TRANSITION METAL CATIONS

- So how do you know which cation you're dealing with? For now, you'll have to be told

- Either the chemical formula of an ionic compound or the name of an ionic compound can tell you what charge is on the transition metal cation.

Examples:

Fe_3N_2

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

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

Fe^{2+}

+6 −6

This compound has iron ions with a +2 charge. This form of iron is called "iron(II)" pronounced "iron two"!

FeN

Fe^{3+} N^{3-}

+3 −3

This compound has iron ions with a +3 charge. This form of iron is called "iron(III)" pronounced "iron three"!

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 these formulas!

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

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.

YOU MUST MEMORIZE THE NAMES AND FORMULAS OF THE MOST COMMON POLYATOMIC IONS. CHECK THE COURSE WEB SITE FOR A LIST!

(p132, Gobbins)

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, also see Ebbing/Wentworth p133)

$C_2H_3O_2^{-}$: "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

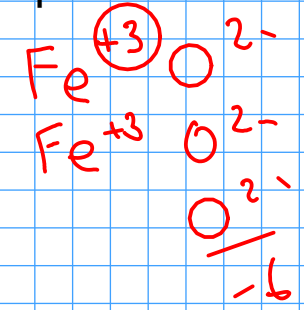
Examples:

$Mg(OH)_2$

magnesium hydroxide

Fe_2O_3

iron(III) oxide

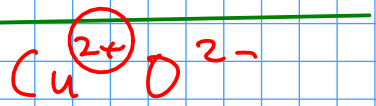


Na_2S

sodium sulfide

CuO

copper(II) oxide

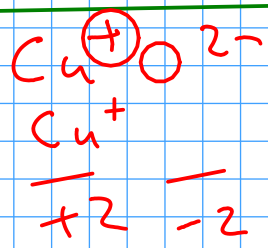


$BeBr_2$

beryllium bromide

Cu_2O

copper(I) oxide



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

NAMING IONIC COMPOUNDS

$(NH_4)_2S$

ammonium sulfide

$FeCO_3$

iron(II) carbonate

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

TiS_2

titanium(IV) sulfide

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

-4

$Ba_3(PO_4)_2$

barium phosphate

$Ca(NO_3)_2$

calcium nitrate

Na_3P

sodium 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^-

$CaBr_2$

p132 - chart

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^-

$Ba(OH)_2$

titanium(IV) chloride

Ti^{4+} Cl^-

Cl^-

Cl^-

Cl^-

$TiCl_4$

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:

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

(The prefixes are also on p135 in the textbook!)

MEMORIZE THE GREEK PREFIXES. SEE COURSE WEB SITE FOR A LIST!

BINARY MOLECULAR COMPOUNDS

Examples:

BF_3 — boron trifluoride

Cl_2O_7 — dichlorine hept(a)oxide

CO — carbon monoxide

CO_2 — carbon dioxide

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carbon tetrachloride

dihydrogen monoxide

dinitrogen tetrafluoride

$MgCl_2$