Chemistry 6A Fall 2007

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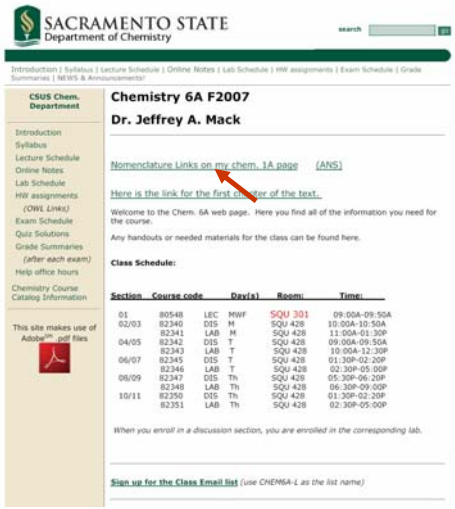
9/21/07

Please note that Friday is not an "*optional*" day for attendance in chem. 6A lecture.

If there are a significant number of people absent or tardy as was the case today, in the future, I will password protect the notes.

Dr. Mack



I've posted a worksheet for nomenclature on the web site.

You don't have to use it, but it will help you learn the material…

Compounds:

A compound is a distinct substance that contains two or more elements combined in a definite proportion by weight.

Atoms of the elements that constitute a compound are always present in simple whole number ratios.

They are never present as fractional parts.

Examples: AB A_2B AB_2

Never: $A_{1/2}B$

Ionic Compounds:

All chemical compound must have a net charge of zero. ***(neutral)***

Since inorganic compounds (***metal and a non-metal***) contain ions, then the charge on the cations must cancel the charge on the anions. (***equal zero***)

charge from cation (+) + charge from anion (–) = 0

Chemical Formulas:

Since we are large (macroscopic) and atoms and compounds are small (microscopic), we need a symbolism to communicate the identity of an atom or compound.

A chemical formula tells us not only which elements make up a compound, but also their proportions.

A compound made of calcium and chlorine has the formula:

$CaCl_2$

The metal atom is written first followed by the anion.
The subscript indicates the number of each element *(1's are not shown)*

$CaCl_2$

The formula tells us that there are two chlorine ions for every calcium ion in the compound

We pronounce the name: ***"Calcium Chloride"***

One does not use the prefixes "mono", "di", "tri" etcetera for ionic compounds

We'll get into that later…

Binary Compounds: Metal & non-Metal

Metal of fixed oxidation (charge) state combined with a non-metal.

Examples:

Cation	Anion	Formula	Name
K^+	Cl^-	KCl	Potassium chloride
Ca^{2+}	O^{2-}	CaO	Calcium Oxide
Na^+	S^{2-}	Na_2S	Sodium sulfide
Al^{3+}	S^{2-}	Al_2S_3	Aluminum sulfide

Al^{3+} + S^{2-} ⟶ Al_2S_3

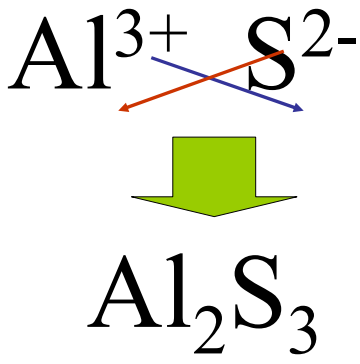
since the charges on the cation and anion don't match we must have multiples of both

$2 \times +3 = +6$ $3 \times -2 = -6$

Al_2S_3

$+6 + -6 = 0$

Or one can use the "Chris-Cross" method:



Metals of variable charge with a non-metal

Examples:

Cation	Anion	Formula	Name
Pb^{2+}	Cl^-	$PbCl_2$	lead (II) chloride
		pronounced: *lead - two - chloride*	
Pb^{4+}	Cl^-	$PbCl_4$	lead (IV) chloride
Fe^{3+}	O^{2-}	Fe_2O_3	Iron (III) oxide

Two ***complex anions*** are named like simple ions with the suffix (ending) -***ide***.

Example: OH^- ⟶ hydrox***ide*** ion

CN^- ⟶ cyan***ide*** ion

Most other complex ions end in -***ate*** or -***ite***.

SO_4^{2-} ⟶ sulf***ate*** ion

SO_3^{2-} ⟶ sulf***ite*** ion

See table 6.6 page 117

More examples:

Ion:	Name:
NO_2^-	nitrite
SO_3^{2-}	sulfite
HCO_3^-	bicarbonate *or* *hydrogen carbonate*
MnO_4^-	permanganate

