AP CHEMISTRY 2017 SUMMERWORK

Instructor: Enyonam Akondo
Summer Contact: enyonamakondo@cusd.com

Intent of Assignment:

- ✓ Establish basic expectations of AP level chemistry in terms of student work and text.
- ✓ Reintroduce and Refine some of the basic concepts and skills learned in chemistry.
- ✓ Demonstrate student commitment and work ethic.
- ✓ Allows us to spend more class time on the more rigorous and less familiar concepts during the school year.

Assignment Due Date:

Assignments must be completed and turned in by ***August 25, 2017***

Resources:

- ✓ Chemistry 7th Edition (Zumdahl & Zumdahl)…LMC
- ✓ Lab Experiments for AP Chemistry, 1st Edition (Dr. Sally Vonderbrink)…LMC
- ✓ http://socratic.org/chemistry...225 Chemistry Topics on file
- ✓ https://www.youtube.com/watch?v=6pUzPh_lCO8&list=PLllVwaZQkS2op2kDuFifhStNsS49LAxkZ
  - **Bozeman Science AP Chemistry**
- ✓ AP Chemistry Crash Course (Adrian Dingle)…Optional, but strongly recommended

Assignment Requirements

1. ALL calculation-based question must be supported by mathematical setup. Units must be included in work and answer. Sloppy work will result in deduction of points. I must be able to clearly understand your work.
2. Work must be completed in PENCIL only.
3. Complete each section/segment of questions on separate sheets of paper, and be sure to include a section title (Page number, Question title, and problems).

Topic & Resource	ASSIGNMENT Task(s)
Uncertainty in Measurement & Significant Figures ✓ **PREVIEW…Ch.1.4 – 1.5** ✓ **WATCH Video Tutorial Accuracy and Precision, Systematic Error and Random Uncertainty.** **https://www.youtube.com/watch?v=icWY7nICrfo** ✓ **WATCH Video Tutorials @ socratic.org…** o Significant Figures o Scientific Notation o Accuracy, Precision, and Percent Error ✓ **REVIEW "Reporting Laboratory Data" in Lab Manual**	**A. WORKSHEET 1…***Error and Error Analysis in Chemistry Experiments* **B. WORKSHEET 2…***Chemistry Lab Hardware Scavenger Hunt*
Fundamental Chemical Laws & Early Experiments ✓ **PREVIEW Ch.2.2-2.5** ✓ **REVIEW: Fundamental Chemical Laws** http://chemwiki.ucdavis.edu/Textbook_Maps/General_Chemistry_Textbook_Maps/Map%3A_Chemistry_(Zumdahl_and_Zumdahl)/02%3A_Atoms_Molecules_and_Ions/2.02_Fundamental_Chemical_Laws **http://chemistry.csudh.edu/faculty/krodriguez/CHEM110/Ch2_Atoms_Molecules_and_Ions/2_2_Fundamental_Chemical_Laws.pdf** ✓ **WATCH Video Tutorials @ socratic.org…** o Atomic Models o Mass Conservation o Laws of Proportions o Cathode Ray Tube Experiment o Millikan's Oil Drop Experiment o Rutherford's Gold Foil Experiment o Discovery of the Neutron	**C. WORKSHEET 3…***Law of Definite & Multiple Proportions*
Molecules & Ions, Periodic Table (Introduction), & Naming Compounds ✓ **PREVIEW Ch. 2.6 – 2.8** ✓ **WATCH Video Tutorials @ socratic.org…** o The Periodic Table o Metals and Nonmetals o Metalloids o Ionic Compounds o Polyatomic Ions o Writing Ionic Formulas o Naming Ionic Compounds o Covalent Formulas and Nomenclature	D. **WORKSHEET 4:** *Writing Formulas and Naming Compounds (AKA Chemical Nomenclature)* E. **WORKSHEET 5:** *Drawing Lewis Dot Structures & Determining Bond Polarity*

