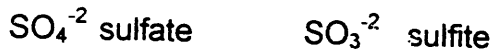


2. COMPOUND INVOLVING POLYATOMIC IONS

Many negative ions and one positive, rather than being made up of a single atom, are actually made up of many atoms. These ions, however, behave as if they are a monatomic ion, and the rules for writing formulas are the same.

Almost all of the negative polyatomic ions contain oxygen and end in either **-ate** or **-ite**. If two ions are the same, except for the number of oxygen's, the one with the fewest oxygen's ends in **ite** and the one with more oxygen's ends in **ate**.



With a few ions there are more than two variations. The table below summarizes how these are named.

FORMULA	RULES FOR NAMING	EXAMPLE
XO^{-1}	hypo (name)ite	ClO^{-1} hypochlorite
XO_2^{-1}	(name)ite	ClO_2^{-1} chlorite
XO_3^{-1}	(name)ate	ClO_3^{-1} chlorate
XO_4^{-1}	per(name)ate	ClO_4^{-1} perchlorate

Two exceptions to this are the hydroxide ion, OH^{-1} , and the cyanide ion CN^{-1} . They are polyatomic ions that end in **ide**. The only positive polyatomic ion is ammonium NH_4^{+1} .

To write a formula for such a compound remember that the polyatomic ion is treated just like it is a monatomic ion, with the exception that you must use parenthesis if a subscript is used.



For example, aluminum sulfate	Al^{+3}	SO_4^{-2}	is	$\text{Al}_2(\text{SO}_4)_3$
calcium nitrate	Ca^{+2}	NO_3^{-1}	is	$\text{Ca}(\text{NO}_3)_2$
Barium sulfite	Ba^{2+}	SO_3^{-2}	is	BaSO_3

Some polyatomic ions come with a hydrogen as part of the ion. For example, a sulfate ion, SO_4^{-2} with a hydrogen, HSO_4^{-1} is called the **bisulfate** ion or the **hydrogen sulfate** ion. Notice that you can only add a hydrogen to an ion that has a charge above -1. That is because when you add a hydrogen the charge is reduced by 1. What is the name of this ion

HCO_3^{-1} ----- bicarbonate or hydrogen carbonate ion

NAME THE FOLLOWING

(a) $\text{Ca}(\text{NO}_2)_2$ (b) NH_4OH (c) Na_3PO_4 (d) NaHCO_3 (e) Al_2CO_3

(calcium nitrite, Ammonium hydroxide, sodium phosphate, sodium bicarbonate, aluminum carbonate)

WRITE FORMULAS FOR THE FOLLOWING

(a) sodium sulfite (b) magnesium phosphate (c) calcium bisulfite
(d) aluminum carbonate (e) barium hydroxide.

(Na_2SO_3 , Mg_3PO_4 , $\text{Ca}(\text{HSO}_3)_2$, Al_2CO_3 , $\text{Ba}(\text{OH})_2$)

3. IONIC COMPOUNDS WHERE THE METALLIC ION HAS MORE THAN ONE CHARGE.

Some metals, especially many transition metals, have more than one charge. For example, iron, Fe, can be a +2 ion or a +3 ion. To distinguish between the two there are two systems. In the classical system, the higher charge ends in **-ic** and the lower charge ends in **-ous**. In the stock system of naming these compounds a Roman numeral in parenthesis is used after the name of the metal to indicate the charge.

SOME MULTI CHARGED POSITIVE IONS

Cu^{+1}	Cuprous or copper (I)	Cu^{+2}	Cupric or copper (II)
Fe^{+2}	Ferrous or iron (II)	Fe^{+3}	Ferric or iron (III)
Ni^{+2}	Nickelous or nickel (II)	Ni^{+3}	Nickelic or nickel (III)
Cr^{+2}	Chromous or chromium (II)	Cr^{+3}	Chromic or chromium (III)
Co^{+2}	Cobaltous or cobalt (II)	Co^{+3}	Cobaltic or cobalt (III)
Hg_2^{+2}	Mercurous or mercury(I)*	Hg^{+2}	Mercuric or mercury (II)
Pb^{+2}	Plumbous or lead (II)	Pb^{+4}	Plumbic or lead (IV)

Hg_2^{+2} is an exception and must always be written this way.

