

## Ionic Nomenclature

Ionic nomenclature is the simplest of the three types of nomenclature here. Of course, the presumption is that you completed the summer assignment and remember the names of the common ions.

First identify the cation (positive ion) by name. Second, identify the anion by name. Then, put the two names together.

### Examples:

**AlCl<sub>3</sub>** – The cation is aluminum. The anion is chloride. The compound is *aluminum chloride*.

**Na<sub>2</sub>SO<sub>4</sub>** – The cation is sodium. The anion is sulfate. The compound is *sodium sulfate*.

Notice that there is no use of prefixes to denote the quantity of each ion. That is because the charge of the ions guarantees that there is only one proportion in which they can combine, so prefixes are unnecessary.

For metals that can have more than one oxidation state, it is important to identify the oxidation state in the name, using Roman numerals.

### Examples:

**FeCl<sub>3</sub>** – Because the three chloride ions have a TOTAL charge of -3, so the iron must have a +3 charge. Therefore, the compound is *iron(III) chloride*.

**Cr(NO<sub>3</sub>)<sub>3</sub>** – Three nitrate ions have a TOTAL charge of -3, so the chromium must have a +3 charge. Therefore, the compound is *chromium(III) nitrate*.

When writing formulas from names:

1. Write the formula of the cation
2. Write the formula of the anion
3. Balance the formula electrostatically, using subscripts
  - a. If you need more than one of a polyatomic ion, you must place the subscript outside of a set of parentheses that surround the polyatomic ion.

### Examples:

**Calcium phosphide** – Calcium is Ca<sup>2+</sup> and phosphide is P<sup>3-</sup>. The balanced formula is Ca<sub>3</sub>P<sub>2</sub>.

**Aluminum nitrite** – Aluminum is Al<sup>3+</sup> and nitrite is NO<sub>2</sub><sup>-</sup>. The balanced formula is Al(NO<sub>2</sub>)<sub>3</sub>.

| Write the name   |  | Write the formula   |  |
|--|--|---------------------|--|
| PbCl <sub>2</sub>  |  | Iron(III) nitride   |  |
| Na <sub>2</sub> C <sub>2</sub> O <sub>4</sub>                  |  | Calcium thiocyanate |  |
| KCN  |  | Sodium sulfite      |  |
| (NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>                |  | Copper(I) phosphate |  |
| Cu(NO <sub>3</sub> ) <sub>2</sub>                              |  | Cesium nitrite      |  |
| MgO <sub>2</sub>   |  | Cobalt(III) oxide   |  |
| SnF <sub>2</sub>   |  | Aluminum sulfate    |  |
| FeBr <sub>3</sub>  |  | Lithium sulfide     |  |
| Ca(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> |  | Ammonium phosphate  |  |

## Binary Molecular Nomenclature

| <b>Rules for Binary Molecular Compounds</b>  | <b>Prefixes</b> |
|--|-----------------|
| 1. The naming system is for compounds composed of two <u>nonmetallic</u> elements. | 1 – mono        |
| 2. The first element keeps its name  | 2 – di          |
| a. The first element gets a prefix if it has a subscript in the formula            | 3 – tri         |
| 3. The second element gets the <i>-ide</i> suffix (ending)                         | 4 – tetra       |
| a. The second element ALWAYS gets a prefix   | 5 – penta       |
|  | 6 – hexa        |
|  | 7 – hepta       |
|  | 8 – octa        |
|  | 9 – nona        |
|  | 10 – deca       |

| <b>Compound Name</b>     | <b>Compound Formula</b> |
|--------------------------|-------------------------|
| Carbon dioxide           |                         |
| Carbon monoxide          |                         |
| Diphosphorus pentoxide   |                         |
| Dinitrogen monoxide      |                         |
| Silicon dioxide          |                         |
| Carbon tetrafluoride     |                         |
| Sulfur dioxide           |                         |
| Phosphorus pentafluoride |                         |
| Oxygen difluoride        |                         |
| Nitrogen dioxide         |                         |
| Dinitrogen trioxide      |                         |

| <b>Compound Formula</b>        | <b>Compound Name</b> |
|--------------------------------|----------------------|
| N <sub>2</sub> O <sub>4</sub>  |                      |
| SO <sub>3</sub>                |                      |
| NO                             |                      |
| NO <sub>2</sub>                |                      |
| As <sub>2</sub> O <sub>5</sub> |                      |
| PF <sub>3</sub>                |                      |
| CS <sub>2</sub>                |                      |
| H <sub>2</sub> O               |                      |
| SeF <sub>6</sub>               |                      |
| N <sub>2</sub> O <sub>4</sub>  |                      |
| CH <sub>4</sub>                |                      |

## Naming Acids

Acids are divided into two groups: Binary and Oxyacids. Binary acids consist of two elements. Oxyacids consist of 3 elements, one of which is oxygen.

