Nomenclature

A systematic method of writing chemical formulas and naming compounds

Chemical symbols

- Symbols are used to represent elements
- Either one capital letter, or a capital letter with a lower case letter

Chemical formulas

- Formulas are used to represent compounds
- All formulas have more than one symbol
  - Two or more capital letters
- All chemical names have two words
  - No need to capitalize words in name

I. Binary Ionic compounds

- Binary = two elements
- Ionic means cation and anion
- Cations (+ ions) are usually metals
- Anions (- ions) are usually nonmetals
- Therefore:
  - Two elements, one metal and one nonmetal

a) naming them

- Name the metal
- Name the nonmetal, changing the ending to "ide"
- Example: name $MgCl_2$

- Mg = magnesium
- Cl = chlorine, so write "chloride"
- Name is magnesium chloride

Name these…

- NaF — sodium fluoride
- Al_2O_3 — aluminum oxide
- Ca_3P_2 — calcium phosphide
- K_3N — potassium nitride
- BaS — barium sulfide
- SrI_2 — strontium iodide
- Mg_3N_2 — magnesium nitride
- BeI_2 — beryllium iodide

b) Writing formulas

- Notice: subscripts in the name did not effect the naming of these compounds

- The subscripts tell us how many of each element are present in the finished formula

- ***SMALLEST POSSIBLE WHOLE NUMBERS***

  Example: Al_2S_3 means 2 aluminum ions and three sulfurions in one "**formula unit**"

- The subscripts are there to balance charges

  ALL IONIC *COMPOUNDS* ARE <u>NEUTRAL</u>

b) Writing formulas - steps

1) Write the symbol for each **ion**
   - the element *and* its charge
2) Balance the charges
   - The total (+) charge must equal the total (-) charge
   - *criss cross*
   - Don't write "1's"
3) Re-write the formula without any charges

Most likely ionic charge

- 1A = 1+
- 2A = 2+
- 3A = 3+
- 4A = +/- 4
- 5A = 3-
- 6A = 2-
- 7A = 1-

Special case

- Zinc (Zn) is *always* a 2+ ion
- Silver (Ag) is *always* a 1+ ion
- These must be memorized

Write the formula for:

- barium phosphide
- barium is Ba, the charge is 2+ (column 2A)
- phosphide was phosphorus, so P; charge is 3- (column 5A)
- $Ba^{2+}P^{3-}$
- Criss-cross to balance charges (2+ with 3-)
- Ba_3P_2

Write the formula for:

- calcium iodide
- calcium is Ca, the charge is 2+ (column 2A)
- iodide was iodine, so I; charge is 1- (column 7A)
- $Ca^{2+}I^{1-}$
- Criss-cross to balance charges (2+ with -)
- Ca_1I_2
- Re-write as CaI_2

Write the formula for:

- potassium phosphide
- potassium is K, the charge is 1+ (column 1A)
- phosphide was phosphorus, so P; charge is 3- (column 5A)
- $K^{1+}P^{3-}$
- Criss-cross to balance charges (+ with 3-)
- K_3P_1
- Re-write as K_3P

Write the formula for:

- magnesium oxide
- magnesium is Mg, the charge is 2+ (column 2A)
- oxide was oxygen, so O; charge is 2- (column 6A)
- $Mg^{2+}O^{2-}$
- Charges are already balanced (2+ with 2-)
- Re-write as MgO

II. Transition metal ionic nomenclature

- Transition metals form several possible cations
- Example: manganese (Mn) is found as 2+, 3+, 4+, 5+, 6+ and 7+ ion!
- There is no compound just called "manganese oxide" – there are at least four compounds that are different manganese oxides
- Different charges result in *different subscripts*

II. Transition metal ionic nomenclature

- Iron is commonly found as both Fe^{2+} and Fe^{3+}
- Fe^{2+} is called iron(II)
- Fe^{3+} is called iron(III)
- and,…
- Cu^{+} is called copper(I)
- Cu^{2+} is called copper(II), etc…

