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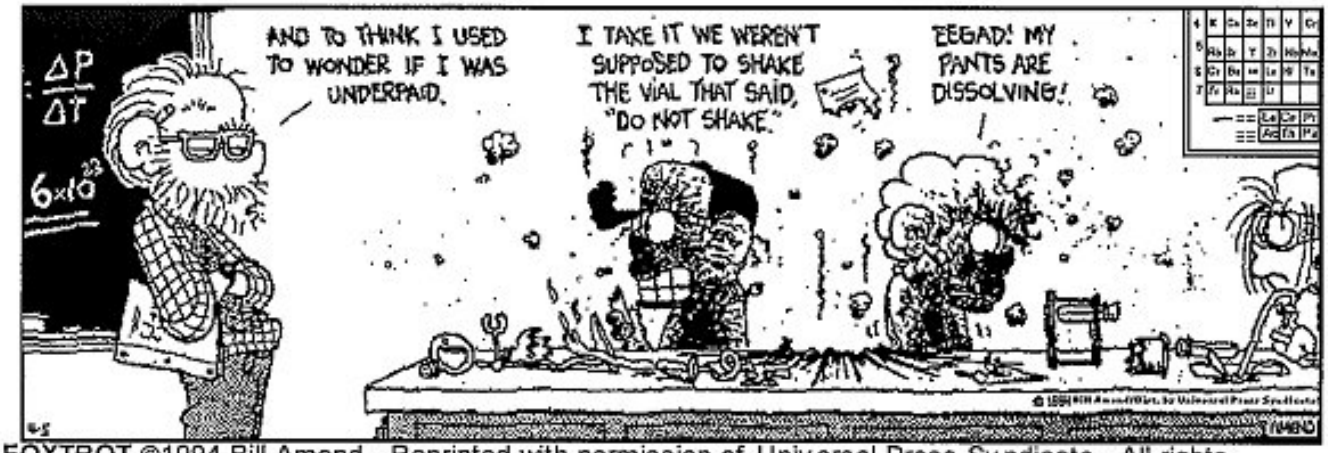
AP Chemistry: Summer Assignment 2019



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Dear AP Chemistry Student,

Welcome to AP Chemistry! I am very excited to have you enrolled in my class and cannot wait to get started. AP Chemistry is a difficult course. This is why I give a summer assignment. So, be ready for some challenging assignments this upcoming year! Don't forget that this course is designed to match the first year of college chemistry. You need to prepare for the start of the school year by reviewing the things you learned in chemistry.

This assignment is due on the first day of school. I have included a lot of information in this packet, but you may access outside sources to help you with any topic you find challenging. Please use the guidelines below in completing your work:

SHOW YOUR WORK (where possible): *To receive full credit, you must show a clear logical progression of steps leading to the answer. Your solutions should be neat and easy to follow. Answers with no work (for computational questions) will not receive credit. Obviously you can't show work for things like naming compounds, so for things like that, work is not expected.*

COLLABORATION: *You are encouraged to work with other students and to receive help from any source available to you. AP Chemistry is a difficult subject and you are not expected to understand it all on your own. However, it would be considered cheating to simply copy another student's work. If you understand the solution to a problem explained by another student, that is great, but then you should go work it on your own.*

Enjoy your summer and be ready for a great year in AP Chemistry!!! If you need to reach me, please feel free to email me at jbomgardner@gracechristian.net. I look forward to teaching you in the fall.

- Mrs. Bomgardner

Part I — Letter of Introduction: Send me an email at jbomgardner@gracechristian.net introducing yourself. This should include at least one paragraph about you personally (interests, favorites e.g. food/books/dessert/music, family, academic strengths/weaknesses, etc) and one paragraph about your thoughts and questions regarding AP Chemistry (reason for taking it, concerns and hopes, most interesting chemistry fact you know, and/or what you want to learn about). Be creative yet professional.

Part II — Memorize the Basics: AP Chemistry is not all about memorization; however, having the following items memorized is essential for success in learning the concepts covered in the course. Make flashcards, have your friends and family quiz you, take the lists with you on vacation, or do whatever it takes to get this information firmly planted in your head. You will be quizzed on this material the first week of school. Students who wait until the last minute may do well on the quiz, but will struggle the rest of the year trying to remember these important things! Studies have shown that memory is improved by studying material frequently for short periods over a long stretch of time. So start learning these early!

