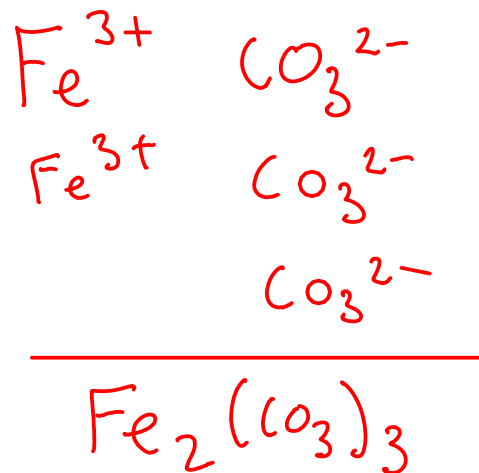# DETERMINING THE FORMULA OF AN IONIC COMPOUND FROM THE NAME
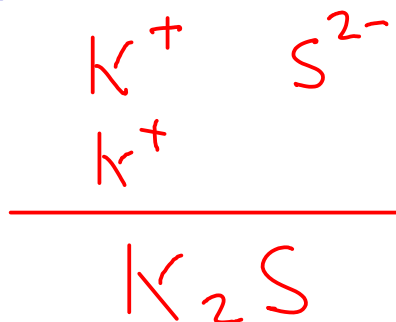
- The name of an ionic compound is made of the names of the CATION and ANION in the compound.

- To get the FORMULA, you must figure out the SMALLEST RATIO of cation to anion that makes the charges balance out
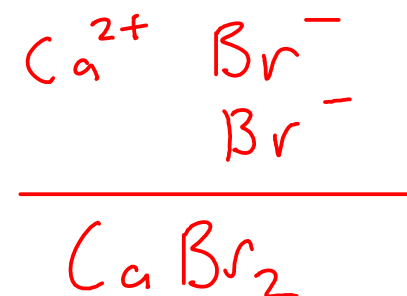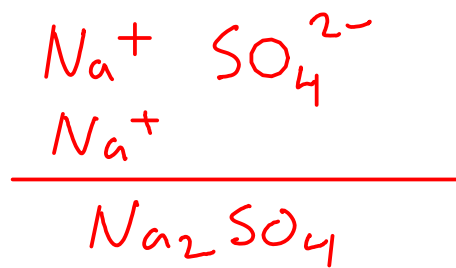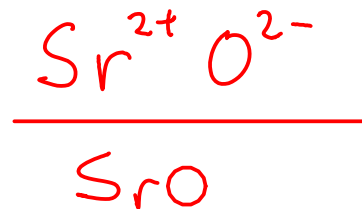
Examples:

iron(III) carbonate

Fe^{3+} CO_3^{2-}

Fe^{3+} CO_3^{2-}

CO_3^{2-}

$$Fe_2(CO_3)_3$$

potassium sulfide

K^+ S^{2-}

K^+

$$K_2S$$

calcium bromide

Ca^{2+} Br^-

Br^-

$$CaBr_2$$

DETERMINING IONIC FORMULAS

sodium sulfate

$$Na^+ \quad SO_4^{2-}$$
$$Na^+$$
$$\overline{}$$
$$Na_2SO_4$$

strontium oxide

$$Sr^{2+} \quad O^{2-}$$
$$\overline{}$$
$$SrO$$

tin(II) phosphate

$$Sn^{2+} \quad PO_4^{3-}$$
$$Sn^{2+} \quad PO_4^{3-}$$
$$Sn^{2+}$$
$$\overline{}$$
$$Sn_3(PO_4)_2$$
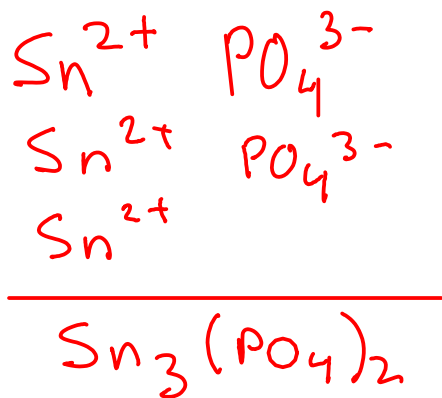
chromium(III) nitrate

