AP Chemistry Summer Assignment 2015-2016

What are the skills and knowledge that I need to be competent in for the beginning of this course?

- **Nomenclature**
  - Ionic Compounds
    - Learn the charges of the monoatomic ions and how to assign charges based on location on the periodic table
    - Learn the list of polyatomic ions
    - Name ionic compounds from formulas
    - Write chemical formulas from names
  - Covalent (Molecular) Compounds
    - Learn the diatomic and polyatomic elements
  - Acidic Compounds
- **Reactions**
  - Predict the products of a reaction if given the names of the reactants
  - Balance the complete equation
  - Learn the solubility rules
  - Use solubility rules to identify the solid precipitates from double displacement reactions
- **Molar Quantities**
  - Calculate molar mass of an element and compound
  - Use mole conversions to convert between grams, moles, particles, and volume of a gas at STP of a single compound
  - Use mole conversions and mole ratio to convert between grams, moles, particles, and volume of a gas at STP for compounds within a balanced equation

Here are the quizzes you will take when you come back to school

- 2nd Day of Class (Tuesday August 4th)→ **Writing Chemical formulas Quiz** → You will be given a series of chemical names (may include polyatomics) and asked to write their formulas (you will not be allowed to use any notes or your polyatomic ion sheet)
- 4th Day of Class (Thursday August 6th)→ **Predicting, balancing, and identifying the precipitate of double replacement reactions Quiz** → you will be given a series of word and symbolic equations and will need to predict the products, balance the equation, and identify the precipitate using the solubility rules (you will not be allowed to use any notes or the solubility rules, you must know them)
- 6th Day of Class (Monday August 10th)→ **Molar Quantities Quiz** → you will be expected to calculate molar mass, perform mole conversions, and stoichiometry calculations for given problems

How do I go about reminding myself of how to do these things?

- Visit Mrs. Portwood's classroom website http://bit.ly/1zOnPQf .
  - Look on the left hand side of the page for Summer Assignment under AP Chemistry. There will be a variety of resources posted here including podcasts, links to tutorials, etc for each portion of the summer assignment.
- Visit YouTube
  - Mrs. Portwood has a channel: MrsPortwoodsClass , there are lots of podcasts here.
  - Crash Course Chemistry has lots of chemistry tutorial videos http://bit.ly/Xw1ODt
  - That Chem Guy also has lots of tutorials http://bit.ly/1EYjdGs
- Khan Academy has lots of videos too
- Chem Tutor has a collection of resources and tutorials http://www.chemtutor.com/
- Email Mrs. Portwood @ LPortwood@paulding.k12.ga.us or lyricshea97@bellsouth.net with questions

I. Nomenclature (Quiz 1)

There are three classifications of compounds/molecules that you must be able to name and determine the formula for in this class. Each type of compound requires you name them according to different sets of rules. Therefore you must be able to tell them apart.

Ionic	Covalent	Acidic
• Metal and nonmetal • Can but does not have to have a polyatomic ion in it	• Two or more nonmetals	• Special kind of ionic compound where hydrogen (H) is always the cation (first element in compound)

* A periodic table that is color-coded according to Metals and Nonmetals can be found here. http://bit.ly/1IoMoXf

a. Ionic Compounds

i. Learn the charges of the monoatomic ions and how to assign charges based on location on the periodic table

1. Remember the rhyme. 1 plus, 2 plus, 3 plus, skip, 3 minus, 2 minus, 1 minus, zip
2. A periodic table example can be found here. http://bit.ly/1zOvMFd

