Naming Ternary Compounds

II. Ternary Compounds

Composed of three elements. e.g. NaOH, $LiNO_3$, $Al_2(SO_4)_3$ etc.

A. **Salts** - Composed of any metal and any complex ion except OH^-.
B. **Acids** - Composed of Hydrogen and any complex ion in aqueous solution. eg. $H_2SO_{4(aq)}$, $HNO_{3(aq)}$
C. **Bases** - Composed of any metal and the complex ion OH^- (hydroxide)

Ternary compounds are composed of three elements, one of which is a metal, and two of which are non-metals bonded together in a stable unit called a **complex** ion, a **polyatomic** ion, or a **radical.** These complex ions are listed along with their name and charge on the table of common ions on your periodic table.

For example:

The ternary compound $NaClO_3$ is called sodium chlorate**,** and is composed of the sodium ion (Na^+) and the chlorate ion (ClO_3^-). Complex ions are extremely stable since the non-metals that form them are bonded to each other very strongly and act as though they were a single indivisible particle. Complex ions tend to organize themselves into what we call families**.** The naming of members of a family must be understood because all ternary compounds are named according to the name of the complex ion they contain. The most common member of the family is given the **-ate** ending, and the other members are named "around" this one. For example, the chlorate family is named as follows.

ClO_4^- is the **per**chlor**ate** ion (**per** means "above")
ClO_3^- is the chlor**ate** ion (most common or abundant)
ClO_2^- is the chlor**ite** ion
ClO^- is the **hypo**chlor**ite** ion (**hypo** means "below")

Not all families of complex ions have four members. Some have three and some have as few as one. For example the nitrate family consists of only **two** members, nitr**ate**, and nitr**ite** as follows:
NO_3^- is the nitr**ate** ion (most abundant)
NO_2^- is the nitr**ite** ion

The phosphate family also consists of only two members, phosphate and phosphite as follows:
PO_4^{3-} si the phosph**ate** ion (most abundant)
PO_3^{3-} is the phosph**ite** ion

A. Ternary Salts

The rules for naming these compounds are extremely simple. First, name the metal, and then name the complex ion. The name or formula of the complex ion can simply be looked up on the periodic table. For example:

Na_2CO_3 is **sodium carbonate**
$KMnO_4$ is **potassium permanganate**

$Fe(NO_2)_2$ is **Iron(II) nitrite**, (or **Ferrous nitrite**)

Try these.

$BaCO_3$ is _____.

$Al_2(SO_4)_3$ is _____.

The formula for potassium dichromate is _____.

The formula for mercury(I) hydrogen carbonate is _____.

(Barium carbonate; aluminum sulfate; $K_2Cr_2O_7$; $HgHCO_3$)

B. Ternary Acids (Oxyacids)

Like all ternary compounds, ternary acids consist of three elements, one of which is hydrogen and the other two are combined in the form of a complex ion. Like binary acids, these compounds are not named as acids unless they are in aqueous solution, as indicated by the symbol $_{(aq)}$. In order to name ternary acids, you must first determine the name of the radical or complex ion in the molecule, and then apply the following rules.

A **per - ate** complex ion is named as a **per - ic** acid
An **-ate** complex ion is named as an **-ic** acid
An **-ite** complex ion is named as an **-ous** acid

For example:
$HClO_{4(aq)}$ contains the **per**chlor**ate** ion and is named **per**chlor**ic** acid
$HClO_{3(aq)}$ contains the chlor**ate** ion and is named chlor**ic** acid
$HClO_{2(aq)}$ contains the chlor**ite** ion and is named chlor**ous** acid
$HClO_{(aq)}$ contains the hypochlor**ite** ion and is named hypochlor**ous** acid

Try these.

$H_2CO_{3(aq)}$ is named _____.

$HNO_{2(aq)}$ is named _____.

$H_3PO_{4(aq)}$ is named _____.

$H_3BO_{3(aq)}$ is named _____.

The formula for **Per**mangan**ic** acid is _____.

The formula for **Hypo**chlor**ous** acid is _____.

(carbonic acid; nitrous acid; phosphoric acid; boric acid; $HMnO_{4(aq)}$; $HClO_{(aq)}$)

C. Bases

The formula unit of a common base consists of a metallic ion and the hydroxide ion (OH^-). Bases are named as hydroxides.

For example:

NaOH is sodium hydroxide
LiOH is lithium hydroxide

$Ca(OH)_2$ is calcium hydroxide
$Fe(OH)_2$ is iron(II) hydroxide