The Mole, Molar Mass, Percent Composition of Compounds, Empirical & Molecular Formulas ✓ **PREVIEW Ch.3.3 – 3.5** ✓ **WATCH Video Tutorials @ socratic.org…** o The Mole o Percent Composition o Empirical and Molecular Formulas **STOICHIOMETRY** ✓ **PREVIEW Ch. 3.9 – 3.10** ✓ **WATCH Video Tutorials @ socratic.org…** o Stoichiometry o Mole Ratios o Equation Stoichiometry o Limiting Reagent o Percent Yield	**F. WORKSHEET 6:** *Empirical & Molecular Formula* **G. WORKSHEET 7:** *Mass Conservation in Chemical Reactions*
Solutions: Solubility & Concentration Expression **HOMOGENEOUS MIXTURES** ✓ **PREVIEW Ch. 4.1 – 4.2 & 11.3** ✓ **WATCH Video Tutorials @ socratic.org…** o Solutions o Solute o Solvent o Solution Formation o Solvation and Dissociation o Saturated and Supersaturated Solutions o Measuring Concentration o Solving Using PPM (Parts Per Million) o Molarity o Percent Concentration o Dilution Calculations o Factors Affecting Solubility o Solubility Graphs o Separating Mixtures	**H. WORKSHEET 8:** *Solutions*

AP Chemistry Summer Assignment Worksheets (1-8)

WORKSHEET 1 (Ch.1: Error and Error Analysis in Chemistry Experiments)

SCENARIO A:

Suppose an experiment has been performed to determine the mass percent of sulfate ions in a sample. To show the precision of the method used, the experiment was repeated four times, with the following results:

Sample	% Sulfate	Absolute Deviation
A	**44.02**	
B	**44.11**	
C	**43.98**	
D	**44.09**	

1. What is the experimental "mean" or "average" value?

2. Determine the "Absolute Deviation", and record the values in the table above. You need only show a sample calculation using "SAMPLE A" data.

3. Determine the experimental "Average Deviation".

4. Determine the "Percent Deviation" (AKA. Relative Precision) value for the experiment.

5. For each of the values you determined, discuss the relevance/purpose to the results. Be concise, BUT specific in your explanation.

SCENARIO B:

An AP Chemistry student was given the very challenging task (on the 1st day of school) to determine the density of an irregular object. The student used a digital balance to measure the object's mass, and then measured the object's volume by displacing water in a graduated cylinder, with gradations of 0.1mL. The mass of the object was determined to be 4.52g and the level of the water in the cylinder was 19.55mL and 23.55mL when the object was placed into the water.

6. Calculate the object's density.

7. Determine the uncertainty of the
   a. Mass

   b. Volume

   c. Density

8. Calculate the percent error that resulted if the theoretically accepted value (according to the handbook of Chemistry & Physics) for the sample measured is known to be 0.703 g/cm^3.