ii. Learn the list of polyatomic ions

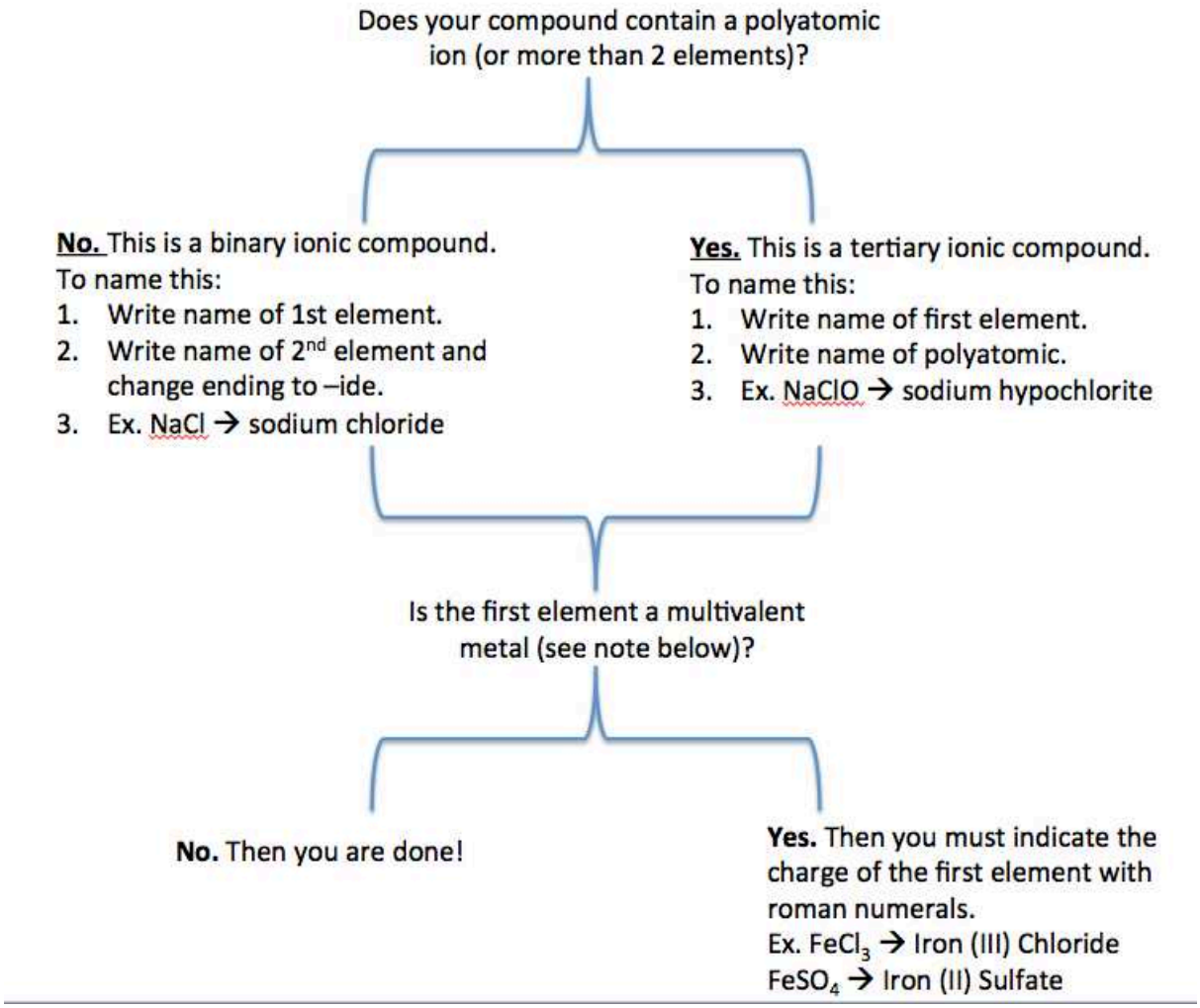
The following polyatomics follow a pattern based on their number of oxygen atoms

Greatest number of oxygen atoms; **Per---ate**	1 less oxygen atom; **---ate**	2 less oxygen atoms; **---ite**	3 less oxygen atoms; **Hypo---ite**
Perchlor**ate** ClO_4^{1-}	Chlor**ate** ClO_3^{1-}	Chlor**ite** ClO_2^{1-}	**Hypo**chlor**ite** ClO^{1-}
Period**ate** IO_4^{1-}	Iod**ate** IO_3^{1-}	Iod**ite** IO_2^{1-}	**Hypo**iod**ite** IO^{1-}
Perbrom**ate** BrO_4^{1-}	Brom**ate** NO_3^{1-}	Brom**ite** BrO_2^{1-}	**Hypo**brom**ite** BrO^{1-}
	Nitr**ate** NO_3^{1-}	Nitr**ite** NO_2^{1-}	
	Sulf**ate** SO_4^{2-}	Sulf**ite** SO_3^{1-}	
	Bisulf**ate** HSO_4^{1-}	Bisulf**ite** HSO_3^{1-}	
	Phosph**ate** PO_4^{3-}	Phosph**ite** PO_3^{3-}	
	Carbon**ate** CO_3^{2-}		
	Chrom**ate** CrO_4^{2-}		
	Thiosulf**ate** $S_2O_3^{2-}$		
	Silicate SiO_3^{2-}		