II. Transition metal ionic nomenclature

- Lead (Pb) and tin (Sn) behave like the transition metals, and therefore follow the same rules
- Pb^{2+} is lead(II)
- Sn^{4+} is tin(IV)
- Zinc and silver DO NOT follow these rules, because zinc is always Zn^{2+} and silver is always Ag^{+}

a) Writing formulas

- Follow the same rules as the other ionic compounds
- Iron(II) oxide is
  - $Fe^{2+}O^{2-}$
  - Charges balance, so formula is FeO
- Iron(III) oxide is
  - $Fe^{3+}O^{2-}$
  - Criss cross to balance charges
  - Fe_2O_3

Write the formula for:

- vanadium(III) oxide
- vanadium is V, the charge is 3+ (roman numeral III)
- oxide was oxygen, so O; charge is 2- (column 6A)
- $V^{3+}O^{2-}$
- Criss cross to balance charges (3+ with 2-)
- Re-write as V_2O_3

Write the formula for:

- Cobalt (II) iodide
- Cobalt is Co, the charge is 2+ (roman numeral II)
- iodide was iodine, so I; charge is 1- (column 7A)
- $Co^{2+}I^{-}$
- Criss cross to balance charges (2+ with 1-)
- Re-write as CoI_2

Write the formula for:

- Lead(IV) sulfide
- lead is Pb, the charge is 4+ (roman numeral IV)
- sulfide was sulfur, so S; charge is 2- (column 6A)
- $Pb^{4+}S^{2-}$
- Criss cross to balance charges (4+ with 2-)
- Re-write as Pb_2S_4
- Reduce subscripts!! PbS_2

b) Writing names

- Same rules as other ionic compounds, except…
- You must write a roman numeral in parentheses after the name of the metal to show what the positive charge on the metal is
- Only do this with transition metals
  - *And* Pb, Sn
  - *But not* Zn, Ag

Name these

- $NiCl_2$
- Ni is nickel, and it is a transition metal
- Cl is chlorine, so write chloride
- nickel(?) chloride
- But, what is the roman numeral?
- Note: uncriss cross subscripts to determine charges
  - $Ni^{2+}Cl^{-}$
- nickel(II) chloride

Name these

- CuS
- Cu is copper, and it is a transition metal
- S is sulfur, so write sulfide
- copper(?) sulfide
- But, what is the roman numeral?
- Note: no subscripts, so charges are balanced
  - S is always 2-, so the copper in this compound must be 2+ !
- copper(II) sulfide

Name these

- Cu_3N
- Cu is copper, and it is a transition metal
- N is nitrogen, so write nitride
- copper(?) nitride
- But, what is the roman numeral?
- Note: subscripts, so charges are <u>not</u> balanced
- copper(I) nitride

Name these

- Co_3P_2
- Co is cobalt, and is a transition metal
- P is phosphorus, so write phosphide
- cobalt(?) phosphide
- But, what is the roman numeral?
- Note: un-crisscross subscripts to determine charges
  - $Co^{2+}P^{3-}$
- cobalt(II) phosphide

Be careful…

- When the charges become subscripts that can be reduced
- Examples:
- 4+/2- SnO_2 is tin(IV) oxide
- 6+/3- CrP_2 is chromium(VI) phosphide
- 6+/2- MnS_3 is manganese(VI) sulfide

Name these

- PbO_2
- Pb is lead, and it behaves like transition metals
- O is oxygen, so write oxide
- lead(?) oxide
- But, what is the roman numeral?
- Note: subscripts show charges are not balanced
- lead(II) oxide, right?
- NO!

Name these

- PbO_2
- Careful - O is oxide – and is always 2-
- So the total (-) charge is 4-!
- So, what is the roman numeral?
- To balance the 4- charge, you need a 4+ charge
- lead(IV) oxide, right?
- YES!

Nomenclature

A systematic method of writing chemical formulas and naming compounds