Name:

AP Chemistry - Summer Packet

Teacher: **Dr. Moore** dmoore@rutherfordschools.org

Directions:

Please complete the following packet before the first day of class in September.

This packet will be collected and graded, and the material will be covered on the first test.

The first test of the year will be within the first 2 weeks of school.

This summer packet is split into 2 sections: Part 1: Memorization/Content Review & Part 2: Review Problems

Part 1: Memorization/Content Review: *You are to memorize/review the following topics:*

- ⇒ Common ions and Polyatomic ions
- ⇒ Rules for naming covalent compounds
- ⇒ Rules for naming ionic compounds
- ⇒ Rules for naming acids
- ⇒ Rules for determining oxidation numbers
- ⇒ Solubility rules

Part 2: Review Problems: *A series of worksheets on the following topics:*

Worksheet #1: Significant Figures and Dimensional Analysis

Worksheet #2: Structure of the Atom and the Periodic Table

Worksheet #3: Naming Inorganic Compounds

Worksheet #4: Writing Equations for Chemical Reactions

Worksheet #5: The Mole

Worksheet #6: Empirical and Molecular Formulas

Worksheet #7: Stoichiometry Problems

Worksheet #8: Limiting Reactants and Theoretical Yield

Worksheet #9: Molarity

Worksheet #10: Solubility Rules

Have a great summer, and I'll see you in September!

PERIODIC TABLE OF THE ELEMENTS

1												13	14	15	16	17	18
1 **H** 1.008	2																2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30	3	4	5	6	7	8	9	10	11	12	13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc**	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57-71 *	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po**	85 **At**	86 **Rn**
87 **Fr**	88 **Ra**	89-103 †	104 **Rf**	105 **Db**	106 **Sg**	107 **Bh**	108 **Hs**	109 **Mt**	110 **Ds**	111 **Rg**	112 **Cn**	113 **Nh**	114 **Fl**	115 **Mc**	116 **Lv**	117 **Ts**	118 **Og**

*Lanthanoids	57 **La** 138.91	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm**	62 **Sm** 150.36	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97
†Actinoids	89 **Ac**	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**

Part1: Memorization/Content Review

Polyatomic Ion List:

Make flashcards, take the lists with you on vacation, or do whatever it takes to get this information firmly planted.

-1	-2	-3
$Acetate\ CH_3COO^-$	$Carbonate\ CO_3^{2-}$	$Phosphite\ PO_3^{3-}$
$Hydroxide\ OH^-$	$Peroxide\ O_2^{2-}$	$Phosphate\ PO_4^{3-}$
$Bicarbonate\ HCO_3^-$	$Sulfite\ SO_3^{2-}$	$Arsenide\ As^{3-}$
$Nitrite\ NO_2^-$	$Sulfate\ SO_4^{2-}$	
$Nitrate\ NO_3^-$	$Chromate\ CrO_4^{2-}$	
$Chlorite\ ClO_2^-$	$Dichromate\ Cr_2O_7^{2-}$	
$Chlorate\ ClO_3^-$	$Oxalate\ C_2O_4^{2-}$	
$Perchlorate\ ClO_4^-$	$Silicate\ SiO_3^{2-}$	$+1$
$Cyanide\ CN^-$	$Thiosulfate\ S_2O_3^{2-}$	$Ammonium\ NH_4^+$
$Thiocyanate\ SCN^-$		
$Hypochlorite\ OCl^-$		
$Iodate\ IO_3^-$		
$Permanganate\ MnO_4^-$		

Rules for Naming Covalent Compounds:

⇒ For a diatomic molecule (1 element only): $Br_2,\ I_2,\ N_2,\ Cl_2,\ H_2,\ O_2,\ F_2$

These simply become "gases," meaning: Bromine gas, Iodine gas…etc.