To determine what the charge of an ion is you must remember that compounds are electrical neutral, that is they have no charge. For example what is the name of the compound FeCl_3 . Since chlorine can only be a -1 ion and you have three chloride ions { $3(-1) = -3$ } the Fe must have a charge of +3 to cancel out the -3 charge of the three chlorides. So this compound is Ferric chloride or iron (III) chloride. What is the name of the compound CuSO_4 . The sulfate ion has a charge of -2, so the charge on the copper must be +2. Therefore the name of the compound is cupric sulfate or copper (II) sulfate

NAME THE FOLLOWING COMPOUNDS

(a) FeBr_2 (b) $\text{Cr}_2(\text{SO}_4)_3$ (c) $\text{Ni}(\text{NO}_2)_2$ (d) PbCl_4 (e) HgCO_3
(Iron (II) bromide, Chromium (III) sulfate, Nickel (II) nitrite, Lead(IV) Chloride, Mercury(II) carbonate)

WRITE FORMULAS FOR THE FOLLOWING

(a) ferric nitrate (b) cobalt(II) sulfide (c) Cupric hydroxide
(d) nickelic perchlorate (e) iron (II) iodide
($\text{Fe}(\text{NO}_3)_3$, CoS , $\text{Cu}(\text{OH})_2$, $\text{Ni}(\text{ClO}_4)_3$, FeI_2)

NAMING MOLECULAR COMPOUNDS

Molecular compounds are formed by covalent bonds when non metals combine. Perhaps the best example is the two compounds made up of carbon and oxygen. They are CO and CO_2 . How is each named? Carbon monoxide and carbon dioxide. Have you figured out how to name molecular compounds. If not, here are some other examples with the name given

FORMULA

NO

NO₂N₂ON₂O₃N₂O₅**NAME**

nitrogen monoxide

Nitrogen dioxide

dinitrogen monoxide

dinitrogen trioxide

dinitrogen pentoxide

Because with molecular compounds there are so many combinations, it is necessary to tell how many of each atom there is. If there is only one of the first atom you do not have to include mono, it is understood, however, you must always tell how many of the second atom there are. The prefixes are one - mono, two - di, three-tri, four - tetra, five-penta, six-hexa, seven-hepta, eight-octa, nine-non, ten-deca.

NAME THE FOLLOWING: (a) SO₂ (b) SO₃ (c) SO (d) S₂O₃ (e) S₂O₅
 (sulfur dioxide, sulfur trioxide, sulfur oxide, disulfur trioxide, disulfur pentoxide)

NAMING ACIDS

An important class of compounds are acids. You can always recognize an acid because all acids start with a hydrogen. There are two kinds of acids, binary acids and acids based on polyatomic ions. The easiest way to remember how to name an acid is to realize that for most acids the ending of the negative ion is the key to naming the acid

ENDING OF NEG. ION	NAME OF ACID	SAMPLE
-ide	hydro(name)ic	HCl hydrochloric acid
-ate	(name)ic	H ₂ SO ₄ Sulfuric acid
-ite	(name)ous	H ₂ SO ₃ Sulfurous acid

Here are some examples:

HBr

Hydrobromic acid

HNO₃

Nitric Acid

HClO₄

Perchloric acid

H₂CrO₄

Chromic acid

NAME THE FOLLOWING(a) HF (b) H₂SO₄ (c) HNO₂ (d) HClO

(Hydrofluoric acid, Sulfuric acid, Nitrous acid, Hypochlorous acid)

WHAT IS THE FORMULA FOR(a) Perchloric acid (b) Hydroiodic acid (c) Sulfurous acid (HClO₄, HI, H₂SO₃)HClO₄

HI

H₂SO₃