$$Cr^{3+} \quad NO_3^-$$
$$NO_3^-$$
$$NO_3^-$$
$$\overline{}$$
$$Cr(NO_3)_3$$

titanium(IV) chloride

$$Ti^{4+} \quad Cl^-$$
$$Cl^-$$
$$Cl^-$$
$$Cl^-$$
$$\overline{}$$
$$TiCl_4$$

barium hydroxide

$$Ba^{2+} \quad OH^-$$
$$OH^-$$
$$\overline{}$$
$$Ba(OH)_2$$
$$\cancel{BaOH_2}$$
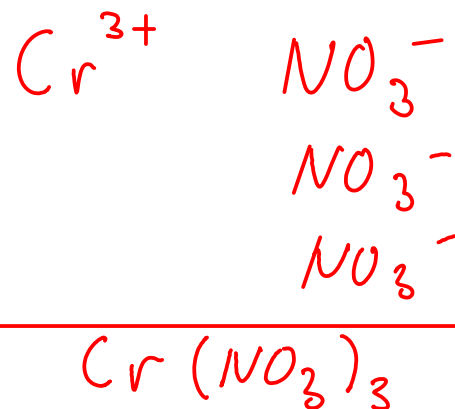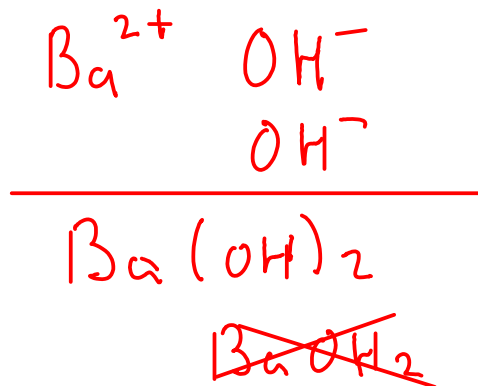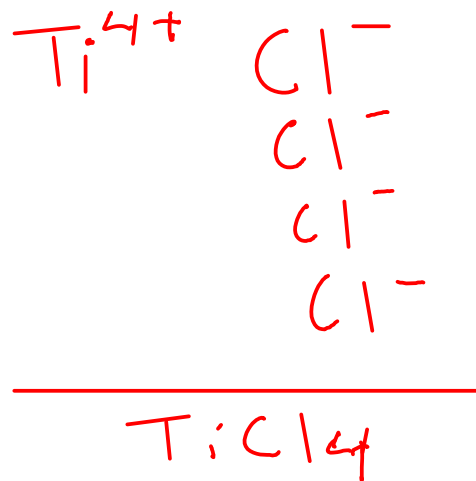
MOLECULAR COMPOUNDS

- There are several kinds of molecular compound. We will learn to name two simple but important classes

(1) <u>BINARY MOLECULAR COMPOUNDS</u>

  - molecular compounds containing only two elements

(2) <u>ACIDS</u>

  - molecular compounds that dissolve in water to release H^+ ions
  - corrosive to metals (react with many to produce hydrogen gas)
  - contact hazard: can cause chemical burns to eyes and skin
  - sour taste
  - turn litmus indicator RED
  - two kinds of acids:

    (1) <u>BINARY ACIDS</u>

      - contain <u>hydrogen</u> and one other element

      usually Group VIIA

    (2) <u>OXYACIDS</u>

      - contain <u>hydrogen</u>, <u>OXYGEN</u>, and another element

BINARY MOLECULAR COMPOUNDS

- Named based on the elements they contain, plus prefixes to indicate the number of atoms of each element in each molecule

(1) FIRST ELEMENT

     - Add a GREEK PREFIX to the name of the element.

