Safety Rules:

1. *Prepare for each experiment by reading all of the directions before lab starts.*
2. *Locate the Safety Equipment.* Know the locations of the eye wash, safety shower, fire extinguishers, fire blankets, first aid kit, fume hoods, telephone and all exits that are to be used in an emergency. Your laboratory instructor will describe the use of the safety equipment.
3. *Protect your eyes.* Wear safety glasses or goggles at all times. Your laboratory instructor will tell you which of these you must have. Goggles provide maximum safety. Prescription glasses, if you need them, must be worn under safety glasses or goggles. Contact lenses should not be worn in the laboratory because fumes may accumulate under the lenses and injure your eyes and the lenses make it difficult to flush chemicals from your eyes.
4. *Tie long hair back.* This precaution will keep your hair out of burner flames and harmful chemicals.
5. *Do not wear clothing with loose, flowing sleeves.* This precaution will keep your sleeves out of burner flames and harmful chemicals.
6. *Wear shoes that cover all of your feet.* Broken glass on the laboratory floor and spilled chemical reagents are all too common. Shoes that cover your feet completely will protect them from broken glass and chemical splashes. The best types of shoes are closed-toe made out of leather.
7. *Wear clothes that cover your torso and your legs to the knees.* Clothing will give your body needed protection. Good clothing can be protected with a lab apron or coat.
8. *Do not eat or drink in the laboratory.*
9. *Do not taste any chemical reagent.*
10. *Do not smell chemical reagents directly.* When you are instructed to smell a chemical, do so by gently wafting the vapors toward your face. Do not inhale deeply.
11. *Do not pipet solutions by mouth.* Use a rubber suction bulb to fill the pipet.
12. *Do not work with flammable liquids near a flame.*
13. *Do not engage in games or horseplay in the laboratory.* Never run in the laboratory.
14. *Do not attempt unauthorized experiments in the laboratory.*
15. *Do not work in the laboratory in the absence of your instructor or his or her authorized representative.*
16. *Use a fume hood when required.*
17. *Handle glass tubing and thermometers carefully.* When inserting glass tubing or thermometers through a rubber stopper, always hold the glass close to the stopper and use a lubricant such as glycerin to help the glass slide through the stopper. Do not continue to try to force glass through a stubborn stopper, get a new stopper and/or get help. When inserting a pipet into a pipet bulb, hold the pipet near the bulb and GENTLY insert the pipet.
18. *When diluting, never pour water into concentrated reagents.* Always pour the reagent into the water.
19. *If you spill a chemical reagent on yourself, immediately flood the exposed area with water, then summon the laboratory instructor. Inform the instructor immediately about any other accidents or spills.*
20. *Be aware of your neighbors. Are they obeying the safety rules?* A neighbor's accident may injure you.
21. *Avoid touching your face and rubbing your eyes while in the laboratory.* If you must do so, first wash your hands.
22. *Wash your hands before leaving the laboratory.*

23. *Never heat a closed container.* Pressure build up can cause the container to explode.
24. *Assume any chemical is hazardous if you are unsure.*
25. *Do not violate any other safety rule issued by your laboratory instructor.*

Housekeeping Rules:

1. *Clean up broken glass immediately with a broom and dustpan. Do not use your hands.* Dispose of broken glass in the special container that is provided.
2. *Chemical spills must be cleaned up immediately.* Immediately notify your instructor who will advise you how to clean it up and/or assist you. Dispose of the collected contaminated chemical properly as instructed.
3. *Do not pour any chemical down into the sink or in the trash without authorization.* Clearly labeled disposal bottles will be provided when needed.
4. *Take containers to the stock of chemical reagents.* Do not bring stock chemicals to your laboratory bench.
5. *Read the label on a reagent bottle carefully.* Is it the correct chemical? Is it the correct concentration?
6. *Do not insert your own pipet, medicine dropper or spatula into a stock bottle.*
7. *Use special care with stoppers or tops of stock bottles.* Do not allow them to pick up contamination. Your instructor will provide additional instructions for handling the stoppers or tops found in your laboratory.
8. *Always replace the stopper or top of a stock bottle when you are finished taking some of the reagent.* Make sure that you put the stopper or top back onto the correct bottle.
9. *When pouring liquid from bottles, hold the bottle with the label against the palm of your hand so that the liquid is poured from the side opposite the label.* If any liquid runs down the outside of the label, immediately wipe off the liquid.
10. *Do not take any more of a reagent than is required.* Many of the chemicals used in the laboratory, including deionized water, are costly.
11. *Never return any unused reagent to a stock bottle.* If you take too much of a chemical, dispose of it as directed by your instructor or offer it to a classmate who needs it.
12. *Set up your glassware and apparatus away from the edge of your laboratory bench.*
13. *Thoroughly clean the area around your laboratory bench and the top of your laboratory bench before leaving lab.*
14. *Keep shared areas of the laboratory clean.* This includes areas such as the balance room and where the stock bottles are stored. It is especially important to keep the balances clean and free of chemical spills.
15. *Keep your laboratory equipment clean.* Good results depend on clean equipment.
16. *If a piece of equipment containing mercury is broken, inform your laboratory instructor immediately.* Keep the area blocked off to avoid scattering the mercury.
17. Follow any other housekeeping rules given by your laboratory instructor.

General Guidelines:

1. *Missed labs generally cannot be made-up.* Since lab lecture covers an outline of the safety concerns for that lab, the department feels students who have missed the lab lecture are a safety risk to themselves and others in the lab. Students who arrive late to the lab lecture will not be allowed to participate. A student is allowed to miss one lab a quarter without penalty.
2. *No unsupervised work in the lab is allowed.*
3. *You must come to your assigned lab section.* Floating between different sections of lab is not allowed.
4. *The lab schedule will be provided by your instructor.*

Checking In and Out of Your Drawer:

Check-In

1. A $20 security deposit is required for each drawer. Please make a check payable to “Foothill College” for $20. It will be returned when you check-out of your drawer. Also write the chemistry course and drawer number on the bottom left corner of the check. On the back of the check write “For deposit only”. Cash is also acceptable. This deposit is due by the first day of the third week of the quarter.
2. Obtain a key, name slip and equipment list from your instructor. Check the condition of the equipment in your drawer. Examine the glassware carefully. Replace any broken or cracked items with new ones from the stockroom. Please specify to the stockroom staff the size and number of items you need. After you check in, you are responsible for the equipment and will have to pay for any missing or broken items.
3. After you have finished checking in, complete the name slip, sign the equipment list, and then give both slips to the stockroom attendant.
4. After you finish working in the lab, lock your drawer and return your key to the keyboard.