1) Rules for naming
    a. Acids
    b. Ionic Compounds
    c. Covalent Compounds
2) Ions (including polyatomic)
3) Rules for significant figures

Part III — Review and Practice Basic Chemistry Skills:

1) Significant Figures WS
2) Naming and Writing Chemical Formulas WS
3) Dimensional Analysis WS
4) Writing Chemical Equations WS
5) Stoichiometry WS

M1: Rules For Naming

Rules for Naming an Acid

1. For binary acids (meaning a compound between hydrogen and one other element), the acid name begins with the prefix hydro-, the stem of the anion has the suffix –ic and it is followed by the word acid.

Ex. -ide becomes hydro _____ic Acid. Cl^- is the Chlor**ide** ion so HCl = **hydro**chlor**ic acid**

2. When the anion name ends in **–ite**, the acid name is the stem of the anion with the suffix –**ous**, followed by the word acid.

Ex. -ite becomes _____ous Acid

ClO_2^- is the Chlor**ite** ion so $HClO_2$ = Chlor**ous** acid

3. When the anion name ends in **–ate**, the acid name is the stem of the anion with the suffix **–ic**, followed by the word acid.

Ex. -ate ClO_3- becomes _____ic Acid

is the Chlor**ate** ion so $HClO_3$ = Chlor**ic** acid

Rules for Naming Ionic Compounds (metal & nonmetal)

1. Balance Charges (charges should equal zero)

2. Cation is always written first (in name and in formula)

3. Change the ending of the anion to –ide

Ex. Mg_2Cl is magnesium chloride

Rules for Naming Covalent Compounds (two nonmetals)

1. If the cation has a subscript of 1, do not use the prefix "mono." For example, CO is carbon monoxide, not monocarbon monoxide.

2. Other than that, always use prefixes for both words.

3. Change the ending of the anion to –ide

M2: Ions (Including Polyatomic)

From the table:	
Cations	**Name**
H^+	Hydrogen
Li^+	Lithium
Na^+	Sodium
K^+	Potassium
Rb^+	Rubidium
Cs^+	Cesium
Be^{2+}	Beryllium
Mg^{2+}	Magnesium
Ca^{2+}	Calcium
Ba^{2+}	Barium
Sr^{2+}	Strontium
Al^{3+}	Aluminum
Anions	**Name**
H^-	Hydride
F^-	Fluoride
Cl^-	Chloride
Br^-	Bromide
I^-	Iodide
O^{2-}	Oxide
S^{2-}	Sulfide
Se^{2-}	Selenide
N^{3-}	Nitride
P^{3-}	Phosphide
As^{3-}	Arsenide
Type II Cations	**Name**
Fe^{3+}	Iron(III)
Fe^{2+}	Iron(II)
Cu^{2+}	Copper(II)
Cu^+	Copper(I)
Co^{3+}	Cobalt(III)
Co^{2+}	Cobalt(II)
Sn^{4+}	Tin(IV)
Sn^{2+}	Tin(II)
Pb^{4+}	Lead(IV)
Pb^{2+}	Lead(II)
Hg^{2+}	Mercury(II)

Ions to Memorize	
Cations	**Name**
Ag^+	Silver
Zn^{2+}	Zinc
Hg_2^{2+}	Mercury(I)
NH_4^+	Ammonium
Anions	**Name**
NO_2^-	Nitrite
NO_3^-	Nitrate
SO_3^{2-}	Sulfite
SO_4^{2-}	Sulfate
HSO_4^-	Hydrogen sulfate (bisulfate)
OH^-	Hydroxide
CN^-	Cyanide
PO_4^{3-}	Phosphate
HPO_4^{2-}	Hydrogen phosphate
$H_2PO_4^-$	Dihydrogen phosphate
NCS^-	Thiocyanate
CO_3^{2-}	Carbonate
HCO_3^-	Hydrogen carbonate (bicarbonate)
ClO^-	Hypochlorite
ClO_2^-	Chlorite
ClO_3^-	Chlorate
ClO_4^-	Perchlorate
BrO^-	Hypobromite
BrO_2^-	Bromite
BrO_3^-	Bromate
BrO_4^-	Perbromate
IO^-	Hypoiodite
IO_2^-	iodite
IO_3^-	iodate
IO_4^-	Periodate
$C_2H_3O_2^-$	Acetate
MnO_4^-	Permanganate
$Cr_2O_7^{2-}$	Dichromate
CrO_4^{2-}	Chromate
O_2^{2-}	Peroxide
$C_2O_4^{2-}$	Oxalate
NH_2^-	Amide
BO_3^{3-}	Borate
$S_2O_3^{2-}$	Thiosulfate