⇒ For a Covalent Binary (Nonmetal / Nonmetal) use the list of prefixes to the right →

1. Name the first element by adding the appropriate prefixes EXCEPT "mono-"
2. Name the second prefixes (including mono)
3. Change the ending of the second element to "-ide"

Examples:

P_2O_5 = diphosphorous pentoxide

C_2Cl_4 = dicarbon tetrachloride

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

Rules for Naming Covalent Compounds:

Examples: NaCl = sodium chloride, BaF_2 = barium fluoride, CuO = copper (II) oxide

1. The full name of the cation is listed first. (A cation is a positive ion).
2. The root of the anion name is listed second and is followed by the suffix "ide."(An anion is a negative ion).
3. If the compound contains a transition metal, a Roman numeral is included after the cation name to indicate the oxidation number of the metal.
4. Remember that the cation(s) and anion(s) combine in the simplest ratio that balances the charge. That is, the sum of the charge must be equal to zero in the compound formed.

Rules for Naming Ionic Compounds Containing Polyatomic Ions

Examples: $CaCO_3$ = calcium carbonate, $Fe(OH)_3$ = iron (III) hydroxide, $(NH_4)_2SO_4$ = ammonium sulfate

1. The full name of the cation is listed first.
2. The full name of the anion is listed second.
3. Use the table below for common polyatomic ions
4. Remember that the cation(s) and anion(s) combine in the simplest ratio that balances the charge. That is, the sum of the charge must be equal to zero in the compound formed.
5. Finally, use parentheses when the simplest ratio requires more than one polyatomic ion in the compound formula.

Rules for Naming Acids

⇒ H + element:

Hydro + the root of the element + -ic acid

Examples: HI = hydroiodic acid, HBr = hydrobromic acid

⇒ H + Polyatomic Ion

Root of the polyatomic ion name + appropriate ending

- Polyatomic ion ends in -ate, change the ending to -ic acid.
- Polyatomic ion ends in -ite, change the ending to -ous acid.

Examples: H_2SO_4 = sulfuric acid, HNO_2 = nitrous acid

Worksheet #1: Significant Figures & Dimensional Analysis

Directions: For each problem below, write the equation and show your work. Be sure to *box your final answer.*

Part 1: Solve the following problems using scientific notation and rounding to the appropriate value.

a. 300.235800 _____

b. 456,500 _____

c. 0.000957830 _____

d. – 0.035000 _____

Part 2: Solve the following problems, and show your final answer with the appropriate number of significant figures.

a. 1.24056 + 75.80 _____

b. (8 + 9)/(34.0 – 20.) _____

c. 0.8897 x 2.15 + 0.002/.1 _____

d. 45.0 x 9.0 + 89.22/ 75 _____

e. (2.88 + .5) x (23,000 - 0.11) _____

Part 3: *For each problem below, show your work. Always use units and box in your final answer.*

a. The density of pure silver is 10.5 g/cm^{3}at 20^{o}C. If 5.25 g of pure silver pellets are added to a graduated cylinder containing 11.2 mL of water, to what volume level will the water in the cylinder rise?

b. An aluminum block has a density of 2.70 g/mL. If the mass of the block is 24.60 g, find the volume of the substance.

Part 4: Convert the following measurements to the desired unit:

a. 0.050 cm = _____ mm

b. 1872 mg = _____ kg

c. 1.9 dL = _____ cL

d. 3.4x10^{-3} ks = _____ cs

Worksheet #2: Structure of the Atom & The Periodic Table

1. What were the main points of Dalton's Atomic Theory? Which of these points are still accepted today? Which ones do we no longer accept, and why?

2. Summarize the evidence used by J.J. Thomson to argue that cathode rays consist of negatively charged particles.

3. Let's pretend you are holding two atoms of carbon that are isotopes.
   Describe what the two atoms have in common and how they are different.

4. Fill in the gaps in the table, assuming each column represents a neutral atom.

Symbol	K				
# Protons		**25**			82
# Neutrons		**30**	64		
# Electrons			48	**56**	
Mass #				**137**	207