Check-Out

1. All students are required to check out of their lab drawer during their regularly scheduled check-out time in the last week of classes. Your instructor MUST be the one to check you out, as his/her signature is required. Please do not ask other instructors or stockroom personnel to check you out.
2. If you drop the class, you must come during a regularly scheduled lab time to have your instructor check you out of your drawer. Your instructor MUST be the one to check you out, as his/her signature is required. Please do not ask other instructors or stockroom personnel to check you out.

If you fail to check-out of your drawer as described above, you will forfeit your $20 security deposit!

Chemistry Laboratory Safety and Lab Locker Check-out Agreement

Whenever I am working in the laboratory, I will follow all the recommended safety practices including all verbal instructions and take the following precautions:

1. Always follow the printed **and verbal** instructions given for the experiment.
2. Dispose of all chemicals as directed by the experimental procedure or as directed by my instructor. Never discharge chemicals down the sink.
3. Wear approved splash-proof goggles at all times.
4. Immediately report **all** accidents and chemical spills to my laboratory instructor, no matter how minor.
5. Read labels on reagent bottles carefully before use. Learn of any hazards associated with the reagents.
6. Know the location and operation of all emergency safety equipment.
7. Never work without supervision.
8. Do only the experiment assigned by my instructor.
9. Wear clothing that will provide maximum protection.
10. Place book bags, backpacks and other bulky objects on the empty shelves in the lab, not in the walkways.
11. Never eat, drink, chew gum, or apply cosmetics in the laboratory.
12. Help keep the laboratory clean and uncluttered.
13. Use a fume hood when so directed.
14. Use good judgment, care, and common sense.
15. Use detergent or soap to wash my hands before I leave the laboratory.

Make sure you have a copy of the documents below and have read them prior to signing this form.

1. Foothill College Department of Chemistry Safety Rules and Regulations
2. Foothill College Department of Chemistry Laboratory Guidelines
3. Laboratory Syllabus
4. Lecture Syllabus

By signing this form I agree to the following:

1. I have carefully read and understand the required safety practices given in the Foothill College Department of Chemistry Safety Rules and Regulations document. I understand the importance in preserving the safety of everyone in the laboratory.
2. I have carefully read and understand the Department of Chemistry Laboratory Check-in and Check-out Guidelines and agree to follow them as written.
3. I recognize that it is my responsibility to follow these established practices and precautions while in the laboratory.
4. I understand that failure to follow these practices or any others outlined by my instructor is cause for dismissal from this course.
5. I have read the lecture and lab syllabi and agree to abide by all the terms given. I realize there are no make-up exams or quizzes provided and rescheduling of exam or quiz dates is not an option. Furthermore, there are no make-up lab sessions. Missing more than one lab will result in a zero for that lab session and will negatively affect my overall grade.

Print Your Name: ____

Your Signature: ____

Date: __________________________ Locker # _____________________

Course and section: _____________________ Instructor _____________________

Name: _______________ **Date:** _______________

Section #: _______________ **Partner:** _______________

Experiment 1: Density of Solids and Liquids

Objectives:

- To learn how to use common lab equipment including top loading balances, rulers, and the small and large graduated cylinders.
- To practice making measurements and reporting them correctly.
- To practice problem solving skills.

Prelab:
Read Appendix A from this manual and chapter 2 from McMurry's "Fundamentals of GOB Chemistry". Complete the online prelab assignment for "Density of Solids and Liquids" in Mastering Chemistry BEFORE the start of the lab session. NOTE: Students that do not complete the online prelab assignment will receive zero credit for this lab and the postlab.

You will work in pairs for this experiment.

Discussion:
A physical property is a property that can be measured or observed without changing the composition of a substance. Density is a physical property. It is defined by a substances mass per unit volume. In this lab, we will use common lab equipment to measure the density of a liquid (isopropyl alcohol), an irregular shaped solid (sulfur chunks) and a regular shaped solid (wood blocks). By the end of this lab you should be able to use the top loading balance, graduated cylinders, and the CRC Handbook. You should also be able to relate mass, volume and density mathematically, and you should be able to define and calculate percent error.

Equipment:
Isopropyl alcohol
Sulfur chunks
Wood blocks
CRC Handbook of Chemistry and Physics

Safety: Always wear your safety goggles while in the lab room. Do not dispose of anything in the drain unless specifically directed to by your instructor.

Procedure:
Part A: Density of isopropyl alcohol

1. Measure the mass of your small graduated cylinder by following the instructions below for the top loading balance:
    a. Place a piece of weighing paper on the balance pan
    b. Press zero/tare and wait for the balance to read 0.00 g
    c. Place your small cylinder on the paper and wait for the digital readout to stabilize
    d. Record the mass of the cylinder in the data section
    e. Remove the cylinder from the pan and return to your lab bench

2. Add between 5-10 mL of isopropyl alcohol to your small cylinder and record the volume in the data section. Be sure to measure from the base of the meniscus and use the correct number of significant figures by reading to the hundredth of a milliliter.
3. Being careful not to spill the isopropyl alcohol, measure the mass of the cylinder with alcohol on the same balance that you used before. Remember to follow the instructions below for the top loading balance:
    a. Place a piece of weighing paper on the balance pan
    b. Press zero/tare and wait for the balance to read 0.00 g
    c. Place your cylinder with isopropyl alcohol on the paper and wait for the digital readout to stabilize
    d. Record the mass of the cylinder with isopropyl alcohol in the data section
    e. Remove the cylinder with isopropyl alcohol from the pan and return to your lab bench
4. Calculate the mass of the isopropyl alcohol alone, and record this in the data section.
5. Calculate the density of the isopropyl alcohol in the calculations section, and record this in the data section.
6. Pour the isopropyl alcohol into the labeled waste container.

