Basic Inorganic Nomenclature

Many Chemical compounds are possible; in fact an infinite number of compounds are possible even with only about 100 naturally occuring elements. It is estimated that over 10 million different chemicals have been synthesized, and this number grows every day. We cannot hope to name all these chemicals in a non-systematic way, for we would soon be overwhelmed by the amount of memorization it would take. So, we need a naming scheme that will allow us to name a new compound uniquely and in such a way as to make clear its' molecular formula.

The complete system of naming chemical compounds is very complex and well beyond the scope of this course. However, we can look at some simple parts of the nomenclature to get an idea of how it works. In fact, the naming scheme used by chemists tells us about chemistry, because the nature of the material named is used in the choice of its name.

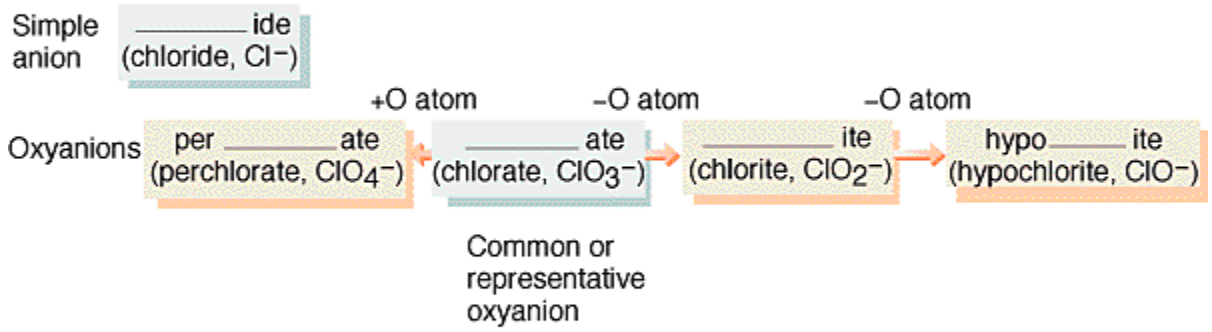
When elements from the far left of the periodic table (metals) react, they tend to loose electrons to form positive ions or cations. When elements from the right react with metals, they gobble up these electrons to form negative ions, or anions. Compounds formed between metals and nonmetals where this takes place are called ionic compounds and they are named from the ions that compose them.

Cations formed from metals have the same name as the metal. If the metal can form more than one different positive ion, the charge state of the metal is put in roman numerals within parenthesis following the metal name. Sometimes an older naming scheme is used: when only two ions can be formed from a given metal, an *-ous* ending is given to the Latin name of the metal for the lower charged (less positive) ion and and *-ic* ending is given for the higher charged ion. Cations formed from non-metals are given an *-ium* ending. Here are some examples of names of cations:

Common Cations

Charge	Formula	Name	Formula	Name
1+	H^+	Hydrogen ion	NH_4^+	Ammonium ion
	Li^+	Lithium ion	Cu^+	Copper(I) or cuprous ion
	Na^+	Sodium ion		
	K^+	Potassium ion		
	Cs^+	Cesium ion		
	Ag^+	Silver ion		
2+	Mg^{2+}	Magnesium ion	Co^{2+}	Cobalt(II) or cobaltous ion
	Ca^{2+}	Calcium ion	Cu^{2+}	Copper(II) or cupric ion
	Sr^{2+}	Strontium ion	Fe^{2+}	Iron(II) or ferrous ion
	Ba^{2+}	Barium ion	Mn^{2+}	Manganese(II) or manganous ion
	Zn^{2+}	Zinc ion	Hg_2^{2+}	Mercury(I) or mercurous ion
	Cd^{2+}	Cadmium ion	Hg^{2+}	Mercury(II) or mercuric ion
			Ni^{2+}	Nickel(II) or nickelous ion
			Pb^{2+}	Lead(II) or plumbous ion
			Sn^{2+}	Tin(II) or stannous ion
3+	Al^{3+}	Aluminum ion	Cr^{3+}	Chromium(III) or chromic ion
			Fe^{3+}	Iron(III) or ferric ion

Monoatomic **anions** are named by shortening the name of the element ad adding an *-ide* ending. Some simple polyatomic anions are also given the *-ide* ending (like hydroxide). Many polyatomic anions contain oxygen and these are called oxyanions. Usually, these anions come in groups that have the same charge but different numbers of oxygen atoms. The names of these species have the root derived from the non-oxygen atom, and the most common ion is given the *-ate* ending. Names for the ion with more and fewer oxygen atoms are given different suffixes and sometimes prefixes:



Oxyanaions that can combine with hydrogen ions (H^+), are given the prefix *hydrogen* or *dihydrogen*, or in the older literature the prefix *bi-*. eg:

