2.8 Naming Simple Compounds

1. Chemical Nomenclature
   1) Chemical Nomenclature is the systematic naming of chemical compounds
   2) Organic Compounds are derivatives of hydrocarbons
   3) Inorganic compounds are compounds containing elements other than carbon.
2. Ionic Compounds
   1) Ionic compounds are formed of a cation and an anion
   2) The cation is always named first; the anion second
   3) Monatomic anions have ending changed to -ide
   4) Polyatomic ion names have a regular pattern:
      a. The "ate" ion should be memorized e.g. SO_4^{2-} (sulfate)
      b. The "ite" ion has one less oxygen e.g. SO_3^{2-} (sulfite)
      c. The prefix hypo (meaning below) is used with the "ite" ending to indicate one less oxygen than the ite form e.g. SO_2^{2-} (hyposulfite)
      d. The prefix per (from hyper, above) is used with the "ate" ending to indicate one more oxygen than the ate form e.g. SO_5^{2-} (persulfate)

   Examples:

perchlorate	ClO_4^-
chlorate	ClO_3^-
chlorite	ClO_2^-
hypochlorite	ClO^-

pernitrate	NO_4^-
nitrate	NO_3^-
nitrite	NO_2^-
hyponitrite	NO^-

   Warning: These are the mechanics; not all these ions exist
   5) Cations with more than one oxidation state (the transition metals) must have a roman numeral to indicate the oxidations state
   e.g. Cu^{2+} is Copper(II) (stock system)
   6) The older method was to employ the suffix -ous or -ic at the end of the cation to tell which ion was formed (-ous was the lower charge)
   The following charges and suffixes should be known

Fe^{2+}	Ferrous
Fe^{3+}	Ferric
Cu^{+}	Cuprous
Cu^{2+}	Cupric
Co^{2+}	Cobaltous
Co^{3+}	Cobaltic

Sn^{2+}	Stannous
Sn^{4+}	Stannic
Pb^{2+}	Plumbous
Pb^{4+}	Plumbic
Ni^{2+}	Nickelous
Ni^{3+}	Nickelic

Cr^{2+}	Chromous
Cr^{3+}	Chromic
Hg^{+}	Mercurous
Hg^{2+}	Mercuric
Mn^{2+}	Manganous
Mn^{3+}	Manganic

3. Binary MolecularCompounds
   1) A binary compound is composed of only two elements
   2) Binary Molecular compounds are composed of two non-metals or metalloids.
   3) When the two elements form only one compound, the compound is named by using the name of the first element followed by the stem of the second element with the suffix -ide added. e.g hydrogen chloride

4) When the two elements can form more than one compound, the older method was to use Greek prefixes to tell the number of atoms of each element.

mono-	one
di-	two
tri-	three
tetra-	four
penta-	five

hexa-	six
hepta-	seven
octa-	eight
nona-	nine
deca-	ten

5) The first element
   a. Use the full element name
   b. Use the Greek prefix only if there is more than one
6) The second element
   a. The element is named as if it were an ainion (-ide)
   b. The prefix is always used
7) The Stock System uses Roman Numerals to name binary molecular compounds. The roman numeral is the oxidation number of the first element

4. Naming Acids
   1) Binary Acid
      a. composed of two elements: hydrogen and one other nonmetal
      b. Named as follows: HYDRO + root of second element + -IC
         e.g. HCl is Hydrochloric Acid; H_2S is Hydrosulfuric Acid
   2) Oxyacid Acid (or Ternary acids)
      a. composed of three elements: hydrogen, oxygen and one other nonmetal
      b. If the acid contains an anion whose name ends in -ate; use the root of the anion name and the suffix -IC e.g. H_2SO_4 is Sulfuric Acid
      c. There is a regular pattern for naming oxyacids: (not all possibilities exist)

Anion formula	Anion name	Acid Formula	acid name
ClO_4^-	perchlorate ion	$HClO_4$	perchloric acid
ClO_3^-	chlorate ion	$HClO_3$	chloric acid
ClO_2^-	chlorite ion	$HClO_2$	chlorous acid
ClO^-	hypochlorite ion	HClO	hypochlorous acid

   3) Conjugates of Oxyacids
      a. If H_2SO_4 loses a hydrogen (H^+) it becomes HSO_4^- and is called hydrogen sulfate ion or bisulfate ion
      b. H_3PO_4 (phosphoric acid) loses an H^+ to become $H_2PO_4^-$ called dihydrogen phospate ion which can in turn lose another H^+ to become HPO_4^{2-} called the monohydrogen phospate ion

4) Molecular Compounds and associated acids
Be careful of the state of binary molecular compounds. Note the following

HCl(g)	Hydrogen chloride	HCl (aq)	Hydrochloric acid
HF(g)	Hydrogen fluoride	HF (aq)	Hydrofluoric acid

5) Hydrates
   a. A compound that contains water molecules weakly bound in its crystals.
   b. The substance without the water molecules is called an anhydrous substance
   c. The formula for a hydrate is the anhydrous substance followed by a dot and H_2O preceded by the number of water molecules e.g. $MgSO_4 \bullet 7H_2O$
   d. A hydrate is named by naming the anhydrous substance followed by the Greek prefix corresponding to the number of water molecules and then the word hydrate. e.g. for the compound above, the name would be: Magnesium sulfate heptahydrate