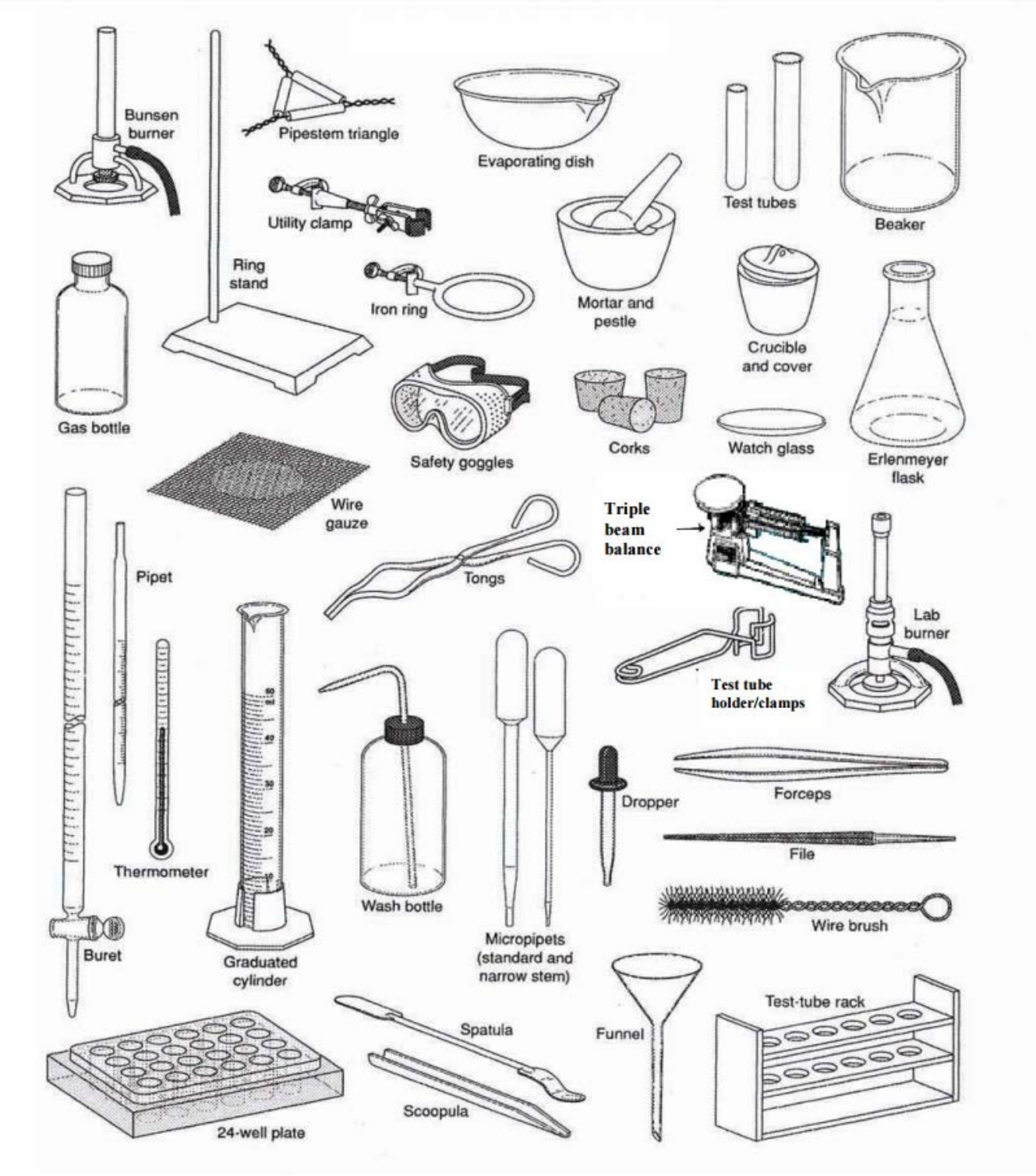
9. Comment on the error. Is the uncertainty greater or less than the percent error? Is the error random or systematic? Briefly explain.

WORKSHEET 2…Chemistry Lab Hardware Scavenger Hunt

DIRECTIONS: The items shown are commonly used in lab. For each of the items shown, (A) provide a name, (B) identify its purpose either as a measuring device (MD), or functional device (FD), and (C) state what it measures (ex: volume, mass, etc.), or how it's used.

Example:

Goggles = FD, used to protect the eyes during labs.



WORKSHEET 3: EXPLORING FUNDAMENTAL CHEMICAL LAWS
Fundamental Chemical Laws

Why?

In the late 1700s, French and English scientists measured how the mass of products of chemical reaction related to the masses of the reactants, with special interest in reactions by which different elements are reacted together to form compounds, or by which compounds are decomposed (usually by heating) into elements. Based on the mass measurements, three fundamental chemical laws were discovered that had (and still have) useful predictive power, and that helped John Dalton develop his Atomic Theory in the early 1800s.

Learning Objectives

- ✓ To understand three laws about mass that were important for development of atomic theory.

Success Criteria

- ✓ Be able to state, describe the usefulness of, and use the laws named in the New Concepts section.

RESOURCES: See "Assignment Task Sheet"

Prerequisites

Meaning of "mass" and units of grams

Vocabulary (these definitions predate Atomic Theory)

- ❑ Substance - a given substance is defined by a set of properties that do not change with time or location.

  (Properties include color, density, melting and boiling temperatures, etc.)
- ❑ Element - a substance that cannot be decomposed into another substance.
- ❑ Compound - a substance that can be synthesized from, or decomposed into two or more elements.
- ❑ Reactant - a substance that is consumed by a chemical reaction
- ❑ Product - a substance that is produced by a chemical reaction.

