Name: _____

a P C H em I S tr Y

S ummer Assignment 2019

- Complete all 7 worksheets in the packet. **They are due the first day of school.**
- Be ready for the Polyatomic Ion/Common Ion Quiz that will take place the first week of school. See page 3 for the ions you will need to memorize.

C ambridge C hristian S chool

Cambridge Christian School
Serving Christ through Excellence in Academics, Athletics and Fine Arts

AP Chemistry 2019 Summer Assignment

To: All Incoming AP Chemistry Students

From: Mrs. Peake, AP Chemistry Instructor

Greetings and welcome to AP Chemistry! I am so excited you decided to embark on the AP Chemistry journey. AP Chemistry is equivalent to a year of General Chemistry in college. It will be a challenging class that requires effort and dedication. Just know, my desire is to prepare you to be successful on the AP exam in May!

Over the summer, you will be responsible for completing all 7 worksheets and problems in this review packet. **You must show your work!** They are due the first day of school and will count as your first grade in AP Chemistry. You will have a memorization quiz the first week of school on the common ions and polyatomic ions listed in your packet – you will be allowed to use the periodic table, but you will need to know the name as well as the ion symbol with charge.

Please work on this packet throughout the summer – it will take you some time, so please don't wait until the last minute. Arrive ready to learn – I am excited for a great year!! Have a great summer!

Mrs. Peake

Lisa Peake
Chemistry Teacher
Cambridge Christian School
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Our Textbooks will be:

- Chemistry The Central Science, Brown and Lemay
- The General Chemistry Workbook by Bassam Z. Shakhashiri, and Rodney Schreiner – this has been a favorite and most treasured resource of my students for years – you will get this when you arrive to school

IUPAC Periodic Table of the Elements

1																	18
1 H hydrogen 1.008 [1.0078, 1.0082]	2		Key: atomic number **Symbol** **name** conventional atomic weight standard atomic weight										13	14	15	16	17	2 He helium 4.0026
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122												5 B boron 10.81 [10.806, 10.821]	6 C carbon 12.011 [12.009, 12.012]	7 N nitrogen 14.007 [14.006, 14.008]	8 O oxygen 15.999 [15.999, 16.000]	9 F fluorine 18.998	10 Ne neon 20.180
11 Na sodium 22.990	12 Mg magnesium 24.305 [24.304, 24.307]	3	4	5	6	7	8	9	10	11	12		13 Al aluminium 26.982	14 Si silicon 28.085 [28.084, 28.086]	15 P phosphorus 30.974	16 S sulfur 32.06 [32.059, 32.076]	17 Cl chlorine 35.45 [35.446, 35.457]	18 Ar argon 39.948
19 K potassium 39.098	20 Ca calcium 40.078(4)	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845(2)	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546(3)	30 Zn zinc 65.38(2)	31 Ga gallium 69.723	32 Ge germanium 72.630(8)	33 As arsenic 74.922	34 Se selenium 78.971(8)	35 Br bromine 79.904 [79.901, 79.907]	36 Kr krypton 83.798(2)
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224(2)	41 Nb niobium 92.906	42 Mo molybdenum 95.95	43 Tc technetium	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60(3)	53 I iodine 126.90	54 Xe xenon 131.29
55 Cs caesium 132.91	56 Ba barium 137.33	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23(3)	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38 [204.38, 204.39]	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson

57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium	62 Sm samarium 150.36(2)	63 Eu europium 151.96	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

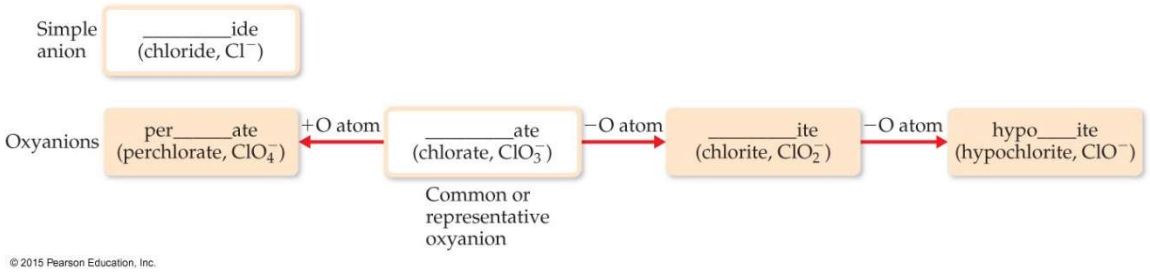
For notes and updates to this table, see www.iupac.org. This version is dated 28 November 2016.

