Welcome to AP Chemistry 2021-2022

According to the College Board, "The AP Chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first college year. The college course in general chemistry differs qualitatively from the usual first secondary school course in chemistry with respect to the kind of textbook used, the topics covered, the emphasis on chemical calculations and the mathematical formulation of principles, and the kind of laboratory work done by students. Quantitative differences appear in the number of topics treated, the time spent on the course by students, and the nature and the variety of experiments done in the laboratory. Students in an AP Chemistry course should spend at least five hours a week in individual study outside of the classroom."

I am excited that you have accepted the challenge that an AP Chemistry course has to offer. To ensure that all students in the AP Chemistry class are ready to partake in this high-pace, rigorous journey on the first day of school, the following summer assignment must be completed. The purposes of the assignment are to revisit chemical concepts learned in your 1st year chemistry class and expose you to the level of rigor demanded by the AP curriculum. This will allow us to focus our attention on the advanced chemistry topics that will be tested on the AP exam on Friday May 13, 2022.

Your summer assignment consists of the following:

1. Read Chapters 1 – 4 of your text and complete the Practice Questions (Parts I-VIII) on the following pages. These problems, worked out in their entirety, are **due the first full day of classes.**
2. Memorize the polyatomic ions and solubility rules listed.

Please take the assignment seriously and start in early August or sooner — there's a lot to do and you won't be able to complete it all the night before! If at any time you would like to ask me a question, please email me at boconnell@achs.net.

I look forward to a great year,

Mrs. O'Connell

All work must be shown for calculations in order to receive credit for the problem.

I. Chemical Quantities

1. How many **significant figures** are in each of the following?
    a) 1.9200 mm
    b) 0.0301001 kJ
    c) 6.022×10^{23} atoms
    d) 460.000 L
    e) 0.000036 cm^3
    f) 10000
    g) 3002
    h) 0.001345
    i) 0.0101
    j) 3.21×10^{-2}

2. Record the following in correct **scientific notation**:
    a) 4050,000,000 cal
    b) 0.000123 mol
    c) 0.00345 grams
    d) 700,000,000 atoms

3. Calculate the following to the **correct number of significant figures**.
    a) 1.270 g / 5.296 cm^3
    b) 12.235 g / 1.010 L
    c) 12 g + 0.38 g
    d) 170g – 27.85 g
    e) 2.1 x 3.2102
    f) 200.1 x 120
    g) 17.6 + 2.838 + 2.3 + 200

II. Atomic Structure and Periodicity

1. Draw and label the Electromagnetic Spectrum.
2. Briefly discuss the contributions made by the following scientists to our understanding of the atom:
    a) JJ Thompson
    b) Ernest Rutherford
    c) Robert Millikan
    d) James Chadwick
    e) Niels Bohr
    f) Erwin Schrödinger
3. Assume silicon has three major isotopes in nature as show in the table below. Calculate and fill in the missing information.

Isotope	Mass (amu)	Abundance
Si-28	27.98	
Si-29		4.70%
Si-32	29.97	3.09%

4. Calculate the average atomic masses of lithium, which occurs as 2 isotopes that have the following atomic masses and abundances in nature: 6.017 amu, 7.30%, 7.018 amu, 92.70%.
5. Write the expected ground-state electron configuration for the following:
    a) the element with one unpaired 5p electron that forms a covalent with compound fluorine
    b) the first-row transition metal with the most unpaired electrons
    c) the metalloid in period 3
    d) the halogen in period 5
    e) the element with atomic number 47
    f) the sodium ion
6. Answer the following questions based on the given electron configuration and identify the elements.
    a) Arrange these atoms in order of increasing size:

$$[Kr]5s^2 4d^{10} 5p^5;\ [Kr]5s^2 4d^{10} 5p^1;\ [Kr]5s^2 4d^{10} 5p^3$$

    b) Arrange these atoms in order of decreasing first ionization energy:

$$[Ne]3s^2 3p^5;\ [Ar]4s^2 3d^{10} 4p^3;\ [Ar]4s^2 3d^{10} 4p^5$$

III. Nomenclature

1. Name each of the following compounds and state whether they are ionic or covalent:
    a) CuI_____
    b) CuI_2_____
    c) CoI_2_____
    d) $NaHCO_3$_____
    e) S_4N_4_____
    f) SF_6_____
    g) $NaOCl$_____
    h) $BaCrO_4$_____

2. Write formulas for each of the following compounds and state whether they are ionic or covalent:
    a) potassium cyanide_____
    b) copper (II) nitrate_____
    c) selenium tetrabromide_____
    d) iodous acid_____
    e) lead (IV) sulfide_____
    f) copper (I) chloride_____
    g) gallium arsenide_____
    h) cadmium selenide_____

3. Each of the following compounds is incorrectly named. What is wrong with each name and what is the correct name for each compound?
    a) $FeCl_3$, iron chloride_____
    b) NO_2, nitrogen (IV) oxide_____
    c) CaO, calcium (II) monoxide _____
    d) Al_2S_3, dialuminium trisulfide _____
    e) $Mg(C_2H_3O_2)_2$, manganese diacetate _____
    f) $FePO_4$, iron (II) phosphide _____
    g) P_2S_5, phosphorous sulfide _____
    h) Na_2O_2, sodium oxide _____
    i) HNO_3, nitrate acid _____
    j) H_2S, sulfuric acid _____