5. Write the correct symbol, with both superscripts and subscripts, for each of the following:

   a. the isotope of sodium with mass 23 _____

   b. the atom of vanadium that contains 28 neutrons _____

   c. the isotope of chlorine with mass 37 _____

   d. an atom of magnesium that has an equal number of protons and neutrons _____

6. Give the name and the common charge for elements found in each of these groups of the Periodic Table:

   a. Group 1 _____

   b. Group 2 _____

   c. Group 17 _____

   d. Group 18 _____

7. Describe where each type of element is found on the Periodic Table:

   a. metals _____

   b. nonmetals _____

   c. transition metals _____

   d. lanthanides _____

   e. actinides _____

Worksheet #3: Naming Inorganic Compounds

1. Give the name for each of the following ionic compounds:

   a. AlF_3 _____

   b. $Fe(OH)_2$ _____

   c. $Cu(NO_3)_2$ _____

   d. $Ba(ClO_4)_2$ _____

   e. Li_3PO_4 _____

   f. Hg_2S _____

   g. $Ca(C_2H_3O_2)_2$ _____

   h. $Cr_2(CO_3)_3$ _____

   i. K_2CrO_4 _____

   j. $(NH_4)_2SO_4$ _____

2. Write the chemical formula for each of the following compounds:

   a. copper (I) oxide _____

   b. potassium peroxide _____

   c. aluminum hydroxide _____

   d. zinc nitrate _____

   e. mercury (I) bromide _____

   f. iron (III) carbonate _____

   g. sodium hypobromite _____

3. Give the name or chemical formula, as appropriate, for each of the following acids:

   a. $HBrO_3$ _____

   b. HBr _____

   c. H_3PO_4 _____

   d. hypochlorous acid_____

   e. iodic acid_____

   f. sulfurous acid_____

4. Give the name or chemical formula, as appropriate, for each of the following molecular substances:

   a. SF_6 _____

   b. IF_5 _____

   c. XeO_3 _____

   d. dinitrogen tetroxide _____

   e. hydrogen cyanide_____

   f. tetraphosphorous hexasulfide _____

Worksheet #4: Writing Chemical Equations

Directions:

⇒ For each equation below, identify the type (synthesis, decomposition, single replacement, double replacement, or combustion), predict the products, and then write the **balanced** equation for the reaction.

⇒ Remember to use the solubility rules for double replacement reactions and the activity series for single replacement reactions. *Hint: when writing these reactions, ignore all of the information about heat, 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.

Answer: This is a double displacement reaction. $2AgNO_3 + MgI_2 \rightarrow 2AgI + Mg(NO_3)_2$

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. Perchloric acid reacts with cadmium to form cadmium perchlorate and a gas.

5. Magnesium and nitrogen gas are heated together.

6. Chlorine gas is bubbled through a solution of sodium bromide.

Worksheet #5: The Mole

Directions: For each problem below, show your work. Always use units and be sure to box your final answer.

1. Determine the molar mass of each of the following compounds:

   a. N_2O_5

   b. disilicon hexabromide

   d. $FeCO_3$

   e. copper (II) sulfate

2. The molecular formula of aspartame, the artificial sweetener marketed as NutraSweet, is $C_{14}H_{18}N_2O_5$.

   a. What is the molar mass of aspartame?

   b. How many moles of aspartame are present in 10.00 g of aspartame? (1000 mg = 1g)

   c. How many molecules of aspartame are present in 10.00 g of aspartame?

3. A sample of glucose, $C_6H_{12}O_6$, contains 2.03×10^{21} atoms of carbon. How many atoms of hydrogen does it contain?

4. What is the mass, in grams, of 1.75×10^{20} molecules of caffeine, $C_8H_{10}N_4O_2$?

Worksheet #6: Empirical & Molecular Formulas

Directions: For each problem below, show your work. Always use units and be sure to box your final answer.

1. Determine the empirical formula of each of the following compounds if a sample contains

   a. 0.104 mol K, 0.052 mol C, and 0.156 mol O

   b. 5.28g Sn and 3.37g F

2. Determine the empirical formulas of the compounds with the following compositions by mass

   a. 10.4% C, 27.8% S, and 61.7% Cl

   b. 21.7% C, 9.6% O, and 68.7% F

3. What is the molecular formula of each of the following compounds?

   a. empirical formula CH_2, molar mass = 84 g/mol

   b. empirical formula NH_2Cl, molar mass = 51.5 g/mol

Worksheet #7: Stoichiometry Problems

Directions: For each problem below, show your work. Always use units and be sure to box your final answer.