Part B: Density of sulfur

1. Add 2-3 sulfur chunks to your 50 mL beaker.
2. Measure the mass of the sulfur chunks following the instructions below for the top loading balance:
    a. Place a piece of weighing paper on the balance pan
    b. Press zero/tare and wait for the balance to read 0.00 g
    c. Place the sulfur chunks onto the paper and wait for the digital readout to stabilize
    d. Record the mass of the sulfur chunks in the data section
    e. Place the sulfur chunks back into your beaker, throw away the weighing paper, and return to your lab bench
3. Add about 25-30 mL of water to your large graduated cylinder and record the volume in the data section. Be sure to read from the base of the meniscus and use the correct number of significant figures by reading to the tenth of a milliliter.
4. Tilt the cylinder and carefully drop the sulfur chunks into the water. Be careful not to let the water splash out of the cylinder. If water splashes out of the cylinder you will need to start part B over!
5. Read the volume of the water plus the sulfur and record this in the data section.
6. Calculate the volume of the sulfur alone, and record this in the data section.
7. Calculate the density of the sulfur chunks in the calculations section, and record this in the data section.
8. Use the CRC Handbook of Chemistry and Physics to look up the density of sulfur. Record this theoretical value in the data section.
9. Determine the percent error by using the equation in the calculations section.
10. Pour the water into the drain, and catch the sulfur chunks with your hands or a funnel. Place the wet sulfur chunks into the container labeled “Wet Sulfur”.

Part C: Density of wooden block

1. Obtain a wooden block and record the block letter in the data section (W, O, P or M).
2. Measure the mass of the block following the directions below for the top loading balance:
    a. Place a piece of weighing paper on the balance pan
    b. Press zero/tare and wait for the balance to read 0.00 g
    c. Place the wood block onto the paper and wait for the digital readout to stabilize
    d. Record the mass of the block in the data section
    e. Remove the block from the balance and return to your lab bench
3. Using your ruler, measure the length, width and height of the wood block in cm, and record each measurement in the data section. Be certain to use the correct number of significant figures by reading to the tenth of a millimeter (the hundredth of a centimeter).

4. Calculate the density of the wood block in the calculations section, and record this in the data section. Your instructor will confirm whether your experimental density is reasonable.
5. Return the wooden block to the bin.

Data:

Part A: Density of isopropyl alcohol

Mass of small graduated cylinder (g)	
Volume of alcohol (mL)	
Mass of cylinder with alcohol (g)	
Mass of alcohol only (g)	
Density of alcohol (g/mL)	

Part B: Density of sulfur

Mass of sulfur (g)	
Volume of water (mL)	
Volume of water plus sulfur (mL)	
Volume of sulfur alone (mL)	
Density of sulfur (g/mL)	
Theoretical density of sulfur (g/mL)	

Part C: Density of wood block: Letter ______

Mass of wood block (g)	
Length (cm)	
Width (cm)	
Height (cm)	
Density of wood block (g/cm^3)	

Calculations:

Show calculations and include all units. Circle your final answers, and be sure to record them in the data section above when necessary.

1. Calculated density of isopropyl alcohol:

2. Calculated density of sulfur:

3. Percent error for sulfur density: Shows by what percent your experimental value is off from the accepted (theoretical) value. Ideally, your percent error will be within 5%. A percent error greater than 10% is considered a very large error.

$$\frac{|\text{Experimental} - \text{Theoretical}|}{\text{Theoretical}} \times 100 =$$

4. Calculated density of wood block:

Concept Question:

1. If another student were to use half the volume of isopropyl alcohol that you used in this experiment, how would their calculated density of isopropyl alcohol differ from yours?

   a. It would be greater than your calculated density
   b. It would be less than your calculated density
   c. It would be about the same as your calculated density

Postlab:

Your instructor must check your data, calculations and concept question before you leave the lab.
Your postlab assignment is due one week after the completion of this lab in Mastering Chemistry, or when specified by your instructor.

Inorganic Nomenclature

Being able to name and write proper formulas for elements, ions and compounds is critical to your success in Chemistry 30A. If you do not master this section in Chemistry 30A you will not be able to move on and be successful in upcoming chapters. In this lab session, you will practice naming and writing formulas for elements, ions and compounds. Element names can be found directly from the periodic table. A summary for how to name ions, ionic compounds and molecular compounds is given below.

To receive credit for the lab session your group must complete the attached worksheet and get checked off by the instructor before leaving the lab. Note that there are no prelab or postlab assignments in Mastering Chemistry for this lab session.

1. Naming Ions:

A. Cations:

When a metal loses its valence electrons it becomes a cation, which is an ion with a positive charge. For main group elements the number of valence electrons is easily predicted based on the group number. A cation is named by using the element name followed by the word "ion".

Some metals can react by losing different numbers of electrons. For example, tin and lead in group 4A can both react by losing two electrons or four electrons. For metals like these, which have multiple possible oxidation states, a roman numeral is needed to specify which oxidation state is appropriate. For example, tin ion should always be expressed as either "tin (II) ion" or "tin (IV) ion", depending on the charge.

Examples:
1. Sodium ion = Na^+
2. Magnesium ion = Mg^{2+}

B. Anions:

When a nonmetal gains valence electrons it becomes an anion, which is an ion with a negative charge. The number of electrons gained by a nonmetal will be equal to the group number subtracted from 8. For example, the group 7 nonmetals (halogens) will gain one electron. The anion is named by using the stem of the element name with the -ide ending.

Examples:
1. Chloride ion = Cl^-
2. Oxide ion = O^{2-}

C. Polyatomic Ions:

Polyatomic Ions are ions that contain two or more atoms (a group of atoms) with an overall charge. Polyatomic ions are held together by covalent bonds (to be discussed later), but they have an overall charge and are therefore ions. The chart on the next page shows the polyatomic ions that **must be memorized for Chem 30A**.

Name	Formula
Acetate	$C_2H_3O_2^-$ (CH_3COO^-)
Carbonate	CO_3^{2-}
Hydrogen carbonate (bicarbonate)	HCO_3^-
Hydroxide	OH^-
Hydronium	H_3O^+
Nitrate	NO_3^-
Nitrite	NO_2^-
Phosphate	PO_4^{3-}
Hydrogen phosphate	HPO_4^{2-}
Dihydrogen phosphate	$H_2PO_4^-$
Ammonium	NH_4^+
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}
Cyanide	CN^-

Practice: Write the name or formula for the following ions.