New Concepts

- ✓ Law of conservation of mass
- ✓ Law of definite proportions
- ✓ Law of multiple proportions

Focus Information (a.k.a. the "Model")

Three fundamental chemical laws:

1. Conservation of Mass (Lavoisier, 1743-1794): The total mass of products of a chemical reaction is exactly the same as the mass of reactants consumed by the reaction.
2. Law of Definite Proportions (Proust, 1754-1826): A given compound always contains exactly the same proportion of elements by mass.
3. Law of Multiple Proportions (Dalton, 1766-1844): When elements A and B form a series of compounds, the ratio of masses of B that combine (in different compounds) with 1 g of A can be reduced to small whole numbers.

Law of Definite and Multiple Proportions

Directions: *Respond to the following questions on a separate sheet of paper*

1. Table sugar is a compound known as sucrose. Sucrose is composed of the elements carbon, hydrogen, and oxygen. Analysis of a 20.0 g of sucrose from a bag of sugar finds that the sugar is composed of 8.44 g of carbon, 1.30 g of hydrogen, and 10.26 g of oxygen.
    a. Express, as fractions, the ratio of the mass of each element to the total mass of the sample.
    b. Using these ratios, calculate the percent composition by mass of each element in the compound.

2. A similar chemical analysis is performed on a 500.0 g sample of the sugar isolated from a sample of pure sugar cane. Analysis shows this sample contains 211.0 g of carbon, 32.5 g of hydrogen, and 256.5 g of oxygen.
    a. Determine the percent composition by mass of each element in the sugar cane sample.
    b. Could the sugar in this sample be sucrose? Justify your conclusion.

3. A similar chemical analysis is performed on a 200.0g sample of the sugar found in corn syrup. This sample contains 80.0g of carbon, 13.3 g of hydrogen and 106.7 g of oxygen.
    a. Determine the percent composition by mass of each element in the sugar cane sample.
    b. Could the sugar in corn syrup be sucrose? Justify your conclusion.

4. A 1.0 g sample of hydrogen reacts completely with 19.0 g of fluorine to form a compound of hydrogen and fluorine.
    a. What is the percent by mass of each element in the compound?
    b. What mass of hydrogen would be present in a 50 g sample of this compound?
    c. Justify your answer to b.

5. Explain how the previous examples help to illustrate the Law of Definite Proportions.

6. Two compounds of hydrogen and oxygen are tested. Compound I contains 15.0 g of hydrogen and 120.0 g of oxygen. Compound II contains 2.0 g of hydrogen and 32.0 g of oxygen.
   a. Determine the ratio of the mass of oxygen to the mass of hydrogen in each of the compounds.
   b. Why are the compounds not the same?
   c. What is significant about these mass ratios?
   d. If compound II is water, what could be the formula of compound I?

7. Nitrogen and oxygen combine to form a variety of compounds. The following data were collected for three different compounds of nitrogen and oxygen:

Analysis Data of Nitrogen & Oxygen Compounds	
Compound	Mass of Nitrogen that combines with 1.00 g of Oxygen
A	1.750 g
B	0.8750 g
C	0.4375 g

   a. Additional evidence shows that the formula of compound B is NO. Sketch particle diagrams of molecules of all three compounds.
   b. Justify your representations above.

8. Explain how the examples in questions 6 and 7 help to illustrate the Law of Multiple Proportions.

WORKSHEET 4: Writing Formulas and Naming Compounds

(AKA Chemical Nomenclature)

BACKGROUND

Writing formulas and naming compounds can be confusing because there are different types of compounds that follow different rules. Additionally, some compounds (H_2O, NH_3, CH_4, etc.) simply have ***common names*** that must be memorized.

The two types of compounds we will focus on first are ***ionic compounds*** (formed from positive and negative ions) and ***binary nonmetal compounds*** (molecular compounds). Later we will add ***acids***. So… you must recognize the ***type*** of compound before you try to name it. [Note: + ion = "cation" and – ion = "anion".]