These are other polyatomic ions you need to know

1+	1-	2-
Ammonium NH_4^{1+}	Bicarbonate HCO_3^{1-}	Dichromate $Cr_2O_7^{2-}$
Hydronium H_3O^{1+}	Acetate $C_2H_3O_2^{1-}$	Thiocyanate $S_2O_3^{2-}$
	Cyanide CN^{1-}	Peroxide O_2^{2-}
	Permanganate MnO_4^{1-}	Oxalate $C_2O_4^{2-}$
	Hydroxide OH^{1-}	

iii. Name ionic compounds from formulas



** Multivalent ions are found in the middle portion and skip (carbon) column of the periodic table. Note that there are two elements that are in the middle of the table that do not require a roman numeral because they are always the same charge: silver, Ag^{1+} and Zinc Zn^{2+}*

***When encountering positive polyatomic ions hydronium and ammonium, name these polyatomics then use binary rules if anion (negative ion) is just an element and tertiary rules if anion is a polyatomic*

iv. Write chemical formulas from names

1. Use must use the swap and drop method. Write positive ion first then negative ion.
2. Assign charges for cation and anion.
3. Swap and drop charges so that they become subscripts. Cancel charges that are opposite in charge but equivalent in value.

b. Covalent (Molecular) Compounds

i. Learn the diatomic and polyatomic elements

Diatomic element	Polyatomic element
H_2	S_8
N_2	O_3 (ozone)
O_2	P_4
F_2	
Cl_2	
Br_2	
I_2	

ii. Name covalent molecules

1. Use prefixes below to indicate the number of each element (exception → never use mono- on first element).
2. Change ending of last element to –ide.

Ex. CO_2 → carbon dioxide

H_2O → dihydrogen monoxide

c. Acidic Compounds

Binary Acids (no oxygen)

- Prefix is **Hydro-**
- Suffix is **-ic**
- Stem: derived from element that combines with hydrogen:

Ex. HBr → hydrobromic acid

H_2S → hydrosulfuric acid

HF → hydrofluoric acid

Tertiary Acids (contains oxygen)

- Name is determined by the polyatomic anion:
- ***-ate endings change to –ic, -ite endings change to –ous.***

Ex. HClO → hypochlorous acid

$HClO_4$ → perchloric acid

HIO_3 → iodic acid

H_2SO_3 → sulfurous acid

Practice for Quiz 1

1. Name these compounds.

a) IF_7
b) N_2O_5
c) XeF_2
d) $NaOH$
e) N_2O_4
f) As_4O_{10}
g) SF_6
h) H_3PO_4
i) PCl_3
j) S_2Cl_2
k) $LiMnO_4$
l) $AlCl_3$
m) MgO
n) BaI_2
o) $CuCr_2O_7$
p) KI
q) $SrBr_2$
r) Na_2S
s) H_2CrO_4
t) CaF_2
u) $CuCl_2$
v) Fe_2O_3
w) SnO
x) $PbCl_4$
y) Cu_2S
z) HgS
aa) AuI_3
bb) CoP
cc) NI_3
dd) $Fe(NO_3)_3$
ee) Cu_2SO_4
ff) $Ca(ClO_3)_2$
gg) KNO_2
hh) $NaHCO_3$
ii) NH_4NO_2
jj) $Cu_2Cr_2O_7$
kk) HCl
ll) HI
mm) $HClO_4$
nn) H_2SO_4
oo) $HC_2H_3O_2$
pp) HNO_2
qq) $H_2C_2O_4$
rr) CO
ss) NH_4CN
tt) HIO_3
uu) Al_2O_3
vv) AlP
ww) OF_2
xx) $HClO$
yy) HF
zz) SO_2 K_2O
aaa) H_2CO_3
bbb) FeF_3
ccc) $KC_2H_3O_2$
ddd) MnS