     - Omit the "MONO-" (1) prefix if there is only one atom of the first element

(2) SECOND ELEMENT

     - Add a GREEK PREFIX to the STEM NAME of the element

     - Add the suffix "-ide" (as if you were naming an anion)

     - DO NOT omit the "mono-" prefix if there is only one atom of the second element
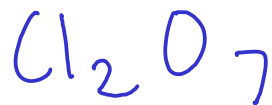
MEMORIZE THE GREEK PREFIXES. SEE COURSE WEB SITE FOR A LIST!

BINARY MOLECULAR COMPOUNDS

Examples:

BF_3

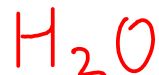boron trifluoride

Cl_2O_7

dichlorine heptaoxide

CO

carbon monoxide

CO_2

carbon dioxide

carbon tetrachloride

CCl_4

dihydrogen monoxide

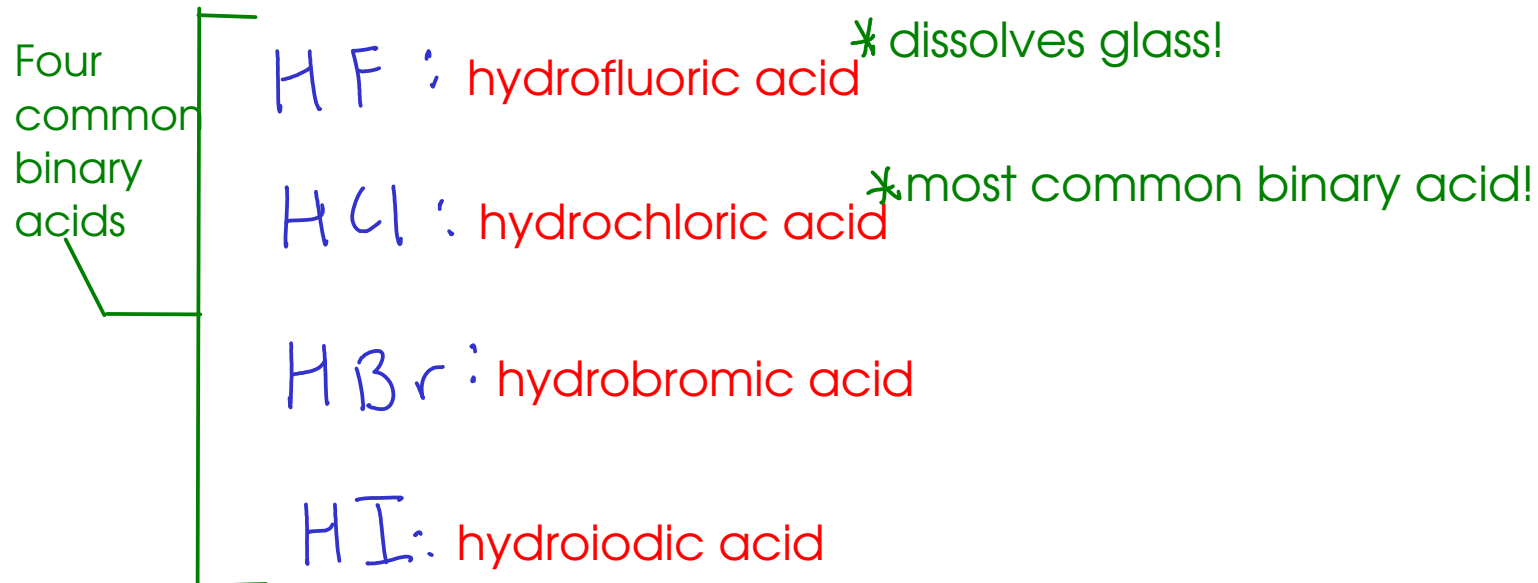H_2O

dinitrogen tetrafluoride

N_2F_4

$MgCl_2$ magnesium chloride, NOT magnesium dichloride. Why? Because this is an IONIC compound. You can recognize this as an ionic compound because it contains a metal combined with a nonmetal. (Magnesium is a metal)

ACIDS

① BINARY ACIDS

- named after the element (other than hydrogen) they contain

- common binary acids include a <u>Group VIIA</u> element

- named: "Hydro-" + STEM NAME OF ELEMENT+ "-ic acid"

Four common binary acids

HF ∴ hydrofluoric acid   * dissolves glass!