SO_3^{2-} ____________________ Ca^{2+} ____________________

Oxide ion ____________________ Iodide ion ____________________

Cyanide ion ____________________ Iron (III) ion ____________________

2. Naming Ionic Compounds:

Ionic compounds are formed when electrons are transferred between atoms to form cations and anions. Although ions are formed, the overall charges balance out and the charge on the compound is neutral. Ionic compounds are held together by electrostatic forces of attraction, and are typically formed when metals react with nonmetals. Below is a summary for naming and writing formulas for binary ionic compounds and ionic compounds containing polyatomic ions.

A. Binary Ionic Compounds contain only one type of metal and one type of nonmetal.

Converting a Formula to a Name:

a. Write the name of the cation (use roman numeral if necessary)
b. Write the name of the anion (use the –ide ending)

Examples:
1. MgO = Magnesium oxide
2. $PbCl_2$ = Lead (II) chloride

Converting a Name to a Formula:

a. Determine the charge on the cation

b. Determine the charge on the anion
c. Determine the ratio of cations to anions needed to make the compound neutral
d. Always express the ratio of cations to anions in the simplest whole number ratio

Examples:
1. Calcium chloride = $CaCl_2$
2. Sodium sulfide = Na_2S

B. Ionic Compounds Containing Polyatomic Ions:

In order to write formulas or names for ionic compounds that contain polyatomic ions, you must be able to recognize and name the polyatomic ion involved. The steps are identical to those outlined above for binary ionic compounds, with the addition of one: when there is more than one polyatomic ion in a formula, you MUST write it in parenthesis and put the subscript indicating the number of polyatomic ions outside the parenthesis.

Examples:
1. Magnesium nitrate = $Mg(NO_3)_2$
2. Iron (II) sulfate = $FeSO_4$
3. Iron (III) sulfate = $Fe_2(SO_4)_3$

Practice: Write the name or formula for the following ionic compounds.

NaCl ____________________ SrF_2 ____________________

Sodium iodide____________________ Calcium nitrate____________________

3. Naming Molecular Compounds:

Molecular compounds form when electrons are shared between atoms in order to achieve octet. The atoms are held together by covalent (molecular) bonds. There are no ions in molecular compounds. Molecular compounds are typically formed between nonmetals only.

There are seven elements that exist in nature as diatomic molecules, thus the element name is referring to the diatomic form: H_2, F_2, Cl_2, Br_2, I_2, N_2, O_2. **You must memorize these.**

When there are two or more different types of atoms in a molecular compound, we use prefixes to tell how many atoms of each element are present. **You must memorize these prefixes,** which are from the Greek number system.

Number	Prefix
1	mono-
2	di-
3	tri-
4	tetra-
5	penta-

6	hexa-
7	hepta-
8	octa-
9	nona-
10	deca-

Converting a Formula to a Name:

a. Write the name of the leftmost nonmetal using the appropriate prefix
b. If there is only one of the first element the mono prefix is dropped
c. Write the stem of the rightmost nonmetal with the –ide ending using the appropriate prefix
d. Do not drop the mono prefix on the second element
e. NOTE: ao is written as o; oo is written as o; ii is written as ii

Examples:

1. SF_6 = sulfur hexafluoride
2. N_2O_4 = dinitrogen tetroxide
3. CO = carbon monoxide

Practice: Write the name or formula for the following molecular compounds.

CO_2 ____________________ SO_3 ____________________

Carbon tetrabromide________________ Nitrogen triiodide__________________

4. Naming Acids:

An acid is a substance that is capable of donating a hydrogen ion (H+). **You must memorize the following binary and oxyacids for Chem 30A.**

A. Binary Acids: Binary acids contain H and one other element. They always start with the prefix hydro- followed by the stem of the other elements name and the word acid. NOTE: These substances are only named by the acid nomenclature rules if they are aqueous state.

Formula	Name
HF	Hydrofluoric acid
HI	Hydroiodic acid
HCl	Hydrochloric acid
HBr	Hydrobromic acid

B. Oxyacids: Oxyacids contain H, O and another element. They NEVER start with the hydro- prefix. They are named from the polyatomic ion names. If the polyatomic ion ends in –ate, the ending is changed to –ic followed by the word acid. If the polyatomic ion ends in –ite, the ending is changed to –ous followed by the word acid.

Formula	Name
H_2SO_4	Sulfuric acid
H_2SO_3	Sulfurous acid
HNO_3	Nitric acid
HNO_2	Nitrous acid
H_2CO_3	Carbonic acid
H_3PO_4	Phosphoric acid
$HC_2H_3O_2$	Acetic acid

Practice: Write the name or formula for the following acids.

Hydrochloric acid____________________ Sulfurous acid ____________________

HNO_3 (aq) ____________________ H_2SO_4 (aq) ____________________

Nomenclature Worksheet **Name:**____________________ **Group #:**_______

1. Ions: Write the formula (including charge) for the following ions.

Calcium ion ______________________ Nitride ion ______________________

Sodium ion ______________________ Nitrite ion ______________________

Carbonate ion ______________________ Nitrate ion ______________________

Ammonium ion______________________ Sulfite ion ______________________

Magnesium ion______________________ Sulfide ion ______________________

Tin (II) ion ______________________ Sulfate ion ______________________

Copper (I) ion______________________ Hydroxide ion ______________________

2. Ionic Compounds

A. Complete the table below by writing the formula for the ionic compound formed from the cation in the left column and the anion in the top row. See the examples for further clarification.