Common Polyatomic Ion List

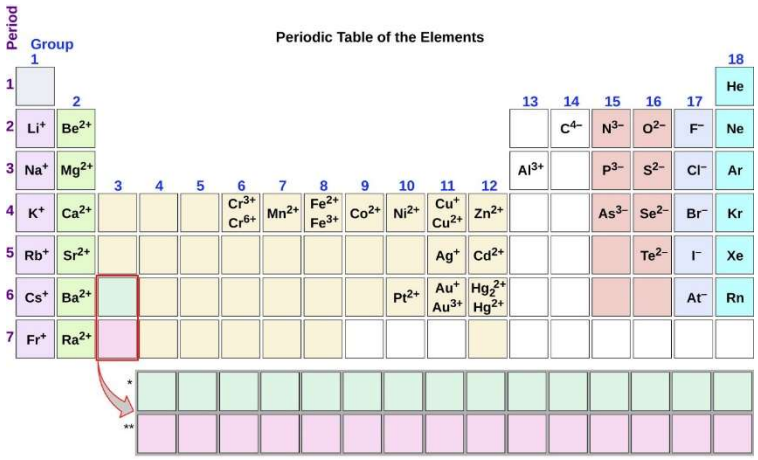
You must memorize this sheet. There will be a quiz on these polyatomic and common ions the first week of school. I will give you a periodic table to use– When I give you the name, you will have to give me the formula and charge AND when I give you the formula and charge, you will have to give me the name. (Remember Stealth Bomber!)

–1 Charge	–2 Charge	–3 Charge	+1 Charge
Dihydrogen phosphate ($H_2PO_4^-$)	Hydrogen phosphate (HPO_4^{2-})	Phosphite (PO_3^{3-})	Ammonium (NH_4^+)
Acetate ($C_2H_3O_2^-$)	Oxalate ($C_2O_4^{2-}$)	Phosphate (PO_4^{3-})	
Hydrogen sulfite (HSO_3^-)	Sulfite (SO_3^{2-})	Borate (BO_3^{3-})	
Hydrogen sulfate (HSO_4^-)	Sulfate (SO_4^{2-})		
Hydrogen carbonate (HCO_3^-)	Carbonate (CO_3^{2-})		
Nitrite (NO_2^-)	Chromate (CrO_4^{2-})		
Nitrate (NO_3^-)	Dichromate ($Cr_2O_7^{2-}$)		
Cyanide (CN^-) Thiocyanate (SCN^-)	Silicate (SiO_3^{2-}) Thiosulfate ($S_2O_3^{2-}$) Peroxide (O_2^{2-})		
Hydroxide (OH^-)			
Permanganate (MnO_4^-)			
Hypochlorite (ClO^-)			
Chlorite (ClO_2^-)			
Chlorate (ClO_3^-)			
Perchlorate (ClO_4^-)			
Benzoate ($C_6H_5COO^-$)			
Bromate (BrO_3^-)			
Iodate (IO_3^-)			

Helpful Hints:



Remember: Most transition metals (3-12) and Group 4A (14) metals form 2 or more positive ions, except Zn^{2+}, Ag^+, and Cd^{2+}, which form only one ion.



AP Chemistry Worksheet 1: Significant Figures

Rules

1. **All non-zero digits are significant.** For example. 123. (3 sig figs)
2. **Zeros between non-zero digits are significant.** For example: 12.507 (5 sig figs)
3. **Zeros to the left of the first non-zero digit are not significant.** For example: 1.02 (3 sig figs), 0.12 (2 sig figs), 0.012 (2 sig figs)
4. **If a number ends in zeros to the right of the decimal point, those zeros are significant.** For example: 2.0 (2 sig figs), 2.00 (3 sig figs) {This signifies greater accuracy.}
5. **If a number ends in zeros to the left of the decimal point, those zeros *may or may not be* significant.** For example:
   If we make a statement that the weight of an object is 120 g, how do we convey our knowledge of whether the balance was accurate to ± 1 g or ± 10 g?
   Answer: The ambiguity can be removed by using *exponential notation.*
   The weight can be expressed as 12. x 10^1 g or 1.2 x 10^2 g if we wish to quote unambiguously to 2 sig figs, and 12.0 x 10^1 g or 1.20 x 10^2 g if we have a confidence level extending to 3 sig figs.
   Note: We cannot write 120.0 g since this requires known accuracy of ± 0.1 g.

