxed{3}}\ PO_{4\boxed{2}}$

- We saw a shortcut way to do this called the Criss-Cross Method (see your chapter 3 notes)



*IMPORTANT: When there is more than one of a polyatomic ion in the formula unit we use parenthesis. There are **2 ions** of phosphate in iron(II)phosphate.*

$Fe_{\boxed{3}}PO_{4\boxed{2}} = Fe_3(PO_4)_2$

Examples: Writing the Formulas of Ionic Compounds

Write the formula for **barium sulfide**.

1) Write the symbol/formula of the first ion in the compound's name, then the symbol/formula of the second ion in the compound's name.

   Ba S

2) Indicate the ratio of the ions in the compound using subscripts after each ion.
   - This step involves filling in the subscripts boxes as we did in the lecture:

     $Ba_{\square}S_{\square}$
   - The ratio of the ions is deduced by **balancing the charges** of the ions.
     - This is done so that the **total charge** in the crystal, when large numbers of cations and anions combine, is **equal to zero**.
     - We find the ion's charge from its position on the periodic table **or** we look it up in a table in the case of polyatomic ions.
     - Transition metal with varying charges will be written in the compound name in Roman numerals.

   - First, temporarily write the charge of each ion above the ion's symbol.

     2+ 2-

     $Ba_{\square}S_{\square}$

   - Next, place numbers in the subscripts such that the total charge of the compound is zero. Note that in this example, we need **one** sulfide ion, with a charge of (2-) to cancel the (2+) charge of the barium ion:
     - (-2) + (+2) = 0 zero total charge.

     2+ 2-

     $Ba_{\boxed{1}}S_{\boxed{1}} = BaS$

   - We saw a shortcut way to do this called the Criss-Cross Method (see your chapter 3 notes)

     2+ 2-

     $Ba_{\boxed{2}}S_{\boxed{2}} = BaS$

   - Note, the subscripts in ionic compound represent the ratio in which large numbers of anions and cations combine to form the ionic compounds. Since we want the **lowest ratio**: we use 1:1, since 2:2 = 1:1

     $\cancel{Ba_2S_2} = BaS$

Write the formula for the following ionic compounds: (see next page for key)

sodium bicarbonate _____

sodium fluoride _____

iron (III) chloride _____

sodium carbonate _____

copper (II) sulfate _____

magnesium hydroxide _____

barium nitrate _____

lithium sulfate _____

magnesium chloride _____

silver nitrate _____

aluminum sulfate _____

calcium hydroxide _____

calcium sulfate _____

mercury (II) nitrate _____

lead (IV) nitrate _____

magnesium iodide _____

sodium nitride _____