	Ionic	**Binary Nonmetal**
Formula	+ ion before – ion ex: $NaCl$ $(NH_4)_2SO_4$ Al_2S_3	usually the less electronegative atom is first ex: CO CO_2 N_2O
Naming	Name of cation + name of anion • sodium chloride • ammonium sulfate • aluminum sulfide	Indicate the number (mono, di, tri, and kind of atoms. First element is simply name of element. Second element name ends with "ide" • carbon monoxide • carbon dioxide • dinitrogen monoxide

1. **Writing Ionic Formulas**

	Cl^-	NO_3^-	S^{2-}	CO_3^{2-}	N^{3-}	PO_4^{3-}	OH^-
Na^+							
NH_4^+							
Sn^{2+}							
Hg_2^{2+}							
Al^{3+}							
Sn^{4+}							

2. **Naming Ionic Compounds**

Cation	**Anion**	**Formula**	**Name**
Cu^{2+}	OH^-		
Ba^{2+}	SO_4^{2-}		
NH_4^+	$Cr_2O_7^{2-}$		
Ag^+	$C_2H_3O_2^-$		
Fe^{3+}	S^{2-}		

PREFIXES

mono	di	tri	tetra	penta	hexa	hepta	octa	nona	deca

III. Writing Formulas of Binary (containing only 2 different elements) Nonmetal Compounds

Name	Formula	Name	Formula
nitrogen trifluoride		phosphorus trichloride	
nitrogen monoxide		phosphorus pentachloride	
nitrogen dioxide		sulfur hexafluoride	
dinitrogen tetroxide		disulfur decafluoride	
dinitrogen monoxide		xenon tetrafluoride	

IV. Naming Binary Nonmetal Compounds

Name	Formula	Name	Formula
	CCl_4		HBr
	P_4O_{10}		N_2F_4
	ClF_3		XeF_3
	BCl_3		PI_3
	SF_4		SCl_2

V. Practice for Both Types of Compounds

Formula	Name
HCl	
PCl_5	
K_2S	
$NiSO_4$	
ClF_3	
OF_2	
$Al(OH)_3$	
NCl_3	
$(NH_4)_3PO_4$	

Formula	Name
	carbon dioxide
	ammonium carbonate
	sulfur dichloride
	calcium iodide
	boron trifluoride
	phosphorus triiodide
	magnesium perchlorate
	potassium permanganate
	aluminum phosphate

WORKSHEET 5:

Drawing Lewis Dot Structures & Determining Bond Polarity

DIRECTIONS – Complete this task series on a SEPARATE SHEET of paper. (A) State whether the bond(s) is/are polar, non-polar, or ionic. (B) Draw the Lewis dot structure

1 H 2.1																
3 Li 1.0	4 Be 1.5											5 B 2.0	6 C 2.5	7 N 3.0	8 O 3.5	9 F 4.0
11 Na 0.9	12 Mg 1.2											13 Al 1.5	14 Si 1.8	15 P 2.1	16 S 2.5	17 Cl 3.0
19 K 0.8	20 Ca 1.0	21 Sc 1.3	22 Ti 1.5	23 V 1.6	24 Cr 1.6	25 Mn 1.5	26 Fe 1.8	27 Co 1.9	28 Ni 1.9	29 Cu 1.9	30 Zn 1.6	31 Ga 1.6	32 Ge 1.8	33 As 2.0	34 Se 2.4	35 Br 2.8
37 Rb 0.8	38 Sr 1.0	39 Y 1.2	40 Zr 1.4	41 Nb 1.6	42 Mo 1.8	43 Tc 1.9	44 Ru 2.2	45 Rh 2.2	46 Pd 2.2	47 Ag 1.9	48 Cd 1.7	49 In 1.7	50 Sn 1.8	51 Sb 1.9	52 Te 2.1	53 I 2.5
55 Cs 0.7	56 Ba 0.9	57 La 1.1	72 Hf 1.3	73 Ta 1.5	74 W 1.7	75 Re 1.9	76 Os 2.2	77 Ir 2.2	78 Pt 2.2	79 Au 2.4	80 Hg 1.9	81 Tl 1.8	82 Pb 1.9	83 Bi 1.9	84 Po 2.0	85 At 2.2
87 Fr 0.7	88 Ra 0.9	89 Ac 1.1														