Multiplication or Division: the result can have no more sig figs than the least accurate number. For example:

If an object has mass of 29.1143 g and a volume of 25.0 cm^3, then its density is given by

$$\text{Density} = \frac{29.1143\ g}{25.0\ cm^3} = 1.164572\ g\ cm^{-3} = 1.16\ g\ cm^{-3}$$

Addition or Subtraction: the result must be reported to the same number of decimal places as the number with the fewest decimal places. For example:

```
 19.2     g
  0.4745  g
127.      g
```

SUM = 146.6745 g = 147. g because one weight is known only to the nearest 1 g!

NOTE: Round off numbers only at the END of calculations; otherwise, errors may be inadvertently carried through.

Rules taken from http://www.dartmouth.edu/~genchem/sigfigs.html

1. Round each of the following numbers to four significant figures, and express the result in scientific notation:

   a. 300.235800 _____

   b. 456,500 _____

   c. 0.006543210 _____

   d. 0.000957830 _____

   e. – 0.035000 _____

2. Carry out the following operations, and express the answers with the appropriate number of significant figures:

   a. 1.24056 + 75.80 _____

   b. 23/67 - 75 _____

   c. 890,000 x 112.3 _____

   d. 78,132 / 2.50 _____

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

1. Complete the following chart – explain the experiment/model each scientist used

Scientist	Discovery with regards to the Atom	Experiment/Model or Theory
John Dalton		
J.J. Thomson		
Robert Millikan		
Ernest Rutherford		
James Chadwick		
Niels Bohr		

2. 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.

3. Fill in the gaps in the following table, assuming each column represents a neutral atom:

	Symbol	Protons	Neutrons	Electrons	Mass Number
a.	$^{39}_{19}K$				
b.		25	30		
c.			64	48	
d.				56	137
e.		82			207

4. 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 _____

AP Chemistry Worksheet 3: Naming Inorganic Compounds

Naming Compounds Flowchart

Compounds

Ionic (m + nm)

Binary (2 elements)
- contains only monatomic ions--find charges from the PT
- name by cation 1st, anion 2nd
- always change second listed element ending to "ide"

Ternary (3+ elements)
- contains at least one polyatomic ion--look to polyatomic ion list first and identify
- name by cation 1st, anion 2nd
- already ends in "ite" or "ate", there are a few "ide" exceptions: no change needed

Some Common Polyatomic Ions

$C_2H_3O_2^{-1}$	acetate	CO_3^{-2}	carbonate
ClO_4^{-1}	perchlorate	CrO_4^{-2}	chromate
ClO_3^{-1}	chlorate	$Cr_2O_7^{-2}$	dichromate
ClO_2^{-1}	chlorite	HPO_4^{-2}	hydrogen phosphate
ClO^{-1}	hypochlorite	$C_2O_4^{-2}$	oxalate
CN^{-1}	**cyanide**	SO_3^{-2}	sulfite
$H_2PO_4^{-1}$	dihydrogen phosphate	SO_4^{-2}	sulfate
HCO_3^{-1}	bicarbonate (or H carbonate)	**O_2^{-2}**	**peroxide**
HSO_3^{-1}	bisulfite (or H sulfite)		
HSO_4^{-1}	bisulfate (or H sulfate)		
OH^{-1}	**hydroxide**		
NO_2^{-1}	nitrite	PO_3^{-3}	phosphite
NO_3^{-1}	nitrate	PO_4^{-3}	phosphate
MnO_4^{-1}	permanganate		
BrO_3^{-1}	bromate	**NH_4^{+1}**	**ammonium**
IO_3^{-1}	iodate		

Bold--exceptions to "ite" or "ate" endings

Acids (H + anion)