IV. Chemical Equations

For each equation below:

- Identify the type (synthesis, decomposition, single replacement, metathesis/double replacement, or combustion)
- Predict the products, then write the balanced equation and net ionic equation where necessary
- Remember to use the solubility rules for double replacement reactions and the activity series for single replacement reactions. Reminder: when writing these reactions, ignore all of the information about excess, or bubbling, or mixing. These are just excess words used to make complete sentences. Simply pull out the chemical formulas.
- For example: Solutions of silver nitrate and magnesium iodide are combined. This is a double replacement reaction.

$$2AgNO_3(aq) + MgI_2(aq) \rightarrow 2AgI(s) + Mg(NO_3)_2(aq)$$

$$2Ag^+(aq) + 2I^-(aq) \rightarrow 2AgI(s)$$

1. Ammonium sulfate reacts with barium nitrate.
2. Zinc metal is added to a solution of copper (II) chloride.
3. Propane gas (C_3H_8) is burned in excess oxygen.
4. Solid calcium chlorate is heated strongly.
5. Magnesium and nitrogen gas are heated together.
6. Chlorine gas is bubbled through a solution of sodium bromide.
7. Sodium metal is added to distilled water.
8. Sulfuric acid is combined with sodium hydroxide.
9. Solid sodium carbonate is heated in a crucible.

V. The Mole

1. How many molecules of propane (C_3H_8) are present in 0.334 grams of propane?
2. How many moles of copper atoms are there in 6.50×10^7 copper atoms?
3. How many formula units of calcium chloride are in 77.4 grams of calcium chloride?
4. How many atoms are present in 8.14 grams of aluminum?
5. How many moles are in 45.5 liters of carbon dioxide?

VI. Percent Composition Empirical and Molecular Formulas

1. Calculate the percentage by mass of the following compounds:
    a) SO_3
    b) CH_3COOCH_3
    c) Ammonium Nitrate.
2. Determine the empirical formula of the compounds with the following compositions by mass:
    a) 10. 4 % C, 27. 8% S, 61. 7 % Cl
    b) 21.7 % C, 9.6 % O, and 68.7 % F
3. The empirical formula of a compound is CH. If the molar mass of this compound is about 78.0 grams, what is the molecular formula?

VII. Stoichiometry

Using the following equation, answer the following questions:

$C_3H_8 + O_2 \rightarrow CO_2 + H_20$

(Balance the equation)

1. How many moles of oxygen are necessary to react completely with 6.00 moles of propane (C_3H_8)?
2. How many grams of water will be produced if you started with 15.0 liters of propane?
3. How many grams of CO_2 will be produced if you start with 75.0 grams of C_3H_8?

VIII. Limiting Reactant

At high temperatures, sulfur combines with iron to form iron (II) sulfide. In an experiment, 7.60 g of iron are allowed to react with 8.59 grams of sulfur.

Fe (s) + S (I) → FeS (s)

1. What is the limiting reactant, and what is the reactant in excess?
2. Calculate the mass of FeS formed.

Table of Common Polyatomic Ions			
Ion Formula	**Name**	**Ion Formula**	**Name**
Hg_2^{2+}	Mercury(I)	SCN^{-1}	Thiocyanate
NH_4^{+1}	Ammonium	CO_3^{2-}	Carbonate
$C_2H_3O_2^{-1}$ or CH_3COO^{-1}	Acetate	CrO_4^{2-}	Chromate
CN^{-1}	Cyanide	$Cr_2O_7^{2-}$	Dichromate
$H_2PO_4^{-1}$	Dihydrogen Phosphate	HPO_4^{2-}	Hydrogen Phosphate
OH^{-1}	Hydroxide	$C_2O_4^{2-}$	Oxalate
HCO_3^{-1}	Hydrogen Carbonate	O_2^{2-}	Peroxide
NO_3^{-1}	Nitrate	SO_3^{2-}	Sulfite
NO_2^{-1}	Nitrite	SO_4^{2-}	Sulfate###
ClO^{-1} or OCl^{-1}	Hypochlorite	$S_2O_3^{2-}$	Thiosulfate
ClO_2^{-1}	Chlorite	PO_3^{3-}	Phosphite
ClO_3^{-1}	Chlorate***	PO_4^{3-}	Phosphate
ClO_4^{-1}	Perchlorate		
MnO_4^{-1}	Permanganate		

SOLUBILITY RULES

1. All common compounds of Group I (Alkali metals) and ammonium ions are soluble.
2. All nitrates, acetates, and chlorates are soluble.
3. All binary compounds of the halogens (Other than F) with metals are soluble, except those of Ag, Hg(I), and Pb. (Pb halides are soluble in hot water.)
4. All sulfates are soluble, except those of barium, strontium, calcium, lead, silver, and mercury (I). The latter three are slightly soluble.
5. Except for rule 1, carbonates, hydroxides, oxides, silicates, and phosphates are insoluble.
6. Sulfides are insoluble except for calcium, barium, strontium, magnesium, sodium, potassium, and ammonium.