

AP Chemistry

Summer Assignment

- Complete the worksheets in this packet.
 - *THEY ARE DUE ON THE FIRST DAY OF SCHOOL!*

- Review the colors of precipitates
- Practice Chemistry Olympiad questions by using the following website

<https://www.acs.org/content/acs/en/education/students/highschool/olympiad/pastexams.html>

- Email me with questions.

PERIODIC TABLE OF THE ELEMENTS

1																	2			
H 1.008																	He 4.00			
3	4															9	10			
Li 6.94	Be 9.01															F 19.00	Ne 20.18			
11	12															17	18			
Na 22.99	Mg 24.30															Cl 35.45	Ar 39.95			
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36			
K 39.10	Ca 40.08	Sc 44.96	Ti 47.90	V 50.94	Cr 52.00	Mn 54.94	Fe 55.85	Co 58.93	Ni 58.69	Cu 63.55	Zn 65.39	Ga 69.72	Ge 72.59	As 74.92	Se 78.96	Br 79.90	Kr 83.80			
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54			
Rb 85.47	Sr 87.62	Y 88.91	Zr 91.22	Nb 92.91	Mo 95.94	Tc (98)	Ru 101.1	Rh 102.91	Pd 106.42	Ag 107.87	Cd 112.41	In 114.82	Sn 118.71	Sb 121.75	Te 127.60	I 126.91	Xe 131.29			
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86			
Cs 132.91	Ba 137.33	*La 138.91	Hf 178.49	Ta 180.95	W 183.85	Re 186.21	Os 190.2	Ir 192.2	Pt 195.08	Au 196.97	Hg 200.59	Tl 204.38	Pb 207.2	Bi 208.98	Po (209)	At (210)	Rn (222)			
87	88	89	104	105	106	107	108	109	110	111										
Fr (223)	Ra 226.02	†Ac 227.03	Rf (261)	Db (262)	Sg (266)	Bh (264)	Hs (277)	Mt (268)	Ds (271)	Rg (272)										
											66	67	68	69	70	71				
											Dy 162.50	Ho 164.93	Er 167.26	Tm 168.93	Yb 173.04	Lu 174.97				
											98	99	100	101	102	103				
											Cf (251)	Es (252)	Fm (257)	Md (258)	No (259)	Lr (262)				
											65	64	63	62	61	60	59	58		
											Tb 158.93	Gd 157.25	Eu 151.97	Sm 150.4	Pm (145)	Nd 144.24	Pr 140.91	Ce 140.12		
											97	96	95	94	93	92	91	90		
											Bk (247)	Cm (247)	Am (243)	Pu (244)	Np (237)	U 238.03	Pa 231.04	Th 232.04		
											*Lanthanide Series									
											†Actinide Series									

Name: _____

AP Chemistry Worksheet 1: *Significant Figures and Dimensional Analysis*

For each problem below, write the equation and show your work. Always use units and box your final answer.

- Round each of the following numbers to four significant figures, and express the result in scientific notation:
 - 300.235800 _____
 - 456,500 _____
 - 0.006543210 _____
 - 0.000957830 _____
 - 0.035000 _____
- Carry out the following operations, and express the answers with the appropriate number of significant figures:
 - $1.24056 + 75.80$ _____
 - $23/67 - 75$ _____
 - $890,000 \times 112.3$ _____
 - $78,132 / 2.50$ _____
- Perform the following conversions: (You need to go online to look up some conversion factors between metric and English units.)
 - 8.60 mi to m _____
 - 3.00 days to s _____
 - \$1.55/gal to dollars per liter _____
 - 75.00 mi/hr to m/s _____
 - 55.35 ft^3 to cm^3 _____
- The density of pure silver is 10.5 g/cm^3 at 20°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?
- The density of air at ordinary atmospheric pressure and 25°C is 1.19 g/L. What is the mass, in kilograms, of the air in a room that measures 12.5 x 15.5 x 8.0 ft?

AP Chemistry Worksheet 2: Structure of the Atom and the Periodic Table

For each problem below, write the equation and show your work. Always use units and box in your final answer.