Ternary Compounds: Those with three different elements

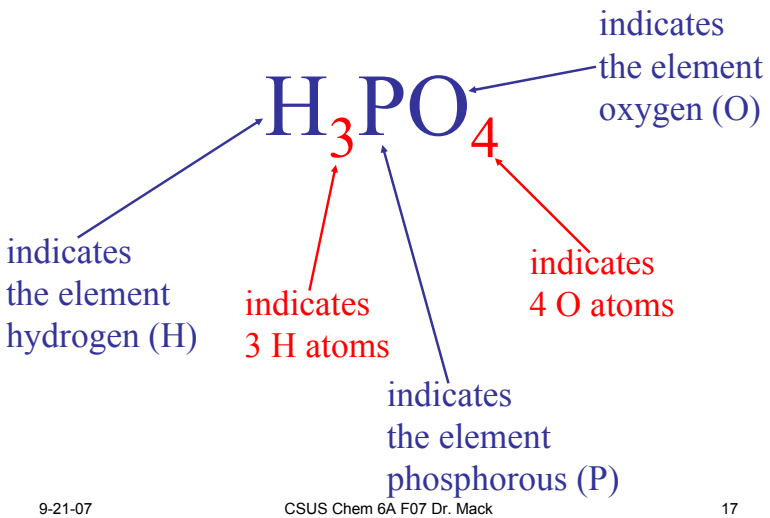
metal of fixed charge with a complex ion

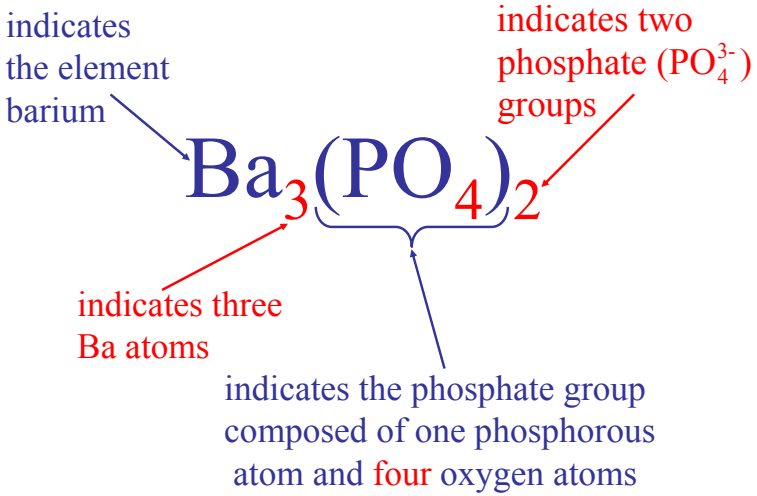
Cation	Anion	Formula	Name
K^+	OH^-	KOH	Potassium hydroxide
Ca^{2+}	OH^-	$Ca(OH)_2$	Calcium hydroxide
Na^+	SO_4^{2-}	Na_2SO_4	Sodium sulfate
Al^{3+}	SO_4^{2-}	$Al_2(SO_4)_3$	Aluminum sulfate

$Al_2(SO_4)_3$

spoken as: Al - two, sulfate, taken three times

or Al -two, parenthesis, sulfate, three





Metal of variable charge with a complex ion

Cation	Anion	Formula	Name
Pb^{2+}	SO_4^{2-}	$PbSO_4$	lead (II) sulfate
Pb^{4+}	SO_4^{2-}	$Pb(SO_4)_2$	lead (IV) sulfate
Fe^{3+}	NO_3^-	$Fe(NO_3)_3$	Iron (III) nitr***ate***
Fe^{2+}	NO_2^-	$Fe(NO_2)_2$	Iron (II) nitr***ite***

Type I Acids: Acids derived from *–ide* anions.

The names for these acids follows the formula:

"hydro" + the root of the ***ide*** anion + ***ic*** "acid"

Anion:	Acid:	Name:
chlor***ide***	HCl	***hydro***chlor***ic*** acid
fluor***ide***	HF	***hydro***fluor***ic*** acid

H^+ and S^{2-}

↓ *it takes 2 H^+ to cancel one S^{2-}*

H_2S

hydro sulfur***ic*** acid

An acid must be an ***aqueous*** (in water) species:

Later on will differentiate acids from molecules by:

HCN(aq) hydrocyanic acid

Vs.

HCN(g) hydrogen cyanide gas

Oxy-acids contain hydrogen, oxygen and one other element.

Example:

H_2SO_4

- The other element is usually a nonmetal, but it can be a metal.
- Its first element is hydrogen.
- Its remaining elements include oxygen in the form of a polyatomic ion.

Oxy Acids: Those derived from –***ate*** anions.

The names for these acids follows the formula:

root name of the anion with –***ic*** replacing the -***ate***

One student remembered it this way:

I ***ate*** something ***ic***ky!

Examples:

	Anion:	Acid:	Name:
(nitrate)	NO_3^-	HNO_3	nitr***ic*** acid
(chlorate)	ClO_3^-	$HClO_3$	chlor***ic*** acid
(sulfate)	SO_4^{2-}	H_2SO_4	sulfur***ic*** acid
(acetate)	$C_2H_3O_2^-$	$HC_2H_3O_2$	acet***ic*** acid *vinegar*

Additional Acids: Those derived from *–ite* anions.

root name of the anion with *–ous* replacing the *-ite*

The *–ite* forma of a complex anion usually has one less oxygen atom than the *–ate* form.

NO_3^- nitr*ate*

NO_2^- nitr*ite*

One can remember the *–ous* acids by:
"one less (oxygen atom) is the –ous acid."

	Anion:	Acid:	Name:
(nitrite)	NO_2^-	HNO_2	nitr*ous* acid
(chlorite)	ClO_2^-	$HClO_2$	chlor*ous* acid
(sulfite)	SO_3^{2-}	H_2SO_3	sulfur*ous* acid