Notes: Naming Chemical Compounds

There are 3 types of elements:

METALS: grouped on left side of periodic table; include the transition metals

NONMETALS: grouped on right side of table

SEMIMETALS (Metalloids): exhibit properties of both; along diagonal line (includes B, Si, As, Ge, Sb)

covalent compound

Prefixes:

mono - 1
di - 2
tri - 3
tetra - 4
penta - 5
hexa - 6
hepta - 7
octa - 8
nona - 9
deca - 10

Molecule = a neutral group of atoms that act as a unit.

Molecular Compounds: composed of two or more nonmetals covalently bonded.

- Molecular formula shows the # and kinds of atoms present in a molecule of a compound.
- For binary molecular compounds, name the compound after the elements it is made up of, using the appropriate prefix to indicate the number of atoms of each element.
- examples: H_2O, CO_2, CCl_4

Ionic Compounds: composed of pos. and neg. ions; overall, they are electrically neutral; *usually formed from a metal and a nonmetal*

- formula unit is the lowest whole # of ratio of ions in an ionic compound.
- examples: NaCl, $Mg_3(PO_4)_2$

*exception:
never start a name w/mono

In forming a chemical compound, some atoms can gain or lose 1 or more electrons (forming an ION).

- atoms of the metals form positive ions by losing 1 or more electrons

(positive ions = CATIONS)

Na:	11 electrons	Mg:	12 electrons
Na^+:	10 electrons	Mg^{2+}:	10 electrons

- atoms of the nonmetals form negative ions by gaining 1 or more electrons

(negative ions = ANIONS)

Cl:	17 electrons	O:	8 electrons
Cl^-:	18 electrons	O^{2-}:	10 electrons

Ionic charges of the elements:

- Metals in groups 1A, 2A, and 3A form positive ions:

Group 1 (1A): 1^+
Group 2 (2A): 2^+
Group 3 (3A): 3^+

- Nonmetals in groups 5A, 6A, and 7A form negative ions

Group 15 (5A): 3^-
Group 16 (6A): 2^-
Group 17 (7A): 1^-

- Groups (14) 4A and 18 (8A) do not commonly form ions.

•Transition metals: many have more than one common ionic charge. To name these ions, use Roman numerals

Examples: Iron (II) = Fe^{2+}

Iron (III) = Fe^{3+}

Lead (II) = Pb^{2+}

Lead (IV) = Pb^{4+}

Polyatomic ions = groups of atoms that behave as a unit and carry an overall charge.
*Notice the -ite/-ate naming for pairs:

-ite:	SO_3^{2-}	NO_2^-	ClO_2^-
-ate:	SO_4^{2-}	NO_3^-	ClO_3^-

*For ionic compounds, name the metal or positive ion first, then the nonmetal or negative ion

*The name of the metal or positive ion remains the same

Na =	sodium	Ca =	calcium
Na^+ =	sodium ion	Ca^{2+} =	calcium ion

*The name of the nonmetal anion is changed:

Cl =	chlorine	O =	oxygen
Cl^- =	chlor<u>ide</u> ion	O^{2-} =	ox<u>ide</u> ion

*Polyatomic ion names remain as they are.

Examples of ionic compound nomenclature:

Magnesium sulfate	$MgSO_4$
Aluminum sulfide	Al_2S_3
Calcium chlorate	$Ca(ClO_3)_2$
Lithium phosphate	Li_3PO_4
Barium nitride	Ba_3N_2
Aluminum nitrite	$Al(NO_2)_3$

Review of Naming Rules

General rules:

1. In an ionic compound, the net ionic charge is zero
2. In an ionic compound, the metal (cation) is named first, then the nonmetal (anion) is named, but the ending is changed to -ide. Example NaCl = sodium chloride; MgO = magnesium oxide; CaF_2 = calcium fluoride.
3. An -ite or -ate ending means the formula has a polyatomic ion.
4. A Roman numeral shows the ionic charge of the cation if it is a transition metal).
5. Prefixes in the name indicate a molecular (covalently bonded) compound (i.e. no ions, formed from two nonmetals). They show the number of each atom in the formula. Examples: CO_2 = carbon dioxide; CO = carbon monoxide; CCl_4 = tetrachloride)

Acids: compounds that give off hydrogen ions (H^+) when dissolved in water.

- Acids have a general formula: HX (where X = an anion)
- When the anion (X) ends in *-ide*, the acid name begins with prefix *hydro-*; the anion ends in *-ic*; and the name is followed with the word "acid".

Examples: HCl (anion = chloride); so, hydrochloric acid
HBr (anion = bromide); so hydrobromic acid
HF (anion = fluoride); so hydrofluoric acid
HCN (anion = cyanide); so hydrocyanic acid

- When the anion (X) ends in *-ite*, the acid name is the stem of the anion with the suffix *-ous*, followed by the word "acid".

Examples: H_2SO_3 (anion = sulfite); so, sulfurous acid
H_3PO_3 (anion = phosphite); so, phosphorous acid
HNO_2 (anion = nitrite); so, nitrous acid

**** notice that, like ionic compounds, the charges balance out to zero!**

- When the anion (X) ends in -ate, the acid name is the stem of the anion with the suffix -ic, followed by the word "acid".

Examples: H_2SO_4 (anion = sulfate); so, sulfuric acid
H_3PO_4 (anion = phosphate); so, phosphoric acid
H_2CO_3 (anion = carbonate); so, carbonic acid
HNO_3 (anion = nitrate); so, nitric acid