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 what they have different.
4. Fill in the gaps in the following table, assuming each column represents a neutral atom:

Symbol	$^{39}_{19}\text{K}$				
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) Non-metals
 - (c) Transition metals
 - (d) Lanthanides
 - (e) Actinides

AP Chemistry Worksheet 3: Naming Inorganic Compounds

For each problem below, write the equation and show your work. Always use units and box in your final answer.

1. Give the name for each of the following ionic compounds:
 - a. AlF_3
 - b. $\text{Fe}(\text{OH})_2$
 - c. $\text{Cu}(\text{NO}_3)_2$
 - d. $\text{Ba}(\text{ClO}_4)_2$
 - e. Li_3PO_4
 - f. Hg_2S
 - g. $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$
 - h. $\text{Cr}_2(\text{CO}_3)_3$
 - i. K_2CrO_4
 - j. $(\text{NH}_4)_2\text{SO}_4$

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

5. Write the balanced chemical equation for each reaction given below.
- Zinc carbonate can be heated to form zinc oxide and carbon dioxide
 - On treatment with hydrofluoric acid, silicon dioxide forms silicon tetrafluoride and water.
 - Sulfur dioxide reacts with water to form sulfurous acid.
 - Liquid butane fuel (C_4H_{10}) burns in the presence of oxygen gas.
 - Perchloric acid reacts with cadmium to form cadmium perchlorate and a gas.
 - A solution of sodium bromide reacts with a solution of vanadium (III) nitrate to form a brightly colored precipitate.

AP Chemistry Worksheet 4: Atomic and Molecular Masses

For each problem below, write the equation and show your work. Always use units and box in your final answer.

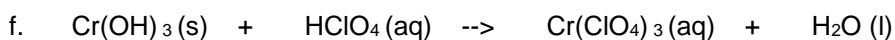
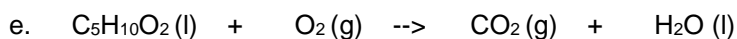
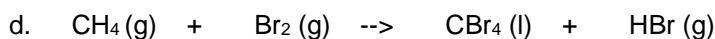
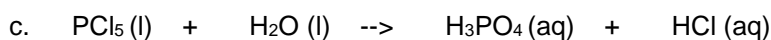
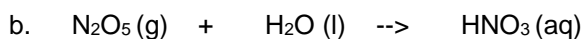
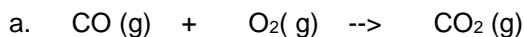
1. What isotope is used as the standard in establishing the atomic mass scale?
2. The atomic weight of magnesium is reported as 24.3, yet no atom of magnesium has the mass of 24.3 amu. Explain.
3. Only two isotopes of copper occur naturally, Cu-63 (abundance 69.09 percent) and Cu-65 (abundance 30.91 percent). Calculate the average atomic mass of copper.
4. Determine the molar mass of each of the following compounds:
 - a. N_2O_5
 - b. FeCO_3
 - c. $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$
 - d. $(\text{NH}_4)_3\text{PO}_4$
 - e. sodium nitrate
 - f. copper (II) sulfate
 - g. disilicon hexabromide
5. Calculate the percentage by mass of oxygen in the following compounds:
 - a. NO_2
 - b. $\text{CH}_3\text{COOCH}_3$
 - c. $\text{Cr}(\text{NO}_3)_3$
 - d. $(\text{NH}_4)_2\text{CO}_3$

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You can draw a pretty chemistry picture below! 😊

AP Chemistry Worksheet 5: Balancing Equations & Patterns of Reactivity

For each problem below, write the equation and show your work. Always use units and box in your final answer.

