POLYATOMIC IONS

- Some MOLECULES can gain or lose electrons to form CATIONS or ANIONS. These are called POLYATOMIC IONS

- Polyatomic ions form ionic compounds in the same way that single-element ions do.

Example: CO_3^{2-} : CARBONATE ION

*Compare to Al_2O_3

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

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

CO_3^{2-}

$Al_2(CO_3)_3$

* Use parenthesis when an ionic compound's formula contains more than one of a polyatomic ion.

See the web site or p63 (9th ed table 2.5)
or p64 (10th ed table 2.6) for a list of common polyatomic ions!

NAMES OF IONS

- To properly discuss ions and ionic compounds, we have to know how to name them!

CATIONS

3 kinds:

1. Main group cations (metals that take only one charge when forming ions)

   - The element's name is the same as the ion's name!

   Mg^{2+}: "magnesium ion"

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2. Transition metal cations (from metals that can form several cations)

   - The CHARGE of the cation must be given. Use a ROMAN NUMERAL after the element name to indicate charge!

   Fe^{2+}: "iron(II) ion"

   Cu^{+}: "copper(I) ion"

   Fe^{3+}: "Iron(III) ion"

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3. Polyatomic cations

   - Memorize list.

   NH_4^{+}: "ammonium ion"

ANIONS

2 kinds

1. Main-group nonmetals

- Use the STEM NAME of the element, then add "-ide" suffix

N^{3-} : "nitride" ion P^{3-} : "phosphide ion" S^{2-}: sulfide ion

O^{2-} : "oxide ion" F^{-} : "fluoride ion"

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2. Polyatomic ions

- Memorize list.(see web site)

$C_2H_3O_2^{-}$: "acetate ion" SO_4^{2-} : "sulfate ion"

NO_3^{-} : "nitrate ion" SO_3^{2-} "sulfite ion"

NO_2^{-} : "nitrite ion"

* Polyatomic ions ending in "-ate" and "-ite" suffixes always contain oxygen! "-ate" ions have more oxygen atoms than their "-ite" counterparts.

NAMING IONIC COMPOUNDS

- The name of the compound is based on the name of the ions in the compound
- Cation first, anion second

Examples:

$Mg(OH)_2$

magnesium hydroxide

Na_2S

sodium sulfide

$BeBr_2$

beryllium bromide

Fe_2O_3

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

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

O^{2-}

+6 −6

iron(III) oxide

CuO

Cu^{2+} O^{2-}

+2 −2

copper(II) oxide

Cu_2O

Cu^{+} O^{2-}

Cu^{+}

+2 −2

copper(I) oxide

Remember to include the Roman numeral for CHARGE in the name of a transition metal compound!

Page 63 (9th edition), page 64 (10th edition): Chart of polyatomic ions

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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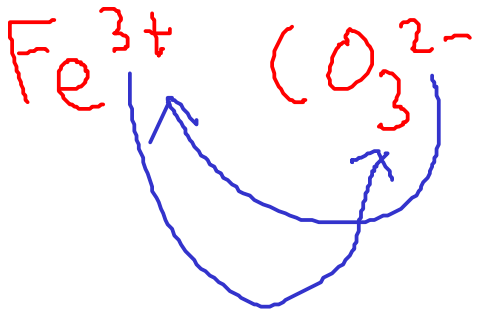
Examples:

iron(III) carbonate



$Fe_2(CO_3)_3$

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

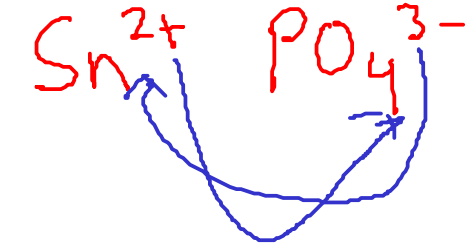
strontium oxide

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

SrO

tin(II) phosphate

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



$Sn_3(PO_4)_2$

chromium(III) nitrate

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

$Cr(NO_3)_3$

barium hydroxide

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

OH^-

$Ba(OH)_2$

~~$BaOH_2$~~

titanium(IV) chloride

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

$TiCl_4$

Be careful with HYDROXIDES and CYANIDES ... to indicate more than one of a polyatomic ion, you NEED parenthesis around the 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-}

copper (II) sulfate pentahydrate

Why "copper(II)"?

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