HCl ∴ hydrochloric acid   *most common binary acid!

HBr ∴ hydrobromic acid

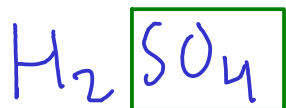HI ∴ hydroiodic acid

ACIDS

② OXYACIDS

- Easy to think about as HYDROGEN IONS combined with POLYATOMIC IONS

- These acids are not true ionic compounds, but they interact with water to PRODUCE ions!

- named based on the polyatomic ion they contain, with an ending change:

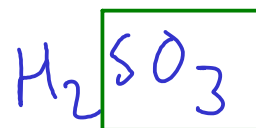 ① - ions ending in -ATE form acids ending in -IC

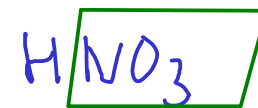 ② - ions ending in -ITE form acids ending in -OUS

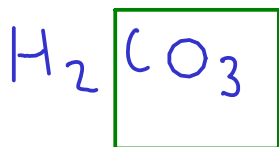$H_2 \boxed{SO_4}$
sulfuric acid

$H_3 \boxed{PO_4}$
phosphoric acid

$H_2 \boxed{SO_3}$
sulfurous acid

$H \boxed{NO_3}$
nitric acid

$H_2 \boxed{CO_3}$
carbonic acid

OXYACID EXAMPLES

acetic acid

$\llcorner$ "-ate" ion

$$\frac{H^+ \quad C_2H_3O_2^-}{H C_2H_3O_2}$$
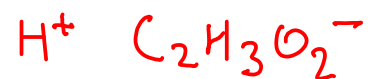
nitrous acid

$\llcorner$ "-ite" ions

$$\frac{H^+ \quad NO_2^-}{HNO_2}$$

carbonic acid

$$\frac{H^+ \quad CO_3^{2-}}{H_2CO_3}$$
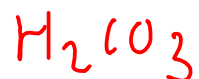
* The number of hydrogen ions to add to the polyatomic to make the acid equals the charge of the polyatomic.

SUMMING UP CHEMICAL NOMENCLATURE

- You need to be able to tell, by looking at a name OR a formula, what kind of compound you are working with!

DON'T GET THE NAMING SYSTEMS MIXED UP! EACH KIND OF COMPOUND IS NAMED WITH ITS OWN SYSTEM!

FROM A CHEMICAL NAME

- If the name has a Roman numeral, the name of a metal, or "ammonium", the compound is likely IONIC

- If the name has a Greek prefix, the compound is BINARY MOLECULAR

- If the name contains the word "acid":

... and starts with "hydro-", then the compound is a BINARY ACID

... and does not start with "hydro-", the compound is an OXYACID

FROM A CHEMICAL FORMULA

- if the formula contains a metal or the NH_4^+ ion, it is likely IONIC

H_2O H_2O_2

- If the formula starts with H and is not either water or hydrogen peroxide, the compound is likely an ACID. Which kind?

    - BINARY ACIDS contain only two elements

    - OXYACIDS contains oxygen

- If the formula contains only nonmetals (and is not an ammonium compound or an acid), the compound is likely MOLECULAR
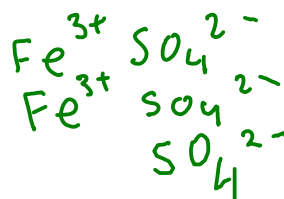
Examples:

PCl_3 : BINARY MOLECULAR
Name: phosphorus trichloride

NH_4Cl : IONIC (ammonium ion)
Name: ammonium chloride

H_3PO_4 : OXYACID (hydrogen, phosphate)
Name: phosphoric acid

$Fe_2(SO_4)_3$? IONIC (iron - metal!)
Name: iron(III) sulfate

Fe^{3+} SO_4^{2-}
Fe^{3+} SO_4^{2-}
SO_4^{2-}

END OF MATERIAL FOR TEST #2
Summer 2009