1. Balance the following equations:



2. Write balanced chemical equations to correspond to each of the following descriptions:

a. Solid calcium carbide, CaC_2 , reacts with water to form an aqueous solution of calcium hydroxide and acetylene gas, C_2H_2 .

b. When solid potassium chlorate is heated, it decomposes to form solid potassium chloride and oxygen gas.

c. Solid zinc metal reacts with sulfuric acid to form hydrogen gas and an aqueous solution of zinc sulfate.

d. When liquid phosphorous trichloride is added to water, it reacts to form a solution of phosphorous acid and hydrochloric acid.

e. When hydrogen sulfide gas is passes over solid hot iron (III) hydroxide, the reaction produces solid iron (III) sulfide and gaseous water.

3. a. What products form when a hydrocarbon is completely combusted in air?
- b. Write a balanced chemical equation for the combustion of octane, C_8H_{18} (l), in air.
- c. How can you determine the chemical formula of the product formed when the metallic element calcium combines with the nonmetallic element oxygen, O_2 ?
- d. Write the balanced chemical equation for the reaction described in (c).
4. Write a balanced chemical equation for the reaction that occurs when
- a. the hydrocarbon heptane, C_7H_{16} (l), is combusted in air
- b. the gasoline additive MTBE (methyl tertiary-butyl ether), $C_5H_{12}O$ (l), burns in air
- c. Rb (s) reacts with water
- d. Mg(s) reacts with Cl_2 (g)
5. Balance the following equations, and indicate what type of reaction each one is:
- a. $Al (s) + Cl_2 (g) \rightarrow AlCl_3 (s)$ _____
- b. $C_2H_4 (g) + O_2 (g) \rightarrow CO_2 (g) + H_2O (l)$ _____
- c. $Li(s) + N_2 (g) \rightarrow Li_3N (s)$ _____
- d. $PbCO_3 (s) \rightarrow PbO (s) + CO_2 (g)$ _____
- e. $C_7H_8O_2 (l) + O_2 (g) \rightarrow CO_2 (g) + H_2O (l)$ _____

AP Chemistry Worksheet 6: *The Mole*

For each problem below, write the equation and show your work. Always use units and box in your final answer.

1. 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 1.00 mg of aspartame? (1000 mg = 1g)

 - c. How many molecules of aspartame are present in 1.00 mg of aspartame?

 - d. How many hydrogen atoms are present in 1.00 mg of aspartame?

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

 - b. How many molecules of glucose does it contain?

 - c. How many moles of glucose does it contain?

 - d. What is the mass of the sample in grams?

3. Calculate the following amounts:
- How many moles of chloride ions are in 0.0750 g of magnesium chloride?
 - What is the mass, in grams, of 3.50×10^{-3} mol of aluminum sulfate?
 - What is the mass, in grams, of 1.75×10^{20} molecules of caffeine, $C_8H_{10}N_4O_2$?
 - What is the molar mass of cholesterol if 0.00105 mol weigh 0.406 g?
4. Calculate the number of molecules in:
- 0.0666 mol propane, C_3H_8 , a hydrocarbon fuel
 - A 50.0 mg tablet of acetaminophen, $C_8H_9O_2N$, an analgesic solid under the name of Tylenol
 - A tablespoon of table sugar, $C_{12}H_{22}O_{11}$, weighing 10.5 g
5. The allowable concentration level of vinyl chloride, C_2H_3Cl , in the atmosphere in a chemical plant is 2.0×10^{-6} g/L.
- How many moles of vinyl chloride in each liter does this represent?
 - How many molecules per liter is this?

AP Chemistry Worksheet 7: Empirical and Molecular Formulas

For each problem below, write the equation and show your work. Always use units and box in 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. 5.28 g Sn and 3.37 g F

- c. 87.5 percent N and 12.5 percent H by mass

2. Determine the empirical formulas of the compounds with the following compositions by mass
 - a. 10.4 percent C, 27.8 percent S, and 61.7 percent Cl

- b. 21.7 percent C, 9.6 percent O, and 68.7 percent 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