1. Why is it essential to use balanced chemical equations in solving stoichiometry problems?

2. a. Write the balanced chemical equation for this reaction.

   b. How many grams of aluminum hydroxide are obtained from 10.5 g of aluminum sulfide?

Reaction: Aluminum sulfide reacts with water to form aluminum hydroxide and hydrogen sulfide.

3. a. Write a balanced chemical equation for this reaction.

   b. How many grams of calcium oxide will be produced after 12.25 g of calcium carbonate reacts?

   c. What volume of carbon dioxide gas is produced from this amount of calcium carbonate, at STP?

Reaction: Calcium carbonate decomposes upon heating, producing calcium oxide and carbon dioxide gas.

4. a. Write a balanced chemical equation for this reaction.

   b. How many grams of hydrogen bromide gas can be produced using the amounts in (b)?

Reaction: Hydrogen gas and bromine gas react to form hydrogen bromide gas.

5. a. Write a balanced chemical equation for this reaction.

   b. Calculate the mass of each product produced when 225 g of oxygen gas is reacted with an excess of the other two reactants.

Reaction: When ammonia gas, oxygen gas and methane gas (CH_4) are combined, the products are hydrogen cyanide gas and water.

Worksheet #8: Limiting Reactants & Theoretical Yield

Directions: For each problem below, show your work. Always use units and be sure to box your final answer.

1. A manufacturer of bicycles has 50 wheels, 30 frames, and 24 seats.
   a. How many bicycles can be manufactured using these parts?
   b. How many parts of each kind are left over?
   c. Which part is like a limiting reactant in that it limits the production of bicycles?

2. The fizz produced when an Alka-Seltzer tablet is dissolved in water is due to the reaction between sodium bicarbonate, $NaHCO_3$, and citric acid, $H_3C_6H_5O_7$:

$$3\ NaHCO_3(aq) + H_3C_6H_5O_7(aq) \rightarrow 3CO_2(g) + 3\ H_2O(l) + Na_3C_6H_5O_7(aq)$$

   In a certain experiment 1.00 g of sodium bicarbonate and 1.00 g of citric acid are allowed to react.
   a. Which reactant is the limiting reactant? *You must show work to support your answer.*
   b. What is the theoretical yield of Carbon Dioxide?

3. When hydrogen sulfide gas is bubbled into a solution of sodium hydroxide, the reaction forms sodium sulfide and water. How many grams of sodium sulfide are formed if 2.50 g of hydrogen sulfide is bubbled into a solution containing 1.85 g of sodium hydroxide, assuming that the limiting reagent is completely consumed?

4. Solutions of sulfuric acid and lead (II) acetate react to form solid lead (II) sulfate and a solution of acetic acid. If 10.0 g of sulfuric acid and 10.0 g of lead (II) acetate are mixed. a.) What is the limiting reactant? b.) What is the theoretical yield of Lead (II) Sulfate?

5. A student reacts benzene, C_6H_6, with bromine, Br_2, to prepare bromobenzene, C_6H_5Br, and HBr. a.) What is the theoretical yield of bromobenzene in this reaction when 30.0 g of benzene reacts with 65.0 g of bromine? b.) If the actual yield of bromobenzene was 56.7 g, what was the percent yield?

Worksheet #9: Molarity

Molarity is a measure of concentration. It is how many moles of solute you have per liter of solvent.

The equation for molarity is: $Molarity\ (M) = \frac{moles\ (mol)}{liter\ (L)}$

1. Find the molarity for a mixture that involves 3 moles of potassium for every 6 liters of solution.

2. Find the molarity for a mixture that involves 3 grams of calcium for every 15 liters of solution.

3. Find the molarity for a mixture that involves 0.5 grams of Sodium for every 100 mL of solution.

4. Given 100mL of a 1M dilute solution of HCl, how many moles of HCl are present?

5. Given 100mL of a 1M dilute solute of HCl, how many grams of HCl are present?

6. What us the molarity of a solution formed from 6.75g on NaCl dissolved in water to make a solution with a total volume of 452 mL?

Why did you sign up for AP Chemistry?	*What is your career goal?*