Tips for Learning the Ions

"From the Table" [Left Column]

Their place on the table suggests the charge on the ion, since the neutral atom gains or loses a predictable number of electrons in order to obtain a noble gas configuration. This was a focus in first year chemistry, so if you are unsure what this means, get help BEFORE the start of the year.

- All Group 1 Elements lose one electron to form an ion with a 1+ charge
- All Group 2 Elements (alkaline earth metals) lose two electrons to form an ion with a 2+ charge
- Group 13 metals like aluminum lose three electrons to form an ion with a 3+ charge
- All Group 17 Elements (halogens) gain one electron to form an ion with a 1- charge
- All Group 16 nonmetals gain two electrons to form an ion with a 2- charge
- All Group 15 nonmetals gain three electrons to form an ion with a 3- charge

Metals that can form more than one ion will have their positive charge denoted by a roman numeral in parenthesis immediately next to the name of the element.

Polyatomic Anions [Right Column]

Most of the work on memorization occurs with these ions, but there are a number of patterns that can greatly reduce the amount of memorizing that one must do.

- "ate" anions have one <u>more</u> oxygen then the "ite" ion, but the same charge. If you memorize the "ate" ions, then you should be able to derive the formula for the "ite" ion and vice-versa.
- If you know that a sufate ion is SO_4^{2-} then to get the formula for hydrogen sulfate ion, you add a hydrogen ion to the front of the formula. Since a hydrogen ion has a 1+ charge, the net charge on the new ion is less negative by one.
- Learn the hypochlorite chlorite chlorate perchlorate series, and you also know the series containing iodite/iodate as well as bromite/bromate.
- The prefix "hypo" means "under" or "too little" (think "hypodermic", "hypothermic" or "hypoglycemia"). Hypochlorite is "under" chlorite, meaning it has one less oxygen.
- The prefix "hyper" means "above" or "too much." The prefix "per" is derived from "hyper" so perchlorate (hyperchlorate) has one more oxygen than chlorate.

M3: Significant Figures in Measurement and Calculations

A successful chemistry student habitually labels all numbers, because the unit is important. Also of great importance is the number itself. Any number used in a calculation should contain only figures that are considered reliable; otherwise, time and effort are wasted. Figures that are considered reliable are called *significant figures*. Chemical calculations involve numbers representing actual measurements. In a measurement, significant figures in a number consist of:

Figures (digits) definitely known + One estimated figure (digit).
In class you will hear this expressed as "all of the digits known for certain plus one that is a guess."

Recording Measurements

When one reads an instrument (ruler, thermometer, graduate, buret, barometer, balance), he expresses the reading as one which is reasonably reliable. For example, in the accompanying illustration, note the reading marked *A*. This reading is definitely beyond the 7 cm mark and also beyond the 0.8 cm mark. We read the 7.8 with certainty. We further *estimate* that the reading is five-tenths the distance from the 7.8 mark to the 7.9 mark. So, we estimate the length as 0.05 cm more than 7.8 cm. All of these have meaning and are therefore significant. We express the reading as 7.85 cm, accurate to three significant figures. All of these figures, *7.85*, can be used in calculations. In reading B we see that 9.2 cm is definitely known. We can include one estimated digit in our reading, and we estimate the next digit to be zero. Our reading is reported as 9.20 cm. It is accurate to three significant figures.

Rules for Zeros

If a zero represents a measured quantity, it is a significant figure. If it merely locates the decimal point, it is not a significant figure.

Zero Within a Number. In reading the measurement 9.04 cm, the zero represents a measured quantity, just as 9 and 4, and is, therefore, a significant number. A zero between any of the other digits in a number is a significant figure.

Zero at the Front of a Number. In reading the measurement 0.46 cm, the zero does not represent a measured quantity, but merely locates the decimal point. It is not a significant figure. Also, in the measurement 0.07 kg, the zeros are used merely to locate the decimal point and are, therefore, not significant. Zeros at the first (left) of a number are not significant figures.