Increasing →

Decreasing ↓

Electronegativities of the Elements

Electronegativity difference (Δ)	Bond
$\Delta > 2$	Ionic
$0.4 < \Delta < 2$	Polar Covalent, (or covalent with partial ionic character).
$\Delta < 0.4$	Covalent

Compound	Bond Type	Lewis Dot

1. OF_2	9. H_2O_2	17. CH_3OH
2. CH_3NH_2	10. NH_2^-	18. SiI_4
3. SO_3	11. AlH_3	19. NF_3
4. C_2H_5OH	12. $Mg(SCN)_2$	20. $HClO_4$ (aq)
5. $CaCl_2$	13. C_2H_2	21. CH_3COOH (aq)
6. BeF_2	14. HNO_3 (aq)	22. LiCl
7. ClO_3^-	15. CO	23. $C_2O_4^{2-}$
8. KOH	16. $AsBr_5$	24. C_6H_6 (cyclic)

WORKSHEET 6: Empirical & Molecular Formula

DIRECTIONS- Use the information provided in each question to answer each follow up question on a separate sheet of paper.

1. Give the empirical formula that corresponds to each of the following molecular formulas.
   a. Sodium peroxide, NaO

   b. Terephthalic acid, $C_8H_6O_4$

   c. Phenobarbital, $C_{12}H_{12}N_2O_3$

   d. 1, 4-dichloro-2-butene, $C_4H_6\ Cl_2$

2. Which of the following pairs of compounds have the same **empirical** formula?
   a. Acetylene, C_2H_2, and benzene, C_6H_6

   b. Ethane, C_2H_6, and benzene, C_6H_6

   c. Nitrogen dioxide, NO_2 , and dinitrogen tetroxide, N_2O_4

3. D. Diphenyl ether, $C_{12}H_8O$, and phenol, C_6H_5OHIn an experiment, a 2.514-g sample of calcium was heated in a stream of pure oxygen, and was found to increase in mass by 1.004 g. Calculate the **empirical formula** of calcium oxide.

4. A compound has the following percentages by mass: barium, 58.8%; sulfur, 13.74%; oxygen, 27.43%. Determine the **empirical formula** of the compound.

5. If a 1.271-g sample of aluminum metal is heated in a chlorine gas atmosphere, the mass of aluminum chloride produced is 6.280 g. Calculate the **empirical formula** of the aluminum chloride.

6. If cobalt metal is mixed with excess sulfur and heated strongly, a sulfide is produced that contains 55.06% cobalt by mass. Calculate the **empirical formula** of the sulfide.

7. A compound has the following percentage composition by mass: copper, 33.88%; nitrogen, 14.94%; oxygen 51.18%. Determine the **empirical formula** of the compound.

8. A compound with the empirical formula CH_2 was found to have a molar mass of approximately 84 g. What is the **molecular formula** of the compound?

9. A compound with the empirical formula CH_4O was found in a subsequent experiment to have a molar mass of approximately 192 g. What is the **molecular formula** of the compound?

10. A compound consists of 65.45% C, 5.492% H, and 29.06% O on a mass basis and has a molar mass of approximately 110 g/mol. Determine the **molecular formula** of the compound.

WORKSHEET 7: Mass Conservation in Chemical Reactions

DIRECTIONS- Use the information provided in each scenario to answer each follow up question on a separate sheet of paper.

Scenario A:

Burning coal and oil in a power plant produces pollutants such as sulfur dioxide, SO_2. The sulfur-containing compound can be removed from other waste gases, however, by the following reaction:

____ $SO_2(g)$ + ____ $CaCO_3(s)$ + ____ $O_2(g)$ → ____ $CaSO_4(s)$ + ____ $CO_2(g)$

[MM (g/mol) _____ _____ _____ → _____ _____ **]**

1. Fill-in the missing coefficients.
2. Fill-in the missing molar masses (MM)
3. Provide a molecular interpretation of the reaction:

4. Provide a molar interpretation of the reaction:

5. During a lab experiment, 155g of sulfur dioxide was reacted.
   a. What is the mass percent of sulfur dioxide?

   b. How many moles of sulfur dioxide makes up that amount?

   c. At STP, how much volume (in mL) would that amount of SO_2 gas take up?

   d. How many moles of calcium carbonate ($CaCO_3$) would have to react as well? What would that quantity of moles be in grams?

   e. How many moles of O_2 would also have to react as well? How many mL of space would that quantity of O_2 gas occupy at STP?

   f. How many moles and grams of calcium sulfate ($CaSO_4$), and how many moles, liters, and grams of carbon dioxide were made?