**1. NAMING BINARY ACIDS:** The name of the binary acid consists of two words. The first word has three parts:

- the "hydro" prefix
- the root of the nonmetal element
- the "ic" ending

The second word is always "acid"

Examples:

- HCl = hydro chlor ic acid = hydrochloric acid
- HBr = hydro brom ic acid = hydrobromic acid
- HF = hydro fluor ic acid = hydrofluoric acid

**2. NAMING OXYACIDS:** These are more difficult to name because these acids have hydrogen, a nonmetal, and may have varying numbers of oxygen atoms. For example,  $\text{H}_2\text{SO}_5$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{SO}_3$ , and  $\text{H}_2\text{SO}_2$  are all acids. How do we name them? To begin, we need a point of reference. Our reference point is this:

The "ate" ions (sulfate, nitrate, etc) make the "ic" acids (sulfuric acid, nitric acid)

Examples:

- $\text{SO}_4^{2-}$  = sulfate ion       $\text{H}_2\text{SO}_4$  = sulfuric acid
- $\text{NO}_3^-$  = nitrate ion       $\text{HNO}_3$  = nitric acid

Once we have our point of reference, the acid with one more oxygen than the -ic acid is called the per-\_\_\_\_\_ -ic acid. The acid with one less oxygen than the -ic acid is called the \_\_\_\_\_ -ous acid. If the acid has one less oxygen than the -ous acid, it is called the hypo-\_\_\_\_\_ -ous acid.

Examples:

- $\text{H}_2\text{SO}_5$  = persulfuric acid       $\text{HNO}_4$  = pernitric acid
- $\text{H}_2\text{SO}_4$  = sulfuric acid       $\text{HNO}_3$  = nitric acid
- $\text{H}_2\text{SO}_3$  = sulfurous acid       $\text{HNO}_2$  = nitrous acid
- $\text{H}_2\text{SO}_2$  = hyposulfurous acid       $\text{HNO}$  = hyponitrous acid

The KEY: All you really need to know are the "ate" ions. After that, you can use the above scheme to name any oxyacid. To refresh your memory, here are some of the common "ate" ions:

- sulfate =  $\text{SO}_4^{2-}$
- chlorate =  $\text{ClO}_3^-$
- phosphate =  $\text{PO}_4^{3-}$
- nitrate =  $\text{NO}_3^-$
- bromate =  $\text{BrO}_3^-$
- carbonate =  $\text{CO}_3^{2-}$

## Naming Acids - Problems

Name these binary acids:

HF \_\_\_\_\_ HCl \_\_\_\_\_  
H<sub>2</sub>S \_\_\_\_\_ HBr \_\_\_\_\_  
HI \_\_\_\_\_

Name these oxyacids:

H<sub>2</sub>CO<sub>4</sub> \_\_\_\_\_  
H<sub>2</sub>CO<sub>3</sub> \_\_\_\_\_  
H<sub>2</sub>CO<sub>2</sub> \_\_\_\_\_  
H<sub>2</sub>CO \_\_\_\_\_

HClO<sub>4</sub> \_\_\_\_\_  
HClO<sub>3</sub> \_\_\_\_\_  
HClO<sub>2</sub> \_\_\_\_\_  
HClO \_\_\_\_\_

H<sub>3</sub>PO<sub>5</sub> \_\_\_\_\_  
H<sub>3</sub>PO<sub>4</sub> \_\_\_\_\_  
H<sub>3</sub>PO<sub>3</sub> \_\_\_\_\_  
H<sub>3</sub>PO<sub>2</sub> \_\_\_\_\_

Write the formulas for these acids (they may or may not actually exist!):

perbromic acid \_\_\_\_\_  
nitrous acid \_\_\_\_\_  
hypobromous acid \_\_\_\_\_  
chromic acid \_\_\_\_\_  
chromous acid \_\_\_\_\_  
pernitric acid \_\_\_\_\_  
sulfurous acid \_\_\_\_\_  
perchromic acid \_\_\_\_\_