Zero at the End of a Number. In reading the measurement 11.30 cm, the zero is an estimate and represents a measured quantity. It is therefore significant. Another way to look at this: The

zero is not needed as a placeholder, and yet it was included by the person recording the measurement. It must have been recorded as a part of the measurement, making it significant. Zeros to the right of the decimal point, and at the end of the number, are significant figures.

Zeros at the End of a Whole Number. Zeros at the end of a whole number may or may not be significant. If a distance is reported as 1600 feet, one assumes two sig figs. Reporting measurements in scientific notation removes all doubt, since all numbers written in scientific notation are considered significant.

1.6×10^3 feet	1.60×10^3 feet	1.600×10^3 feet
Two significant figures	Three significant figures	Four significant figures

Sample Problem #1: Underline the significant figures in the following numbers.

(a) 0.0420 cm	answer = 0.0420 cm	(e) 2 403 ft.	answer = 2 403 ft.
(b) 5.320 in.	answer = 5.320 in.	(f) 80.5300 m	answer = 80.5300 m
(c) 10 lb.	answer = 10 lb.	(g) 200. G	answer = 200. g
(d) 0.020 ml	answer = 0.020 ml	(h) 2.4×10^3 kg	answer = 2.4 x 10^3 kg

Rounding Off Numbers

In reporting a numerical answer, one needs to know how to "round off" a number to include the correct number of significant figures. Even in a series of operations leading to the final answer, one must "round off" numbers. The rules are well accepted rules:

. If the figure to be dropped is less than 5, simply eliminate it.

. If the figure to be dropped is greater than 5, eliminate it and raise the preceding figure by 1.

. If the figure is 5, followed by nonzero digits, raise the preceding figure by 1

. If the figure is 5, not followed by nonzero digit(s), and preceded by an odd digit, raise the preceding digit by one

. If the figure is 5, not followed by nonzero digit(s), and the preceding significant digit is even, the preceding digit remains unchanged

Sample Problem #2: Round off the following to three significant figures.

(a) 3.478 m answer = 3.48 m

(b) 4.8055 cm answer = 4.81 cm

(c) 5.333 g answer = 5.33 g

(d) 7.999 in. answer = 8.00 in.

Multiplication

In multiplying two numbers, when you wish to determine the number of significant figures you should have in your answer (the product), you should inspect the numbers multiplied and find which has the least number of significant figures. This is the number of significant figures you should have in your answer (the product). Thus the answer to 0.024 x 1244 would be rounded off to contain two significant figures since the factor with the lesser number of significant figures (0.024) has only *two* such figures.

Sample Problem #3: Find the area of a rectangle 2.1 cm by 3.24 cm.

Solution: Area = 2.1 cm x 3.24 cm = 6.804 cm^2

We note that 2.1 contains two significant figures, while 3.24 contains three significant figures. Our product should contain no more than *two* significant figures. Therefore, our answer would

be recorded as **6.8 cm^2**

Sample Problem #4: Find the volume of a rectangular solid 10.2 cm x 8.24 cm x 1.8 cm

Solution: Volume = 10.2 cm x 8.24 cm x 1.8 cm = 151.2864 cm^3

We observe that the factor having the least number of significant figures is 1.8 cm. It contains two significant figures. Therefore, the answer is rounded off to **150 cm^3.**

Division

In dividing two numbers, the answer (quotient) should contain the same number of significant figures as are contained in the number (divisor or dividend) with the least number of significant figures. Thus the answer to 528 ÷ 0.14 would be rounded off to contain *two* significant figures. The answer to 0.340 ÷ 3242 would be rounded off to contain three significant figures.

Sample Problem #5: Calculate 20.45 ÷ 2.4.

Solution: 20.45 ÷ 2.4 = 8.52083

We note that the 2.4 has fewer significant figures than the 20.45. It has only *two* significant

figures. Therefore, our answer should have no more than two significant figures and should be reported as **8.5.**

Addition and Subtraction

In adding (or subtracting), set down the numbers, being sure to keep like decimal places under each other, and add (or subtract). Next, note which column contains the first estimated figure. This column determines the last decimal place of the answer. After the answer is obtained, it should be rounded off in this column. In other words, round to the least number of decimal places in you data.