Scenario B:

The reaction of methane and water is one way to prepare hydrogen:

_____ $CH_4(g)$ + _____ $H_2O(g)$ → _____ $CO(g)$ + _____ $H_2(g)$

[**Molar masses:** _____ g/mol 18.02g/mol → _____ _____]

6. Assume that you used 995 g of CH_4 and 2510 g of water.
   a. Justify and then identify the "Limiting" reagent/reactant. Determine how many moles of the limiting reagent/reactant will react.
   b. Identify the "Excess" reagent/reactant. Determine how many moles of the "Excess" reacts with the "Limiting".

c. Calculate the maximum volume of H_2 that can be yielded? What is that quantity in moles and grams?
d. Draw a flow-map/chart showing the sequence of steps that have to be carried out to solve the problem
e. Show the units and substance labels involved in each flow sequence.
f. Solve the question. How many moles and grams of the "Excess" reagent/reactant remains unreacted?

SCENARIO C

Diborane, B_2H_6, is a valuable compound in the synthesis of new organic compounds. One of several ways this born compound can be made is by the reaction

$2\ NaBH_4(s) + I_2(s) \rightarrow B_2H_6(g) + 2\ NaI(s) + H_2(g)$

[Molar masses: 37.84 253.8 27.67 149.9 2.02]

Suppose you use 1.203 g of $NaBH_4$ with an excess of iodine and obtain 0.295 g of B_2H_6. What is the percent yield of B_2H_6?

WORKSHEET 8: Solutions

DIRECTIONS- Use the information provided in each question to answer each follow up question on a separate sheet of paper.

Section A: Solubility & Solubility Curves

1. What is the difference between a solute and solvent?

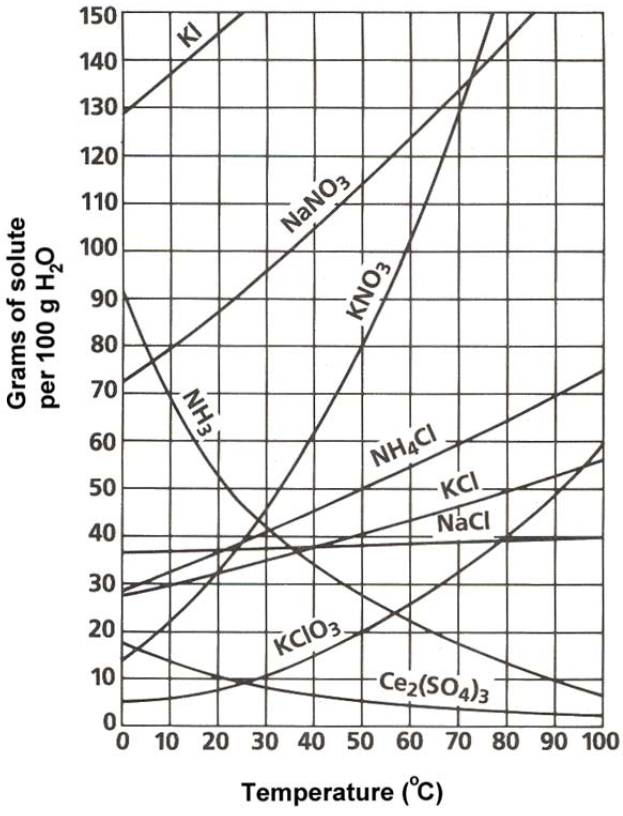
2. Define the terms miscible and immiscible.