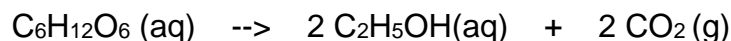
4. Determine the empirical and molecular formulas of each of the following substances:
- Ibuprofen, a headache remedy contains 75.69 percent C, 8.80 percent H, and 15.51 percent O by mass; molar mass about 206 g
 - Benzene contains only carbon and hydrogen and is 7.74% hydrogen by mass. The molar mass of benzene is 78.1 g/mol.
5. Many homes in rural America are heated by propane gas, a compound that contains only carbon and hydrogen. Complete combustion of a sample of propane produced 2.641 g of carbon dioxide and 1.442 g of water as the only products. Find the empirical formula of propane. (Hint: Figure out how many moles of C and H were produced. They all came from the fuel.)
6. (This is probably the hardest problem in the whole packet!) Menthol, the substance we can smell in mentholated cough drops, is composed of C, H, and O. A 0.1005 g sample of menthol is combusted, producing 0.2829 g of CO_2 and 0.1159 g of H_2O .
- What is the empirical formula for menthol?
 - If the compound has a molar mass of 156 g/mol, what is its molecular formula?

AP Chemistry Worksheet 8: Chemical Equations and Calculations

For each problem below, write the equation and show your work. Always use units and box in your final answer.

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

2. The fermentation of glucose, $C_6H_{12}O_6$, produces ethyl alcohol, C_2H_5OH , and CO_2 as shown here:



a. How many moles of CO_2 are produced when 0.300 mol of $C_6H_{12}O_6$ reacts in this fashion?

b. How many grams of $C_6H_{12}O_6$ are needed to form 2.00 g of C_2H_5OH ?

c. How many molecules of CO_2 form when 2.00 g of C_2H_5OH are produced?

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

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?

4. Automotive air bags inflate when sodium azide, NaN_3 , rapidly decomposes to its component elements:



- a. How many moles of N_2 are produced by the decomposition of 1.50 moles of NaN_3 ?
- b. How many grams of NaN_3 are required to form 5.00 g of nitrogen gas?
- c. How many grams of NaN_3 are required to produce 10.0 L of nitrogen gas if the gas has a density of 1.25 g/L?
5. A piece of aluminum foil 0.550 mm thick and 1.00 cm square is allowed to react with bromine to form aluminum bromide.
- a. How many moles of aluminum were used? (The density of aluminum is 2.699 g/cm³.)
- b. How many grams of aluminum bromide form, assuming that the aluminum reacts completely?

AP Chemistry Worksheet 9: Limiting Reactants & Theoretical Yield

For each problem below, write the equation and show your work. Always use units and box in your final answer.

- A manufacturer of bicycles has 50 wheels, 30 frames, and 24 seats.

 - How many bicycles can be manufactured using these parts?
 - How many parts of each kind are left over?
 - Which part is like a limiting reactant in that it limits the production of bicycles?

- 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, $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$:

$$3 \text{NaHCO}_3 (\text{aq}) + \text{H}_3\text{C}_6\text{H}_5\text{O}_7 (\text{aq}) \rightarrow 3 \text{CO}_2 (\text{g}) + 3 \text{H}_2\text{O} (\text{l}) + \text{Na}_3\text{C}_6\text{H}_5\text{O}_7 (\text{aq})$$

In a certain experiment 1.00 g of sodium bicarbonate and 1.00 g of citric acid are allowed to react.

 - Which reactant is the limiting reactant? You must show work to support your answer.
 - How many grams of carbon dioxide form?
 - How much of the limiting reactant is left when the reaction is complete?
 - How much of the excess reactant remains after the reaction is complete?

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, calculate the number of grams of sulfuric acid, lead (II) acetate, lead (II) sulfate, and acetic acid present in the mixture after the reaction is complete.
5. A student reacts benzene, C_6H_6 , with bromine, Br_2 , to prepare bromobenzene, C_6H_5Br , and HBr .
- What is the theoretical yield of bromobenzene in this reaction when 30.0 g of benzene reacts with 65.0 g of bromine?
 - If the actual yield of bromobenzene was 56.7 g, what was the percent yield?

(turn over for one last question!)

3. Write one last paragraph to tell me about yourself. How would you describe yourself? What do you like to do? What are you involved in? What kind of goals do you have in your life?