2. Write the formulas.

a) Tin (IV) phosphide
b) copper (II) cyanide
c) Magnesium hydroxide
d) sodium peroxide
e) Sulfurous acid
f) lithium silicate
g) Potassium nitride
h) chromium (III) carbonate
i) Gallium arsenide
j) cobalt (II) chromate
k) Zinc fluoride
l) dichromic acid
m) Barium sulfate
n) Ammonium chloride
o) Chlorine monoxide
p) Silicone tetrachloride
q) Magnesium fluoride
r) Sodium oxide
s) Sodium peroxide
t) Copper (I) iodide
u) Zinc sulfide
v) Potassium carbonate
w) Hydrobromic acid
x) Perbromic acid
y) Lead (II) acetate
z) Sodium permanganate
aa) Lithium oxalate
bb) Potassium cyanide
cc) Iron (III) hydroxide

II. Reactions (Quiz 2)

a. Predict the products of a reaction if given the names of the reactants
   1. Switch the fronts of both compounds in a double replacement reaction.
   2. Then you will need to assign charges to the cations and anions in the new compounds just made.
   3. Swap and drop these charges to subscripts to get the new formulas

b. Balance the complete equation
   Everyone should keep in practice when it comes to balancing equations. If you don't see coefficients in front of compounds you should check the balancing. Here are two web sites that will help you practice.
   - http://science.widener.edu/svb/tutorial/rxnbalancingcsn7.html
   - http://www.chemistry-drills.com/balance.html
   - A lower level site for practice is http://funbasedlearning.com/chemistry/chemBalancer/default.htm

c. Learn the solubility rules
   These rules are not all inclusive. Rather they provide you with enough info to determine solubility of most compounds. You can look up specifics if you run into a situation with a different anion that is not covered in these rules.

Solubility Rules

1. All compounds containing alkali metal cations and the ammonium ion are soluble.
2. All compounds containing NO_3^-, ClO_4^-, ClO_3^-, and $C_2H_3O_2^-$ anions are soluble.
3. All chlorides, bromides, and iodides are soluble except those containing Ag^+, Pb^{2+}, or Hg^{2+}.
4. All sulfates are soluble except those containing Hg^{2+}. Pb^{2+}, Sr^{2+}, Ca^{2+}, or Ba^{2+}.
5. All hydroxides are insoluble except those compounds of the alkali metals, Ca^{2+}, Sr^{2+}, and Ba^{2+}.
6. All compounds containing PO_4^{3-}, S^{2-}, CO_3^{2-}, and SO_3^{2-} ions are insoluble except those that contain alkali metals or NH_4^+.

*Soluble = dissolves in water, (aq)
**Insoluble = does not dissolve in water, (s), precipitate

d. Use solubility rules to identify the solid precipitates from double displacement reactions.
   Ex. If 10.0ml of 0.20M Calcium nitrate is combined with 10.0ml of 0.20M aluminum hydroxide, what precipitate forms?
   $3Ca(NO_3)_2 + 2Al(OH)_3 \rightarrow \underline{3Ca(OH)_2\ (s)} + 2Al(NO_3)_3$,calcium hydroxide is the precipitate formed

Practice for Quiz 2

I. Using the solubility rules, identify each of the following compounds as soluble (S) or insoluble (I) in water. You must memorize the solubility rules given in this packet.

a) Na_2CO_3
b) $CoCO_3$
c) $Pb(NO_3)_2$
d) K_2S
e) $BaSO_4$
f) $(NH4)_2S$
g) AgI
h) $Ni(NO_3)_2$
i) KI
j) FeS
k) $PbCl_2$
l) $CuSO_4$
m) Li_2O
n) $Mn(C_2H_3O_2)_2$
o) $Cr(OH)_3$
p) $AgClO_3$
q) $Sn(SO_3)_4$
r) FeF_2