Ions	F^-	S^{2-}	N^{3-}	SO_3^{2-}
Li^+	LiF			
Ca^{2+}				
Al^{3+}				
NH_4^+				$(NH_4)_2SO_3$

B. Write the names for the following ionic compounds.

MgS ______________________ KNO_3 ______________________

LiBr ______________________ Al_2O_3 ______________________

PbI_2 ______________________ SnO ______________________

C. Write the formulas for the following ionic compounds.

Sodium nitrite ____________________

Potassium sulfide ____________________

Barium chloride ____________________

Lead (II) sulfate ____________________

Copper (II) nitrate ____________________

Copper (I) oxide ____________________

Ammonium hydroxide ____________________

Aluminum hydroxide ____________________

3. Molecular Compounds

A. Name the following molecular compounds.

PCl_5 ____________________ NI_3 ____________________

ICl_7 ____________________ N_2O_4 ____________________

B. Write formulas for the following molecular compounds.

Nitrogen dioxide __________________

Silicon tetrachloride __________________

Phosphorus triiodide __________________

4. Acids:

A. Write formulas for the following acids.

Sulfuric acid ____________________

Nitric acid ____________________

Acetic acid ____________________

B. Write names for the following acids.

HI (aq) ____________________ H_3PO_4 (aq) ____________________

HNO_2 (aq) ____________________ H_2CO_3 (aq) ____________________

5. Write formulas for the following ions, elements or compounds.

Hydrobromic acid ____________________

Oxygen ____________________

Lithium carbonate ____________________

Cesium ion ____________________

Tetrasulfur tetranitride ____________________

Lead (II) sulfide ____________________

Phosphorus trifluoride ____________________

Copper (II) sulfate ____________________

6. Write names for the following compounds. HINT: It will help to first identify the substance as an ionic compound, molecular compound or acid.

LiCl	______________________	Na_2SO_3	______________________
HNO_2 (aq)	______________________	K_2CO_3	______________________
KI	______________________	$Al_2(SO_4)_3$	______________________
NH_4Cl	______________________	$BaCl_2$	______________________

Name: _______________ **Date:** _______________

Section #: _______________ **Partner:** _______________

Experiment 2: Separation of a Sand/Salt Mixture

Objectives:

- To gain more experience using common lab equipment including top loading balances, graduated cylinders, beakers and Bunsen burners.
- To practice making measurements and reporting them correctly.
- To learn several useful lab techniques including: extraction, gravity filtration, and evaporation. You will use these techniques in future labs!

Prelab:

Read chapter 1 from McMurry's "Fundamentals of GOB Chemistry". Complete the online prelab assignment for "Separation of a Mixture" in Mastering Chemistry BEFORE the start of the lab session. NOTE: Students who do not complete the online prelab assignment will receive zero credit for this lab and the postlab.

You will work in pairs for this experiment.

Discussion:

A compound is a pure substance that is composed or two or more elements in a fixed ratio. Sodium chloride (NaCl) is an example of a compound. Note that the composition of a compound is fixed. That is, sodium chloride is made up of one sodium cation per chloride anion. There is no other ratio of cations to anions that will make up sodium chloride. A compound can be separated into the elements which make it up by CHEMICAL methods only. This means that a chemical reaction is needed to separate sodium from chlorine in the compound sodium chloride. We show chemical reactions through balanced equations:

$$2NaCl\ (s) \rightarrow 2Na\ (s) + Cl_2\ (g)$$

A mixture results when two or more pure substances are combined. Note that the composition of a mixture can vary. For example, we could have a sand/salt mixture that is 80% sand and 20% salt by mass, a mixture that is 40% sand and 60% salt by mass, or numerous other possible compositions. A mixture can be separated by PHYSICAL methods. This means that our sand/salt mixture can be separated into sand and salt without chemically altering the salt (NaCl) and sand (SiO_2) components. We use differences in physical properties of the two substances to separate them by physical methods. For example, salt is soluble in water but sand is not. Thus, the difference in the physical property of solubility can be used to separate these two substances by a technique known as extraction.

A very common example of a physical property being used to separate components of a mixture is in the distillation of alcohol. To achieve higher concentrations of alcohol in liquor the brew is heated so that the lower boiling component (the alcohol) separates from the higher boiling component (the water). The result is up to 180 proof (90%) alcohol!

In this lab, you will make a sand/salt mixture, and then use extraction, decantation, filtration and evaporation to separate the mixture back into the two individual components. Key terms are defined on the next page.

Extraction: The process of separating components of a mixture based on the selective solubility of one component in a particular solvent.

Filtration: The process of separating a solid component of a mixture from a liquid component by pouring through a filter. The solid that remains on the filter is called the residue. The liquid that passes through the filter is called the filtrate.

Evaporation: The process of separating a liquid solvent from a dissolved solute by heating until the solvent has vaporized. The solute will remain after evaporation of the solvent.

Equipment:
Sand
Salt
Fast flow filter paper
Oven
Bunsen burner

Safety: Always wear your safety goggles while in the lab room. Do not dispose of anything in the drain unless specifically directed to by your instructor.

Procedure:

1. Have one lab partner measure between 0.75-1.25 g of SAND into a 50 mL beaker, and the other partner measure between 0.75-1.25 g of SALT into a 150 mL beaker. Both partners should record the total mass of the pure substance in the data section. If you are unsure of how to use the top loading balance correctly, then follow the steps outlined below:
    a. Place a piece of weighing paper on the balance pan
    b. Set your beaker on top of the weighing paper
    c. Press zero/tare and wait for the balance to read 0.00 g
    d. Add the salt OR sand and wait for the digital readout to stabilize
    e. Record the mass of the salt OR sand in the data section
    f. Remove the beaker with salt OR sand and return to your lab bench
2. Add the sand to the salt so that both components are in the 150 mL beaker. You now have your sand/salt mixture.

Extracting the Salt:

2. Add approximately 45 mL of deionized water to your mixture and stir for a few minutes so that the salt dissolves in the water. After stirring for a few minutes, allow the remaining solid to settle to the bottom of the beaker.

Gravity Filtration:

3. Label a clean, dry 150 mL beaker with your initials (in pencil), and weigh it on the top loading balance. Record the mass in the data section.
4. Set up a gravity filtration as demonstrated by your instructor. If you are unsure, ask your instructor for help! Use only ONE piece of filter paper. The initialed 150 mL beaker will be used in your gravity filtration to collect the filtrate.
5. Pour the liquid from your mixture into the funnel of your gravity filtration assembly. It is good practice to use your glass stir rod to guide the liquid down into the funnel and prevent splashing.
6. Pour the remaining liquid and solid sand into the filter paper. Use a small amount (about 5-10 mL) of deionized water and your rubber policeman to dislodge any remaining sand from the beaker into the filter paper.
7. Use a small amount of additional deionized water to rinse any residue from your rubber policeman into the filter paper.