HCO_3^- is called hydrogen carbonate or bicarbonate

Common Anions

Charge	Formula	Name	Formula	Name
1–	H^-	Hydride ion	$C_2H_3O_2^-$	Acetate ion
	F^-	Fluoride ion	ClO_3^-	Chlorate ion
	Cl^-	Chloride ion	ClO_4^-	Perchlorate ion
	Br^-	Bromide ion	NO_3^-	Nitrate ion
	I^-	Iodide ion	MnO_4^-	Permanganate ion
	CN^-	Cyanide ion		
	OH^-	Hydroxide ion		
2–	O^{2-}	Oxide ion	CO_3^{2-}	Carbonate ion
	O_2^{2-}	Peroxide ion	CrO_4^{2-}	Chromate ion
	S^{2-}	Sulfide ion	$Cr_2O_7^{2-}$	Dichromate ion
			SO_4^{2-}	Sulfate ion
3–	N^{3-}	Nitride ion	PO_4^{3-}	Phosphate ion

Ionic compounds are named by simply putting the cation name first and the anion name second (and leave out the 'ion' word if the compound is electrically neutral). eg.

$BaBr_2$ is called Barium Bromide
$Al(NO_3)_3$ is called Aluminum Nitrate
$Cu(ClO_4)_2$ is called Copper(II) perchlorate or Cupric perchlorate

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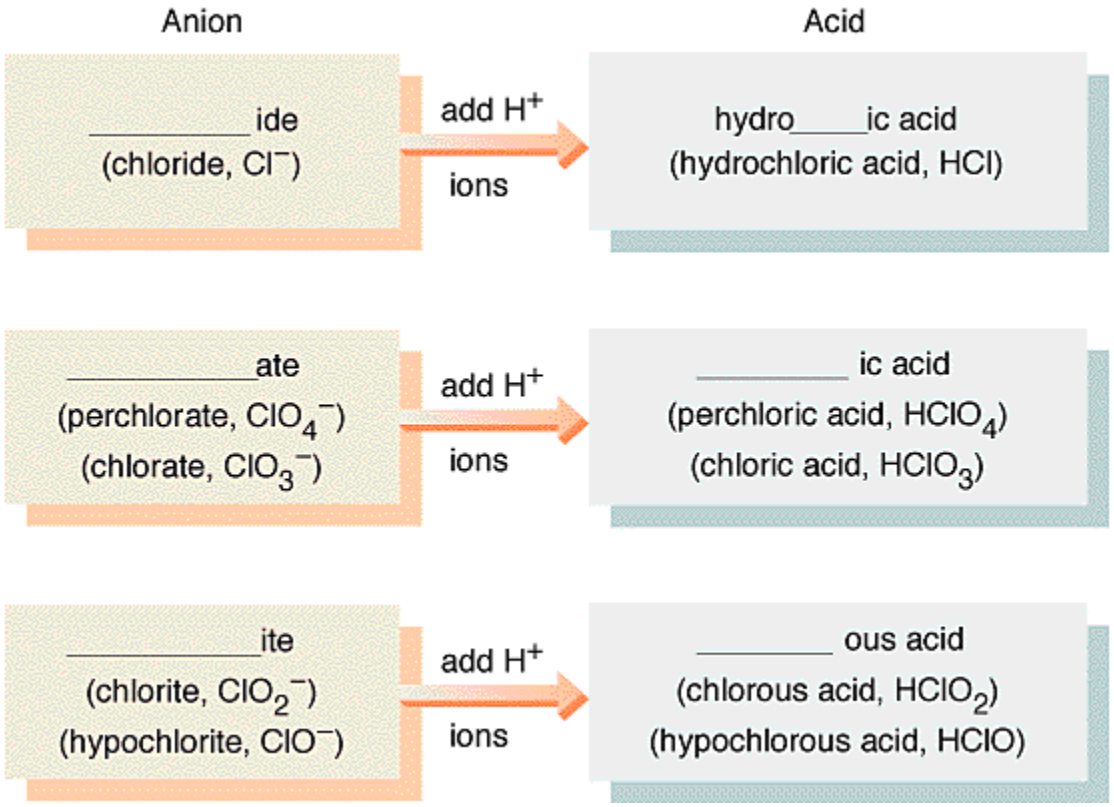
Acids are named from the anions that they are formed from since we know the cation they contain is Hydrogen ion. We just change the suffix of the anion and add the word 'acid'.



Binary moleular compounds that are formed between non-metals do not usually form ions first (they are 'covalent'), so we simple use a prefix to state how many atoms of each non-metal are in the molecule. The element that is furthest left or down in the periodic table (most metallic like) is named first and the second element is given an *-ide* ending. You don't use *mono-* on the first element, and you drop a vowel when they get strung together:

Prefixes Used in Naming Binary Compounds Formed Between Nonmetals

Prefix	Meaning
Mono-	1
Di-	2
Tri	3
Tetra-	4
Penta-	5
Hexa-	6
Hepta-	7
Octa-	8
Nona-	9
Deca-	10

Examples of this type of naming are

Cl_2O is called dichlorine monoxide
NF_3 is called nitrogen trifluoride
N_2O_4 is called dintrogen tetroxide (Note: dropped an 'a')
P_4S_{10} is called tetraphosphorous decasulfide

Do you have to memorize these naming schemes? Yes. The only alternatice is to memorize each chemicals name uniquely (>10 million names) and learn new ones each day...

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