Acids (2 + elements)
- always contains H^+ as cation and an anion, poly- or monatomic
- Anion **DOES NOT** contain oxygen--use a "hydro" + anion root + "ic"
- Anion **DOES** contain oxygen
  1. anions ending in "ate" root anion + "ic" ending
  2. anions ending in "ite" root anion + "ous" ending
- add "acid" to name at end

Molecular (nm + nm)

Binary (2 elements)
- name by element
- use prefixes to indicate how many of each element are present in the formula
- always change second listed element ending to "ide"

Common Polyvalent Ions (for use w/Roman Numerals)

Cu	+1, +2
Hg	+1, +2
Fe	+2, +3
Mn	+ 2, +3
Co	+2, +3
Cr	+2, +3
Sn	+2, +4
Pb	+2, +4

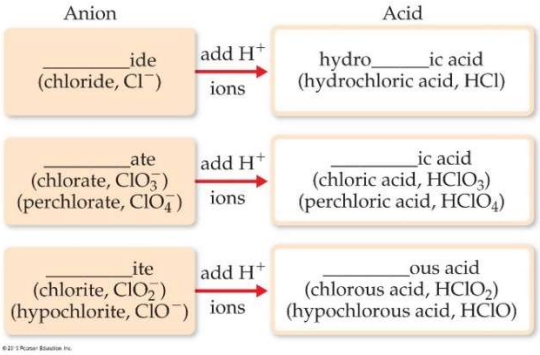
Prefixes (molecular use only)

mono-	one
di-	two
tri-	three
tetra-	four
penta-	five
hexa-	six
hepta-	seven
octa-	eight
nona-	nine
deca-	ten

Chart Found: http://www.gridgit.com/postpic/2011/04/naming-covalent-compounds-flow-chart_261961.png

Remember: Most transition metals (3-12) and Group 4A (14) metals form 2 or more positive ions, except Zn^{2+}, Ag^+, and Cd^{2+}, which form only one ion.

Rules for Naming Acids:



Naming needs to be really strong – please practice and make sure you can tell the difference between ionic, covalent and acids and how to name each of them! If you need instructional videos, check out youtube → tyler dewitt → naming

*Some additional practice can be found here:
http://www.pafaculty.net/biology/keith/KR_Graph_site/ionic_nomenclature_page.htm

Complete the following table – First decide if the substance is Ionic, Covalent or an Acid – you use different naming rules for each of these three types of substances. Then, once you have checked the appropriate classification, complete either the formula or name. (Remember Magic Triangle)

	Name	Formula	Ionic	Covalent	Acid
1.	Copper (I) oxide				
2.	Hypochlorous Acid				
3.	Zinc nitrate				
4.		H_3PO_4			
5.		SF_6			
6.		$Fe(OH)_2$			
7.	Tetraphosphorous hexasulfide				
8.	Sulfurous acid				
9.	Potassium oxide				
10.	Calcium acetate				
11.		IF_5			
12.		Li_3PO_4			
13.		HCl			
14.		N_2O_4			
15.		AgCl			

16. Write the balanced chemical equation for each reaction given below:

a. Zinc carbonate can be heated to form zinc oxide and carbon dioxide

b. On treatment with hydrofluoric acid, silicon dioxide forms silicon tetrafluoride and water.

c. Sulfur dioxide reacts with water to form sulfurous acid.

AP Chemistry Worksheet 4: Atomic and Molecular Masses **Show Your Work!**

1. The atomic weight of magnesium is reported as 24.3, yet no atom of magnesium has the mass of 24.3 amu. Explain.

2. 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. $Ca(C_2H_3O_2)_2$

c. $(NH_4)_3PO_4$

5. Calculate the percentage by mass of oxygen in the following compounds:

a. NO_2

b. CH_3COOCH_3

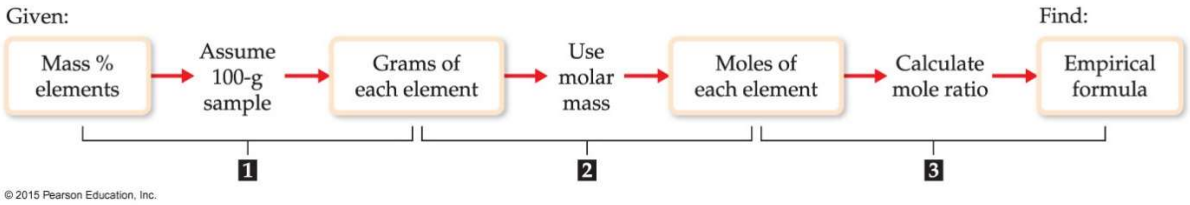
c. $Cr(NO_3)_3$

d. $(NH_4)_2CO_3$

AP Chemistry Worksheet 5: Empirical and Molecular Formulas **Show Your Work!!**

To find the Empirical Formula:

Step 1: Change the % sign to grams
Step 2: Convert grams to moles
Step 3: Divide by the smallest number of moles
Step 4: Multiply if needed to establish a whole number ratio



To Find the Molecular Formula:

Step 1: Divide the Molar Mass by the Mass of the Empirical Formula – you should get a whole number
Step 2: Use the whole number from step 1 – multiply subscripts of empirical formula to get molecular formula

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:

a. 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

b. 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: Write the reaction – combustion means hydrocarbon + O_2. Then, figure out how many moles of C and H were produced. They all came from the fuel.)

6. 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.

a. What is the empirical formula for menthol?

b. If the compound has a molar mass of 156 g/mol, what is its molecular formula?

AP Chemistry Worksheet 6: Stoichiometry (you must show work and set up using dimensional analysis!)

Table 3.2 Mole Relationships

Name of Substance	Formula	Formula Weight (amu)	Molar Mass (g/mol)	Number and Kind of Particles in One Mole
Atomic nitrogen	N	14.0	14.0	6.02×10^{23} N atoms
Molecular nitrogen	N_2	28.0	28.0	6.02×10^{23} N_2 molecules $2(6.02 \times 10^{23})$ N atoms
Silver	Ag	107.9	107.9	6.02×10^{23} Ag atoms
Silver ions	Ag^+	107.9[a]	107.9	6.02×10^{23} Ag^+ ions
Barium chloride	$BaCl_2$	208.2	208.2	6.02×10^{23} $BaCl_2$ formula units 6.02×10^{23} Ba^{2+} ions $2(6.02 \times 10^{23})$ Cl^- ions

[a]Recall that the mass of an electron is more than 1800 times smaller than the masses of the proton and the neutron; thus, ions and atoms have essentially the same mass.

1. 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?

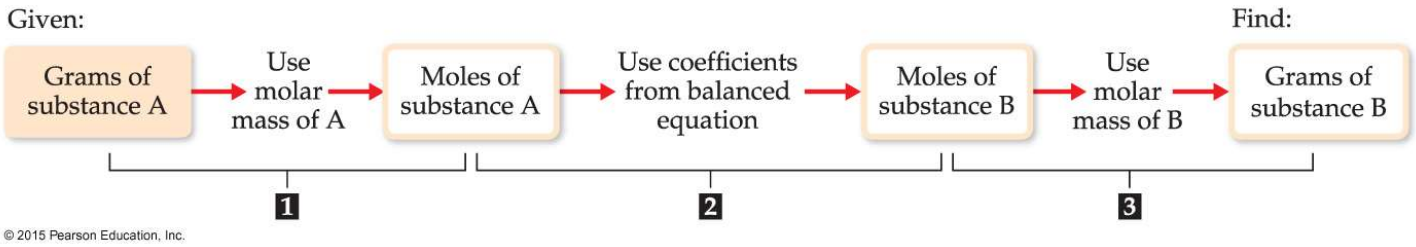
2. Calculate the following amounts:

   a. How many moles of **chloride ions** are in 0.0750 g of magnesium chloride?

   b. What is the mass, in grams, of 3.50×10^{-3} mol of aluminum sulfate?

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

   d. What is the molar mass of cholesterol if 0.00105 mol weigh 0.406 g?



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:

$$2\ NaN_3\ (s) \rightarrow Na(s) + 3\ N_2\ (g)$$

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?

AP Chemistry Worksheet 7: Limiting Reactants and Theoretical Yield (you must show your work and set up using dimensional analysis!)

For each problem below, write the equation and show your work. Always use units and box in 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, $H_3C_6H_5O_7$:

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

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. How many grams of carbon dioxide form?

c. How much of the limiting reactant is left when the reaction is complete?

d. 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.

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?

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