Evaporating the Solvent (Water):

8. Carefully remove the filter paper with the sand from the funnel and throw it away in the garbage can. Be careful not to tear the filter paper. This could allow your residue to fall into your filtrate!
9. Set up a ring stand and Bunsen burner as demonstrated by your instructor. If you are unsure, ask your instructor for help!
10. Gently heat the filtrate to a low boil over a blue flame until enough water has evaporated to see a wet slurry of salt. At this point, transfer the salt solution to the oven for 30 minutes to finish evaporating the water.
11. After 30 minutes, check to see if all of the water has evaporated. You should only have solid salt in the beaker. If you see water remaining, put it back in the oven immediately and wait another 15 minutes. CAUTION: Use beaker tongs or an oven mitt to remove the hot beakers from the oven. NEVER try to remove a hot beaker using crucible tongs or your bare hands!
12. Allow the beaker and salt to cool for 5-10 minutes before using the top loading balance to find the mass of the beaker and salt component. Record this mass in the data section. CAUTION: The balances can only measure the mass of objects at room temperature! If you do not cool the beaker before weighing it then you will not get an accurate mass and your results will suffer.
13. Place the beaker with salt back into the oven for another 10 minutes. After reheating it, allow it to cool for 5-10 minutes and then reweigh it using the same balance as before. If the mass of the beaker with salt changes after reheating it, you can conclude that the salt is still slightly wet with water. If the mass does not change, or if it changes by a negligible amount, you can conclude that your salt is completely dry and free of water. +/-0.03 g is negligible.
14. If the two mass readings are within +/-0.03 g then you can proceed to the calculations and concept question. If they are not within +/-0.03 g then you must reheat for another 10 minutes and record the third mass obtained after reheating in the data section. CAUTION: Do not discard the salt until you have completed the calculations and checked in with your instructor. When your instructor approves, you can use water to rinse the salt into a labeled waste container for sodium chloride.

Data:

Mass of sodium chloride (salt) (g)	
Mass of silicon dioxide (sand) (g)	
Mass of clean, dry 150 mL beaker (g)	
First mass of 150 mL beaker with salt (g)	
Second mass of 150 mL beaker with salt (g)	
Third mass of 150 mL beaker with salt (g) ONLY IF NEEDED!	
Mass of salt recovered (g)	

Calculations:

Show calculations and include all units. Circle your final answers, and include them in the data section as needed.

1. Calculate the mass of salt recovered:

2. Calculate the percent recovery of NaCl:

HINT: The mass of salt that you started with is the theoretical amount that could have been recovered. Percent recovery will show what percent of this theoretical amount was actually recovered. A higher percent recovery is better. Note that percent recovery is not the same as percent error!

$$\frac{\text{Experimental}}{\text{Theoretical}} \times 100 =$$

Concept Question:

1. Percent recovery should never be greater than 100%. This makes sense because we cannot create more salt than what we started with. Percent recovery will actually be less than 100% since there are always sources of loss that are difficult or impossible to avoid. Assume that a pair of students reported over 100% for their percent recovery. List two possible errors that this pair may have made. Assume that they used the balance correctly! Be specific with respect to which step may have been in error.

   a.

   b.

Postlab:

Your instructor must check your data, calculations and concept question before you leave the lab.

Your postlab assignment is due one week after the completion of this lab in Mastering Chemistry, or when specified by your instructor.

Name: _______________ **Date:** _______________

Section #: _______________ **Partner:** _______________

Experiment 3: Chemical Reactions

Objectives:

- To make observations when reactants are combined, and to determine when a chemical reactions occurs.
- To learn how to classify reactions and write proper balanced equations to reflect chemical changes.
- To become familiar with the indications of chemical change.

Prelab:

Read chapter 6 from McMurry's "Fundamentals of GOB Chemistry". Complete the online prelab assignment for "Chemical Reactions" in Mastering Chemistry BEFORE the start of the lab session. NOTE: Students who do not complete the online prelab assignment will receive zero credit for this lab and the postlab.

You will work in pairs for this experiment.

Discussion:

Chemistry is the study of matter and the changes that matter undergoes. Changes can be physical or chemical. Chemical equations are used to represent chemical change. Learning to write balanced chemical equations is a crucial part of any introductory chemistry course. In this lab, you will determine the reactants and products involved in chemical changes that you observe. You will use your past knowledge of inorganic nomenclature and new information about the basic types of reactions to write balanced chemical equations for the reactions that you see.

We can predict the products of some simple chemical reactions by recognizing the basic reaction types outlined below:

1. Synthesis: Reactants combine to give one product.
Example:
$4Fe\ (s) + 3O_2\ (g) \rightarrow 2Fe_2O_3\ (s)$

2. Decomposition: The reactant is broken down into two or more smaller substances.
Example:
$2NaN_3\ (s) \rightarrow 2Na\ (s) + 3N_2\ (g)$

3. Single-Displacement: One element replaces another element in a compound.
Example:
$Br_2\ (l) + 2KI\ (aq) \rightarrow I_2\ (s) + 2KBr\ (aq)$

4. Double-Displacement: The first elements of two compounds are exchanged to produce two different compounds. NOTE: Double displacement can be further subcategorized as precipitation or acid-base neutralization.
Examples:
$2AgNO_3(aq) + BaCl_2\ (aq) \rightarrow 2AgCl\ (s) + Ba(NO_3)_2\ (aq)$
$NaOH\ (aq) + HNO_3\ (aq) \rightarrow NaNO_3\ (aq) + H_2O\ (l)$

Equipment:
1 M silver nitrate (for instructor demo only)
copper wire approximately 3" long (for instructor demo only)
1 M barium chloride
1 M sodium sulfate
Magnesium ribbon cut in approximately 1" strips
6 M hydrochloric acid
3% hydrogen peroxide
Yeast
Wood splints
1 M Ammonia solution
Dry ice broken into approximately ¾ inch pieces
Universal indicator solution (pH 4-11)

Safety: Always wear your safety goggles while in the lab room. Do not dispose of anything in the drain unless specifically directed to by your instructor. Never hold a test tube (or any other container) in your hand while combining chemicals. There could be an unexpected generation of heat or gas produced. Dry ice (solid carbon dioxide) can cause frostbite. Use the tongs provided when handling the dry ice.