Sample Problem #6: Add 42.56 g + 39.460 g + 4.1g

Solution: 86.120 g

Since the number 4.1 only extends to the first decimal place, the answer must be rounded to the first decimal place, yielding the answer **86.1 g.**

Average Readings

The average of a number of successive readings will have the same number of decimal places that are in their sum.

Sample Problem #7: A graduated cylinder was weighed three times and the recorded weighings were 12.523 g, 12.497 g, 12.515 g. Calculate the average weight.

Solution: 12.512 g

12.523 g + 12.497 g + 12.515 g = (37.535 g) / 3 = 12.512 g

In order to find the average, the sum is divided by (exactly) 3 to give an answer of 12.51167. Since each number extends to three decimal places, the final answer is rounded to three decimal places, yielding a final answer of **12.512 g**. Notice that the divisor of 3 does not effect the rounding of the final answer. This is because 3 is an exact number - known to an infinite number of decimal places.

Significant Figures Worksheet

Give the number of significant figures in each of the following:

____ 402 m	____ 0.00420 g	____ 5.1×10^{4} kg	____ 78 323.01 g
____ 34.20 lbs	____ 3 200 liters	____ 0.48 m	____ 1.10 torr
____ 0.03 sec	____ 0.0300 ft.	____ 1 400.0 m	____ 760 mm Hg

Multiply each of the following, observing significant figure rules:

17 m x 324 m = _____

0.005 in x 8 888 in = _____

0.424 in x .090 in = _____

1.7 mm x 4 294 mm = _____

0.050 m x 102 m = _____

324 000 cm x 12.00 cm = _____

Divide each of the following, observing significant figure rules:

23.4 m ÷ 0.50 sec = _____

12 miles ÷ 3.20 hours = _____

0.960 g ÷ 1.51 moles = _____

1 200 m ÷ 12.12 sec = _____

Add each of the following, observing significant figure rules:

3.40 m + 0.022 m + 0.5 m = _____

102.45 g + 2.44 g +1.9999g = _____

102. cm + 3.14 cm + 5.9 cm = _____

234.1 cm + 62.04 cm = _____

Subtract each of the following, observing significant figure rules:

42.306 m – 1.22 m = _____

14.33 g – 3.468 g = _____

234.1cm – 62.04 cm = _____

Work each of the following problems, observing significant figure rules:

Three determinations were made of the percentage of oxygen in mercuric oxide. The results were 7.40%, 7.43%, and 7.35%. What was the average percentage?

A rectangular solid measures 13.4 cm x 11.0 cm x 2.2 cm. Calculate the volume of the solid.

If the density of mercury is 13.6 g/ml, what is the mass in grams of 3426 ml of the liquid?

Naming and Writing Chemical Formulas Worksheet

Write the formulas for the following:

a. Barium sulfate _____

b. Ammonium chloride _____

c. Chlorine monoxide _____

d. Silicon tetrachloride _____

e. Magnesium fluoride _____

f. Sodium oxide _____

g. Sodium peroxide _____

h. Copper (i) oxide _____

i. Zinc sulfide _____

j. Potassium carbonate _____

k. Hydrobromic acid _____

l. Perchloric Acid _____

m. Lead (ii) acetate _____

n. Sodium permanganate _____

o. Lithium oxalate _____

p. Potassium cyanide _____

q. Iron (iii) hydroxide _____

r. Silicon dioxide _____

s. Nitrogen trifluoride _____

t. Chromium (iii) oxide _____

u. Calcium chlorate _____

v. Sodium thiocyanate _____

w. Nitrous acid _____

Name each of the following:

a. $CuSO_4$ _____

b. PCl_3 _____

c. Li_3N _____

d. $BaSO_3$ _____

e. N_2F_4 _____

f. $KClO_4$ _____

g. NaH _____

h. $(NH_4)_2Cr_2O_7$ _____

i. HNO_2 * _____

j. Sr_3P_2 _____

k. $Mg(OH)_2$ _____

l. Al_2S_3 _____

m. $AgBr$ _____

n. P_4O_{10} _____

o. $HC_2H_3O_2$ * _____

p. CaI_2 _____

q. MnO_2 _____

r. Li_2O _____

s. FeI_3 _____

t. Cu_3PO_4 _____

u. PCl_5 _____

v. $NaCN$ _____

w. HF * _____

* - Name as acids

Dimensional Analysis Worksheet

Much of the work you will do in AP Chemistry evolves around using dimensional analysis. Converting a measurement from one unit to another is accomplished with dimensional analysis.