3. How is "solubility" defined?

4. What are the differences between a saturated solution, unsaturated solution and a supersaturated solution?

5. How could you tell by looking at a solution that it was saturated?

6. Use the solubility curve below to answer questions a - e. Be sure to note the units on the axes of the graph.



a. In general, how does temperature affect solubility?

b. Which compound is least soluble at 10°C?

c. How many grams of KCl can be dissolved in 100g of water at 80°C?

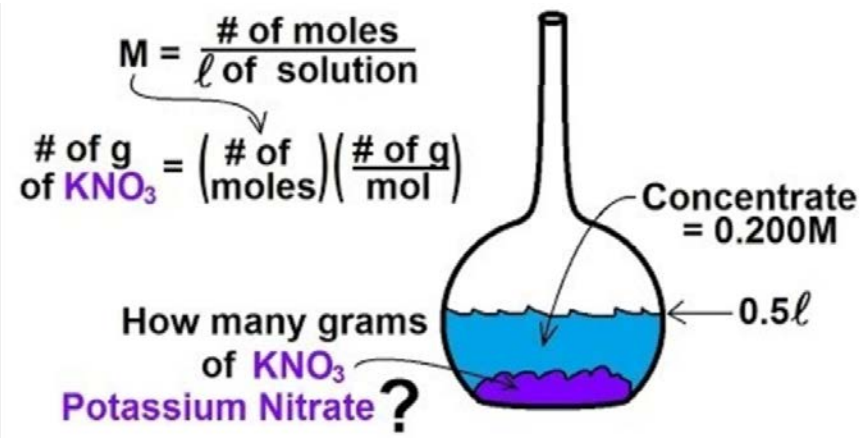
d. How many grams of NaCl can be dissolved in 50g of water at 90°C?

e. At 60°C, 72 g of NH4Cl are dissolved in 100g of Water. This solution is considered to be (check the box that applies):

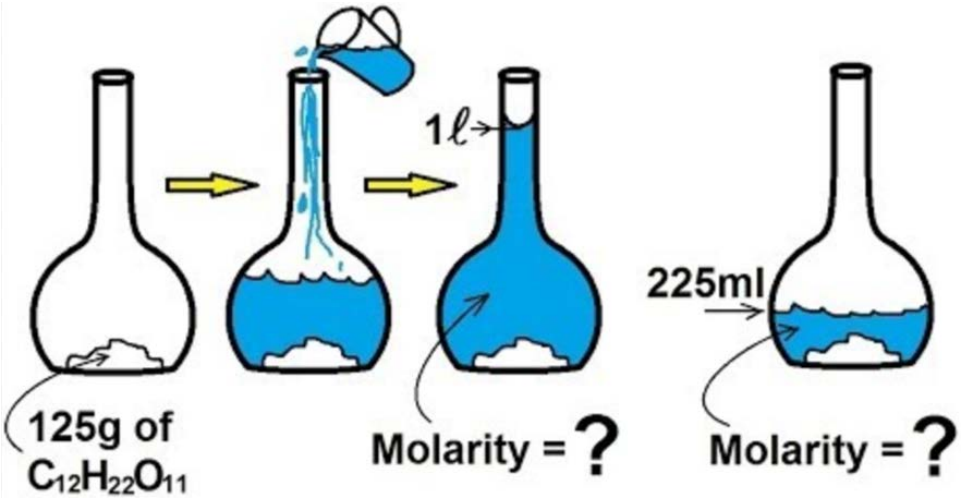
- ❑ Saturated
- ❑ Unsaturated
- ❑ Supersaturated
- ❑ Saturated with some left undissolved

Section B: Solution Concentration

1.



2.



3. What volume of 0.88 M potassium chromate (K_2CrO_4) contains 0.32 moles of potassium ions?
4. Concentrated ammonia contains 26 g per 100 mL of solution. What is the molarity of this solution?
5. What volume of 0.275M $Ba(OH)_2$ must be used to have 8.65 g of barium hydroxide?
6. What is the concentration of all ions present in a solution that is 0.250 M $AlCl_3$?
7. What mass of solute would be needed to prepare 125 mL of 0.188 M sodium phosphate (Na_3PO_4)?