NAMING IONIC COMPOUNDS

$(NH_4)_2S$

ammonium sulfide

$FeCO_3$

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

+2 −2

iron(II) carbonate

TiS_2

Ti^{4+} S^{2-} S^{2-}

+4 −4

titanium(IV) sulfide

$Ba_3(PO_4)_2$

barium phosphate

Spelling matters!

Ba_3P_2

barium phosphide

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

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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^+

Na_2SO_4

strontium oxide

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

SrO

tin(II) phosphate

$Sn^{2+} \quad PO_4^{3-}$

$Sn^{2+} \quad PO_4^{3-}$

Sn^{2+}

$Sn_3(PO_4)_2$

chromium(III) nitrate

$Cr^{3+} \quad NO_3^-$

NO_3^-

NO_3^-

$Cr(NO_3)_3$

barium hydroxide

$Ba^{2+} \quad OH^-$

OH^-

$Ba(OH)_2$

~~$BaOH_2$~~

titanium(IV) chloride

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

Cl^-

Cl^-

Cl^-

$TiCl_4$

Don't forget the parenthesis when you have more than one hydroxide ion!

HYDRATES

- many ionic compounds are formed by crystallizing the compound from water. Sometimes, this causes water molecules to become part of the crystal structure.

- This water is present in a definite ratio to the ions in the compound. Can be removed by heating, but will NOT evaporate if the compound is left standing.

ex: $CuSO_4 \cdot 5H_2O$

water molecules per formula unit of compound

dot indicates that the water is weakly bound to the ionic compound

- many DESSICANTS are hydrates that have had their water molecules driven off. They will slowly reabsorb water from the air (and keep the environment in a dessicator at a low humidity)

- Hydrates are named using the name of the ionic compound, and a Greek prefix in front of the word "hydrate" to indicate how many water molecules are associated

Cu^{2+} SO_4^{2-}

Why "copper(II)"?

copper (II) sulfate pentahydrate

MOLECULAR COMPOUNDS

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

1 BINARY MOLECULAR COMPOUNDS

- molecular compounds containing only two elements

2 ACIDS

- 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:

Usually from Group VIIA

1 BINARY ACIDS

- contain hydrogen and one other element

2 OXYACIDS

- contain hydrogen, OXYGEN, 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!
THESE ARE THE SAME PREFIXES USED FOR THE HYDRATES!

BINARY MOLECULAR COMPOUNDS

Examples:

BF_3	Cl_2O_7	CO	CO_2
boron trifluoride	dichlorine heptaoxide (OR dichlorine heptoxide)	carbon monoxide	carbon dioxide

*Note: metalloids like boron behave chemically like nonmetals do.

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carbon tetrachloride

CCl_4

dihydrogen monoxide

H_2O

dinitrogen tetrafluoride

N_2F_4

$MgCl_2$: magnesium CHLORIDE (*not* magnesium DICHLORIDE) Why not? Magnesium chloride is an ionic compound, and is named using the system we discussed for ionic compounds.

How can we tell magnesium chloride is ionic? It contains a metal combined with a nonmetal, and this combination usually produces an ionic compound.

ACIDS

1 BINARY ACIDS

- named after the element (other than hydrogen) they contain
- common binary acids include a Group VIIA 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

sulfATE

H_2SO_4

sulfuric acid

phosphATE

H_3PO_4

phosphoric acid

sulfITE

H_2SO_3

sulfurous acid

HNO_3

nitric acid

OXYACID EXAMPLES

acetic acid

based on acetate

$H^+ \quad C_2H_3O_2^-$

$HC_2H_3O_2$

nitrous acid

based on nitrite ion

$H^+ \quad NO_2^-$

HNO_2

carbonic acid

based on carbonate

$H^+ \quad CO_3^{2-}$

H^+

H_2CO_3

Basically, the humber of hydrogens at the beginning of the formula equals the charge of the anion the acid is based on!