II. Balance the following equations with the lowest whole number coefficients.

a) ____S_8 + ____ → O_2 ____ SO_3
b) ____$C_{10}H_{16}$ + ____ Cl_2 → ____ C + ____ HCl
c) ____Fe + ____ O_2 → ____ Fe_2O_3
d) ____$C_7H_6O_2$ + ____ O_2 → ____CO_2 + ____ H_2O
e) ____$KClO_3$ → ____ KCl + ____ O_2
f) ____H_3AsO_4 →____As_2O_5 + ____ H_2O
g) ____V_2O_5 + ____ HCl → ____$VOCl_3$ + ____ H_2O
h) ____$Hg(OH)_2$ + ____ H_3PO_4 → ____ $Hg_3(PO_4)_2$ + ____ H_2O

III. Predict the products of each double replacement reaction. Reactants are described for each reaction. TIP: put in the states of matter for all compounds this will reduce the chances of mistakes ie:
aqueous = (aq) solid = (s) liquid = (l) gas = (g)

a) Aqueous solutions of potassium iodide and silver nitrate are mixed
b) An aqueous solution of ammonium phosphate is added to a solution of sodium sulfate..
c) Aqueous solutions of aluminum chloride and sodium hydroxide are mixed.
d) Aqueous solutions of lithium sulfate and calcium nitrate are added together.
e) Aqueous solutions sodium carbonate and manganese (V) chloride are mixed.
f) Lithium chromate solution is added to barium chloride
g) Rubidium iodide solution is mixed with silver nitrate solution.
h) 0.10M of aqueous sodium phosphate is added to 0.10M of Manganese (II) chloride

IV. Write out the balanced chemical equation for each of the following double replacement reactions. Predict whether each of these double replacement reactions will give a precipitate or not based on the solubility of the products. If yes, identify the precipitate.

a) silver nitrate and potassium chloride
b) magnesium nitrate and sodium carbonate
c) strontium bromide and potassium sulfate
d) cobalt (III) bromide and potassium sulfide
e) ammonium hydroxide and copper (II) acetate
f) lithium chlorate and chromium (III) fluoride

II. Molar Quantities (Quiz 3)

a. Calculate molar mass of an element and compound

Chemistry happens in moles and the easiest way to solve problems is using moles. Since we can't directly measure the number of moles we need to take something we can measure, mass, and turn that into moles. This makes calculating molar mass (the mass in grams of a substance which contains one mole of that substance) an important first step in many problems.

All year long we will use the official AP Chemistry Periodic Table for this. A copy of the official Periodic Table is included as a separate file for download and printing.

Use the complete atomic mass from the periodic table.

Example 1: NH_3

NH_3 is (1 x N) + (3 x H) = molar mass

(1 x 14.01) + (3 x 1.008) = 17.034 which rounds to 17.03 g/mol of NH_3

Example 2: $Ca(NO_3)_2$

$Ca(NO_3)_2$ is (1 x Ca) + (2 x N) + (6 x O) = molar mass

(1 x 40.08) + (2 x 14.01) + (6 x 16.00) = 164.1 which becomes 164.10 g/mol of $Ca(NO_3)_2$

b. Use mole conversions to convert between grams, moles, particles, and volume of a gas at STP of a single compound

The mole is a number of things (6.02×10^{23}) just as a dozen is a number of things (12). Because of certain relationships we can set the mole equal to three different things:

- (6.02×10^{23}) atoms or molecules = 1 mole
- 22.4L of any gas at STP = 1 mole
- the atomic mass or molar mass in grams = 1 mole

Since all three of these quantities equal one mole we can easily convert between them. The steps always go through the mole so you can think of it as being at the center of the conversions.

Examples:

What volume does 15.0g of H_2 gas occupy at STP?

$$15.0\,g \times \frac{1\,mol}{2.01\,g} \times \frac{22.4\,L}{1\,mol} = 167\,L$$

How many molecules are in 55.0L of CO_2 at STP?

$$55.0\,L \times \frac{1\,mol}{22.4\,L} \times \frac{6.02 \times 10^{23}}{1\,mol} = 1.48 \times 10^{24}\,molecules$$

c. Use mole conversions and mole ratio to convert between grams, moles, particles, and volume of a gas at STP for compounds within a balanced equation

These problems add an additional step of using mole ratios from the balanced equations to convert between different compounds.