Show work for all problems:

1) How many nanometers are there in 23.2 centimeters?

2) An iron (II) carbonate sample has a mass of 729g. How many moles of iron are in this sample? How many moles of carbon atoms? How many moles of oxygen atoms?

3) Perform the following conversion: $6.00 g/cm^3$ = _____ mg/L ?

4) Convert 23.2 ºC to:

   a. ºF

   b. K

5) An experiment requires 75.0 g of ethyl alcohol (density 0.790 g/mL). What volume, in liters will be required?

6) Calculate the mass of a rectangular solid that has a density of 2.53 g/cm^3, and which measures 2.50 cm by 1.80 cm by 3.00 cm.

7) A sample containing 2.94 mol of elemental calcium contains how many atoms?

8) A sample containing 2.94 mol of elemental oxygen contains how many atoms?

9) How many grams of HCl are required to make 350mL of a 3.0 M solution?

Writing Chemical Equations Worksheet

Give the type for each of the following reactions:

1) $NaOH + KNO_3 \rightarrow NaNO_3 + KOH$ _____

2) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ _____

3) $Fe + 3NaBr \rightarrow FeBr_3 + 3Na$ _____

4) $CaSO_4 + Mg(OH)_2 \rightarrow Ca(OH)_2 + MgSO_4$ _____

5) $NH_4OH + HBr \rightarrow H_2O + NH_4Br$ _____

6) $Pb + O_2 \rightarrow PbO_2$ _____

7) $Na_2CO_3 \rightarrow Na_2O + CO_2$ _____

For each equation below, identify the type (synthesis, decomposition, single replacement, double replacement, or combustion), predict the products, and then write the balanced reaction. Remember to use the solubility rules for double replacement reactions (to figure out if there is a precipitate) 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.

This is a double replacement reaction.

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

8) Ammonium sulfate reacts with barium nitrate.

9) Zinc metal is added to a solution of copper (II) chloride.

10) Propane gas (C_3H_8) is burned in excess oxygen. **[Important fact: The products of burning a hydrocarbon are always CO_2 and H_2O. Use this fact for #14 also]**

11) Chlorine gas is bubbled through a solution of sodium bromide.

12) Solutions of lead (II) nitrate and calcium iodide are combined.

13) Sulfuric acid is combined with sodium hydroxide.

14) Isopropyl alcohol (C_3H_7OH) is burned in oxygen.

15) Iron metal shavings are added to hydrochloric acid.

16) Sodium metal is added to distilled water.

Stoichiometry Problems Worksheet

1) Find the mass percent of nitrogen within each of the following compounds. In other words, what percent of each compound's mass consists of nitrogen?

   a. NO

   b. NO_2

   c. N_2O_4

   d. N_2O

2) Benzene (don't look it up to solve the problem) contains only carbon and hydrogen and has a molar mass of 78.1 g/mol. Analysis shows the compound to be 7.54% hydrogen by mass. Find the empirical (which is the most reduced) and molecular (actual, unreduced) formula of benzene.

3) Calcium carbonate decomposes upon heating, producing calcium oxide and carbon dioxide.

   a. Write a balanced chemical equation for this reaction.

   b. How many grams of calcium oxide will be produced after 12.25 grams of calcium carbonate are completely decomposed?

4) Hydrogen gas and bromine gas react to form hydrogen bromide gas.

   a. Write a balanced equation for this reaction.

   b. 3.2 grams of hydrogen reacts with 9.5 grams of bromine. Which is the limiting reactant?

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

   d. How many grams of excess reactant are left unreacted?

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

   a. Write a balanced equation for this reaction.

   b. Calculate the mass of each product produced when 225 grams of oxygen gas react with an excess of the other two reactants.

   c. If the actual yield of the experiment in (b) is 105 grams of HCN, calculate the percent yield.

6) When solutions of potassium iodide and lead (II) nitrate are combined, the products are potassium nitrate and lead (II) iodide.

   a. Write a balanced equation for this reaction, including (aq) and (s).

   b. Calculate the mass of precipitate produced when 50.0mL of 0.45M potassium iodide solution and 75mL of 0.55M lead (II) nitrate solution are mixed.