Nomenclature

(Naming)

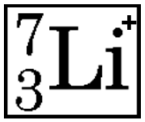
Chemistry 11

Symbols for Atoms, Molecules, and Ions

- Atoms: 

- Remember:
  - the atomic number = # of protons
  - The atomic number = # of electrons in a neutral element
  - # of neutrons = mass # - atomic #

Ion Example:



- How many protons? 3
- How many electrons? 2
- Mass number? 7
- How many neutrons? 4

Ionic Bonding:

- transfer of one or more electrons from a metal to a non-metal to form a cation and an anion that attract each other (electrostatic attraction)
- forms ionic solids (aka. salts)

- **Note**: ALL ionic solids are called salts (not just NaCl)

Types of Ions:

- **Cation**:
  - positive ion (lost electrons)
  - formed by metals (except ammonium)
- **Anion**:
  - negative ion (gained electrons)
  - formed by non-metals

More Types of Ions:

- **Monoatomic**:
  - an ion made up of one atom (mono = one)
    - ex. Cl^-
- **Polyatomic**:
  - an ion made up of more than one atom (poly = many) that acts chemically as one unit
  - Found on the back of the periodic table
    - ex. NO_3^-

Multivalent Elements:

- are elements that can have more than one possible charge
  - many transition metals are multivalent
    - ex. Cu^+ and Cu^{2+}
- Use Roman numerals when naming compounds with these elements

Writing Formulas for Ionic Compounds:

1. The symbol of the metal (cation) is always written first followed by the non-metal (anion)
2. Use subscripts to show the number of each ion present (if there is more than 1)
   - if it is a polyatomic ion the entire polyatomic symbol must be placed in parentheses, with the subscript outside the parentheses

Remember:

- Before combining the elements, you need to know their charges
- The sum of the positive charges and negative charges must equal zero

- Example:
  - Magnesium hydroxide
  - Magnesium = Mg^{2+} Hydroxide = OH^-
  - Formula = $Mg(OH)_2$
  - this formula means you have 2 hydroxide ions for every 1 magnesium ion to end up with a total charge of zero

Writing Names for Ionic Compounds:

- Write the name of the metal (cation) first
- Write the name of the non-metal (anion) second
- The name of the anion needs to end in "ide" unless it is a polyatomic ion (then leave the ending alone)
- If the metal is multivalent you need to include a Roman numeral in parentheses after its name to indicate the charge

- Example:
  - $FeBr_2$
  - Fe^{2+} = iron (multivalent) Br^- = bromide
  - Name = iron(II) bromide

Common Names:

(that don't follow the rules)

- Old way of naming compounds with multivalent ions
- multivalent ions are named according to their Latin names, rather than using Roman numerals
- Name the Latin root for the ion, then change the ending
  - The lower charge ion ends in "ous"
  - The higher charge ion ends in "ic"
- Ex. $FeCl_2$ = ferr**ous** chloride = iron(II) chloride
  $FeCl_3$ = ferr**ic** chloride = iron(III) chloride

Your Turn to Try Some:

Compound	Common Name	Stock Name
$Mg(OH)_2$	----------	
		Iron (III) oxide
$(NH_4)_2SO_4$	----------	
	----------	Sodium hypochlorite
	----------	Calcium fluoride
	Cupric chloride	
$Ca(HCO_3)_2$	----------	
	----------	Potassium oxalate

Your Turn to Try Some:

Compound	Common Name	Stock Name
$Mg(OH)_2$	----------	Magnesium hydroxide
Fe_2O_3	Ferric oxide	Iron (III) oxide
$(NH_4)_2SO_4$	----------	Ammonium sulphate
NaClO	----------	Sodium hypochlorite
CaF_2	----------	Calcium fluoride
$CuCl_2$	Cupric chloride	Copper (II) chloride
$Ca(HCO_3)_2$	----------	Calcium bicarbonate
$K_2C_2O_4$	----------	Potassium oxalate

Writing Dissociation Equations:

- When ionic compounds are put in water, they dissociate (a.k.a. dissolve - split into their ions)
  - Knowing the ions that make up a compound can help you name it!
- An aqueous solution is formed containing the ions that made up the ionic salt
- Example:

$$NaCl_{(s)} \rightarrow Na^+_{(aq)} + Cl^-_{(aq)}$$

Naming Acids:

- How do you know if the compound is an acid?
  - the formula has an "H" at the front
    - One exception we worry about…
      CH_3COOH or $C_2H_4O_2$ = acetic acid
  - the name ends in "acid"
- 3 types of acids to name:
  - binary acids – contain ions ending in "ide"
  - acids containing polyatomic ions ending in "ate"
  - acids containing polyatomic ions ending in "ite"

Naming Binary Acids:

- Hydro_____ic acid

- ex. HCl
- Second ion = Cl^- = Chloride
- Acid name = **hydro**chlor**ic acid**

Naming Acids with Polyatomic Ions Ending in "ate":

- _____ic acid

- ex. HNO_3
- polyatomic ion = NO_3^- = Nitrate
- Acid name = Nitr**ic acid**

Naming Acids with Polyatomic Ions Ending in "ite":

- _____ous acid

- ex. HNO_2
- polyatomic ion = NO_2^- = Nitrite
- Acid name = Nitr**ous acid**

Writing Formulas for Acids:

- The hydrogen always is written first (except in acetic acid – CH_3COOH)
- ex. Hydrochloric acid
  - Hydrochloric = chloride = Cl^-
  - Need 1 H^+ to match up the charges
  - Formula = HCl

Pause!

- **Your assignment:**
  - **Ionic Formulas, Acids and Dissociation Equations Worksheet**

Covalent Bonding:

- sharing of electrons between **non-metal** atoms
- form covalent compounds (aka. molecular compounds)

Greek Prefixes:

- Used in covalent bonding to say how many atoms of each element are present
- You will need to MEMORIZE these prefixes!!!!

Prefix	Meaning
mono	1
di	2
tri	3
tetra	4
penta	5
hexa	6
hepta	7
octa	8
nona	9
deca	10

Writing Formulas for Covalent Compounds:

- Write the symbol of the first element, followed by the subscript corresponding to its prefix
- Repeat for the second element
- Yes, it really is that easy!

- Example:
  - Diphosporous trioxide
  - 2 phosphorous, 3 oxygen
  - P_2O_3

Writing Names for Covalent Compounds:

- Write the name of the first element with the correct prefix before it
  - If the subscript is "1", no prefix is needed
- Write the name of the second element with the correct prefix before it, and change the ending to "ide"
  - Here the mono prefix is used!

- Example:
  - ICl
  - I = iodine (don't put the "mono")
  - Cl = monochloride
  - iodine monochloride

You Try Some:

- S_4N_2
- BrF
- P_2O_6
- Tetraphosphorus trisulphide
- Trisilicon tetranitride
- Oxygen difluoride

You Try Some:

- S_4N_2 - tetrasulphur dinitride
- BrF - bromine monofluoride
- P_2O_6 - diphosphorus hexaoxide
- Tetraphosphorus trisulphide - P_4S_3
- Trisilicon tetranitride - Si_3N_4
- Oxygen difluoride - OF_2

Naming Hydrates:

- **Hydrate**: an ionic salt that has water associated with it (incorporated into the crystal lattice structure)
- Named just like ionic compounds, except…
  - the Greek prefixes are added at the end with the word "hydrate" to show how many water molecules are present
  - A dot is added between the formula of the salt and the formula of the water

- Example #1:
  - iron(III) phosphate octahydrate
  - iron(III) = Fe^{3+} phosphate = PO_4^{3-}
  - octahydrate = $8H_2O$
  - $\therefore$ $FePO_4 \cdot 8H_2O$
- Example #2:
  - $Na_2SO_4 \cdot 10H_2O$
  - Na^+ = sodium SO_4^{2-} = sulphate
  - 10 H_2O = decahydrate
  - $\therefore$ sodium sulphate decahydrate

Counting Atoms

(the easy part)

- How many atoms are in the following compounds?

A. $AgNO_3$

Ag: 1
N: 1
O: 3 = 5 atoms

B. $Pb(SO_4)_2$

Pb: 1
S: 1x2 = 2
O: 4x2 = 8 = 11 atoms

C. $Al(CH_3COO)_3$

Al: 1
C: 2x3 = 6
H: 3x3 = 9
O: 2x3 = 6 = 22 atoms

Your Assignment:

- Mixed naming booklet
  - Parts C+D for tomorrow
  - Parts A+B due the following class
- Watch out for the different types of naming (acids especially!)