Procedure:
Obtain three clean, large test tubes, and set them in your test tube holder. Set out a 150 mL beaker for the collection of waste. The combined waste from this 150 mL beaker will go into the labeled waste container at the very end of the lab session.

Station 1: Barium Chloride and Sodium Sulfate
1. Carry ONE of your large test tubes in a 250 mL beaker to station 1. Add 1-2 mL (about 1 index finger high) of 1 M barium chloride to the test tube.
2. With the test tube sitting propped up in the 250 mL beaker, add about the same amount of 1 M sodium sulfate to the test tube.
3. Record your detailed observations in the data section and return to your lab bench.
4. Pour the contents of the test tube into your designated waste beaker. You can use water to dislodge any solids, but be sure to add this to the waste beaker also.

Station 2: Magnesium and Hydrochloric Acid
1. Carry your small graduated cylinder and ONE of your large test tubes in a 250 mL beaker to station 2.
2. Roll three magnesium strips into balls and drop them into the empty test tube.
3. Measure about 2 mL of 6 M hydrochloric acid in your small graduated cylinder.
4. BEFORE you add the 6 M hydrochloric acid to the magnesium, have your lab partner light a wooden splint.
5. When ready with the splint, add the acid to the test tube with the magnesium ribbon, and immediately have your partner hold the lit end of the splint inside the top of the test tube. NOTE: The flame should not be placed so far down that it reaches the liquid in the test tube!
6. Record your detailed observations in the data section and return to your lab bench.
7. Add a pea size amount of solid sodium bicarbonate to the test tube, and then pour the entire contents into your waste beaker. You can use water to dislodge any solids, but be sure to add this to the waste beaker also.

Station 3: Hydrogen Peroxide and Yeast
1. Clean your small graduated cylinder by rinsing with water. Carry your small cylinder, your spatula, and ONE of your large test tubes in a 250 mL beaker to station 3.

2. Using your spatula, add a pea size amount of yeast to the test tube.
3. Measure about 2 mL of 3% hydrogen peroxide in your small graduated cylinder.
4. BEFORE you add the hydrogen peroxide to the yeast, have the other lab partner light a wooden splint. Allow it to burn for a few seconds, and then gently blow out the flame so that it leaves some red glowing embers.
5. With the test tube sitting propped up in the 250 mL beaker, add the hydrogen peroxide to the yeast and immediately bring the red glowing embers in contact with the bubbles coming out of the test tube. NOTE: You do not want to get the wood splint wet. You just want to bring it into contact with the gas in the bubbles.
6. Add additional pea sized amounts of yeast until there is no further reaction.
7. Record your detailed observations in the data section, and return to your lab bench.
8. Use water to dislodge the contents of the test tube into your waster beaker. The wooden splint goes into the garbage.

Station 4: Dry Ice and Water

At station 4 you will use a color-changing indicator to show the pH of the solution as reactions proceed. There are many color-changing indicators, but we will be using the universal indicator. A color scale will be provided to you in the lab, but in general the colors will change as follows:
pH 4 (acidic) = orange
pH 7 (neutral) = green
pH 10 (basic) = blue

1. Carry your 100 mL beaker and stir rod to station 5.
2. Fill the beaker about one-fourth full of deionized water. Add 7-10 drops of the universal indicator and stir. Note the color, and record your observations in the data section.
3. Add 7-10 drops of the ammonia solution (possibly labeled as ammonium hydroxide). Again, note the color and record your observations in the data section.
4. Using the tongs provided, place 1-2 pieces of dry ice (total size about that of a nickel or quarter) into your beaker and observe for about 1 minute. Please do NOT take excess dry ice! There are other lab sections that will need dry ice too!
5. After 1 minute has passed, note the color and record your observations in the data section. Return to your lab bench.
6. Pour the contents of the beaker into your designated waste beaker.

All remaining solutions from stations 1-4 can be combined into your 150 mL waste beaker, and then collected in the labeled waste container in the hood. All wood splints go in the regular trashcan. Please do not leave them in the sinks or broken glass containers!

Data:

Demo: Silver Nitrate and Copper
Observatons:

Station 1: Barium Chloride and Sodium Sulfate
Observatons:

Station 2: Magnesium and Hydochloric Acid
Observatons:

Station 3: Hydrogen Peroxide and Yeast
Observatons:

Station 4: Dry Ice and Water
Color and pH of water: Color and pH with ammonia solution: Color and pH with dry ice: Observations:

Concept Questions:

1. For each station, write the formula for the reactants used, and include the states.

    a. Station 1: __________ + __________

    b. Station 2: __________ + __________

    c. Station 3: __________ HINT: The yeast is just a catalyst, not a reactant.

    d. Station 4: __________ + __________ HINT: Consider the reaction between dry ice and water only.

2. At station #1, the reaction is a double displacement. Do you expect double displacement by acid-base neutralization or precipitation?

3. Based on your answer above, write a balanced equation for the reaction you observed at station #1. HINT: You already wrote the reactants in problem #1.

4. At station #2, there is an element and a compound reacting. What reaction type do you expect for this reaction?

5. Based on your answer above, write a balanced equation for the reaction you observed at station #2.

6. At station #3, there is only one reactant. What reaction type do you expect for this reaction?

7. Based on your answer above, write a balanced equation for the reaction you observed at station #3. HINT: There are two products, and one is water.

8. At station #4, the initial color of the universal indicator shows that the tap water is:
    a. acidic
    b. basic
    c. neutral

9. At station #4, the color of the indicator after addition of the ammonia solution shows that the solution is:
    a. acidic
    b. basic
    c. neutral

10. At station #4, the color of the indicator after the dry ice has been added indicates that the final solution is:
    a. acidic
    b. basic
    c. neutral

Postlab:

Your instructor must check your data, calculations, and concept questions before you leave the lab. Your postlab assignment is due one week after the completion of this lab in Mastering Chemistry, or when specified by your instructor.

Name: _______________ **Date:** _______________

Section #: _______________ **Partner:** _______________

Experiment 4: Percent Yield of Sodium Carbonate

Objectives:
- To practice using common lab equipment including crucibles, crucible tongs, and Bunsen burners.
- To practice making measurements and reporting them correctly.
- To practice using stoichiometry, and to determine your theoretical and percent yield of product.