Practice for Quiz 3

I. Calculate the molar mass for each of the following:

a) $FeSO_4$ b) $Cu(NO_3)_2$ c) Hg_2Cl_2 d) $AgBr$ e) $KClO_3$ f) $MgCO_3$ g) BaO_2 h) KO_2

i) SnO_2 j) $Pb(OH)_2$ k) $Ni_3(PO_4)_2$ l) $CuC_2H_3O_2$ m) N_2O_4 n) Rb_3P o) S_8 p) $(NH_4)_2SO_3$

q) Without doing any detailed calculations (but using the periodic table), rank the following samples in order of increasing number of atoms: 0.50 mol H_2O, 23 g Na, 6.0×10^{23} N_2 molecules

II. Complete the following mole conversions

a) How many grams of N_2 gas are in 145 L at STP?
b) What is the mass of 4.76×10^{22} molecules of H_2O?
c) How many atoms are in 35.5 L of neon at STP?
d) What is the volume of 100.0 grams of Cl_2 at STP?
e) How many molecules of glucose, $C_6H_{12}O_6$, are in 55.8 grams?
f) How many grams of O_2 gas are in 34.5L at STP?
g) What is the mass of 6.16×10^{25} molecules of H_2S?
h) How many atoms are in 845 mL of neon at STP?
i) What is the volume of 40.0 grams of F_2 at STP?
j) How many molecules of potassium chloride, KCl , are in 85.5 grams?
k) The molecular formula of allicin, the compound responsible for the characteristic smell of garlic is $C_6H_{10}OS_2$. How many S atoms are present in 5.00mg of allicin?
l) A sample of glucose, $C_6H_{12}O_6$, contains 1.250×10^{21} carbon atoms. How many atoms of hydrogen does it contain?

III. Use stoichiometry to solve the following problems

1. Hydrofluoric acid, HF (aq), cannot be stored in glass bottles because compounds called silicates in the glass are attacked by the HF(aq). Sodium silicate (Na_2SiO_3), for example, reacts as follows:

$$Na_2SiO_3(s) + 8HF(aq) \rightarrow H_2SiF_6\ (aq) + 2NaF(aq) + 3H_2O(l)$$

a) How many moles of HF are needed to react with 0.300 mol of Na_2SiO_3?

b) How many grams of NaF form when 0.500 mol of HF reacts with excess Na_2SiO_3?

c) How many grams of Na_2SiO_3 can react with 0.800 g of HF?

2. Several brands of antacids use Aluminum hydroxide to react with stomach acid, which contains primarily hydrochloric acid (HCl):

$$Al(OH)_3\ (s) + 3HCl\ (aq) \rightarrow AlCl_3(aq) + 3H_2O(l)$$

a) Calculate the number of grams of HCl that can react with 0.500 g of Aluminum hydroxide

b) Calculate the number of grams of $AlCl_3$ and the number of grams of H_2O formed when 0.500 g of $Al(OH)_3$ reacts.

c) Show that your calculations in parts (b) and (c) are consistent with the law of conservation of mass. (total mass of reactants = total mass of products)

3. Aluminum sulfide reacts with water to form aluminum hydroxide and hydrogen sulfide. How many grams of aluminum hydroxide are obtained from 14.2 g of aluminum sulfide?

$$Al_2S_3\ (s) + 6H_2O\ (l) \rightarrow 2Al(OH)_3\ (s) + 3H_2S\ (g)$$

4. Automotive air bags inflate when sodium azide, NaN_3, rapidly decomposes into its elements.

$$3NaN_3 \rightarrow 4N_2 + Na_3N$$

a) How many moles of nitrogen gas (remember, it is diatomic molecule) are produced by the decomposition of 1.50 mol of sodium azide?

b) How many grams of sodium azide are required to form 10.0 g of nitrogen gas?

c) How many grams of sodium azide are required to produce 10.0 ft^3 of nitrogen gas, about the size of an automotive air bag, if the gas has a density of 1.25 g/L? (1 ft^3 = 0.0283 m^3)

5. A piece of aluminum foil 1.00 cm square and 0.550 mm thick is allowed to react with bromine to form aluminum bromide.

$$4Al + 3Br_2 \rightarrow 2AlBr_3$$

a) How many moles of aluminum were used? (Density of Al = 2.699 g/cm^3)

b) How many grams of aluminum bromide form, assuming the aluminum reacts completely?