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.

Chart of common polyatomic ions: See page 63 in the 9th edition, or see the course web site.

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

iron(III) oxide

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

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

O^{2-}

$+6\ \ -6$

CuO

copper(II) oxide

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

$+2\ \ -2$

Cu_2O

copper(I) oxide

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

Cu^{+}

$+2\ \ -2$

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

Page 63 (9th edition): Chart of polyatomic ions

NAMING IONIC COMPOUNDS

$(NH_4)_2S$

ammonium sulfide

$FeCO_3$ Fe^{2+} CO_3^{2-}

iron(II) carbonate +2 −2

TiS_2 Ti^{4+} S^{2-} S^{2-}

titanium(IV) sulfide +4 −4

$Ba_3(PO_4)_2$

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^+ SO_4^{2-}

Na^+

Na_2SO_4

strontium oxide

Sr^{2+} O^{2-}

SrO

tin(II) phosphate

Sn^{2+} PO_4^{3-}

Sn^{2+} PO_4^{3-}

Sn^{2+}

$Sn_3(PO_4)_2$

chromium(III) nitrate

Cr^{3+} NO_3^-

NO_3^-

NO_3^-

$Cr(NO_3)_3$

barium hydroxide

Ba^{2+} OH^-

OH^-

$Ba(OH)_2$

~~$BaOH_2$~~

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

titanium(IV) chloride

Ti^{4+} Cl^-

Cl^-

Cl^-

Cl^-

$TiCl_4$