Prelab:
Read chapter 6 from McMurry's "Fundamentals of GOB Chemistry". Complete the online prelab assignment for "Percent Yield of Sodium Carbonate" in Mastering Chemistry BEFORE the start of the lab session. NOTE: Students who do not complete the online prelab assignment will receive zero credit for this lab and the postlab.

You will work in pairs for this experiment.

Discussion:
Stoichiometry allows us to quantitatively relate any two substances in a balanced chemical equation. Thus, we can always calculate the theoretical amount of product that will form from a starting amount of reactant(s). Unfortunately, there are always sources of loss in the lab. When transferring reagents some chemicals may remain adhered to the sides of glassware, spills may occur, and reactions may not go to completion. Depending on the procedure, other sources of loss may occur during a chemical reaction as well.

In this lab you will decompose sodium bicarbonate, use stoichiometry to calculate the theoretical yield of the solid sodium carbonate product, and then determine your percent yield for the experiment. Percent yield reflects how much of the theoretical amount you successfully made in the experiment. The calculation is the same as that for percent recovery used in the "Separation of a Sand/Salt Mixture" lab. Conscientious laboratory practices will help you to achieve a better percent yield.

Equipment:
Solid sodium bicarbonate
Bunsen burner
Ring stand

Safety: Always wear your safety goggles while in the lab room. Do not dispose of anything in the drain unless specifically directed to by your instructor.

Procedure:
When heated, solid sodium bicarbonate will decompose into solid sodium carbonate, water vapor and carbon dioxide gas. Write a balanced equation below to show this reaction. HINT: You did this in the prelab assignment.

1. Wash your porcelain crucible and crucible cover with soap and water and dry well with paper towels.

2. Place the crucible with the lid slightly ajar on a clay triangle supported on a ring and ring stand as demonstrated by your instructor. Heat the empty crucible and lid over a low, cool flame for about 10 minutes. Be sure to have a blue cone shaped flame rather than a yellow wavy flame.
3. Turn the flame off and use your crucible tongs to carefully move the crucible lid and then the crucible onto the asbestos-free pad to cool. Do NOT place the hot crucible directly on to the bench-top as it will burn a circle into the countertop!
4. Wait 5-10 minutes for the crucible to cool, and then hold your finger close to the side of the crucible to see if it is still generating heat. If you do not feel heat then you can assume the crucible has cooled to room temperature. Only room temperature objects can be correctly weighed on the balance!
5. Once cooled, use your crucible tongs to carry the crucible (without the lid) to the top loading balance to obtain its mass. Record this in the data section. NOTE: Do not touch the crucible with your hands during the rest of the experiment. It could become contaminated with oils from your fingers, and this will affect the measured mass of your product!
6. With your crucible still on the balance, add between 2.50 g and 3.00 g of sodium bicarbonate. Record the weight of the sodium bicarbonate plus the crucible in the data section.
7. Using your crucible tongs, reposition your crucible with the contents on the clay triangle. Cover partially with the lid.
8. Reheat the crucible with the sodium bicarbonate for 15 minutes. Start out with a low, cool flame, and gradually increase the flame height until the bottom of the crucible is in the hottest part of the flame. NOTE: If you heat too vigorously you may lose some of the contents to splattering!
9. Turn the flame off and use your crucible tongs to carefully move the crucible lid and then the crucible onto the asbestos-free pad to cool.
10. Wait 5-10 minutes for the crucible to cool before checking to see if it has cooled to room temperature.
11. Once cooled, use the crucible tongs to transfer the crucible (without the lid) and contents to the balance to obtain the total mass. Record the mass in the data section.
12. Repeat steps 8-11. If the second mass is within +/-0.01 g of the first, you can assume the reaction has reached completion. If the mass is not within range, repeat steps 8-11 again.
13. Complete the calculations on page 27 and get instructor approval BEFORE adding water to your product and disposing in the labeled waste container for sodium carbonate.

Data: ALL MEASUREMENTS ARE WITHOUT THE CRUCIBLE LID!

Mass of empty, dry crucible (g):

Mass of crucible with sodium bicarbonate (g):

Mass after first heating (g):

Mass after second heating (g):

Mass after third heating (if needed) (g):

Calculations:

Show calculations and include all units. Circle your final answers, and include them in the data section as needed.

1. Calculate the mass of sodium bicarbonate sample used:

2. Calculate the theoretical yield of sodium carbonate based on your starting mass of sodium bicarbonate:

3. Calculate the mass of sodium carbonate obtained (this is your experimental yield):

4. Calculate the percent yield for sodium carbonate:

$$\frac{\text{Experimental}}{\text{Theoretical}} \times 100 =$$

Concept Questions:

1. If a student loses more than 0.01 g between the first and second heating of sodium bicarbonate, what does this indicate about the decomposition reaction?

2. There are three products in this reaction, yet we assume that the ending mass of product is solely sodium carbonate. Why is this assumption acceptable?

Postlab:

Your instructor must check your data, calculations, and concept questions before you leave the lab. Your postlab assignment is due one week after the completion of this lab in Mastering Chemistry, or when specified by your instructor.

Name: _______________ **Date:** _______________

Section #: _______________ **Partner:** _______________

Experiment 5: Synthesis of Alum[1]

Objectives:

- To utilize techniques, calculations and equipment from experiments 1-4.
- To synthesize potassium aluminum sulfate dodecahydrate (alum) from used aluminum cans.
- To use chemical reactions to recycle used cans into a useful product.

Prelab:

Complete the online prelab assignment for "Synthesis of Alum" in Mastering Chemistry BEFORE the start of the lab session. NOTE: Students who do not complete the online prelab assignment will receive zero credit for this lab and the postlab.

You will work in pairs for this experiment.

Discussion:

Alum (chemical name potassium aluminum sulfate dodecahydrate) is a useful product that is sold in grocery stores. It can be used in pickling recipes as a preservative. In the lab today, you will recycle used aluminum cans to make the compound known as alum. This lab will require several reactions and will involve the use of techniques, equipment and calculations that you have used in past experiments. If possible, you should bring your own empty aluminum can for this lab.

Equipment:

<u>Week One:</u>
Aluminum cans
Tin snips
Sand paper
Fast flow filter paper
Bunsen burners
2 M potassium hydroxide
3 M sulfuric acid

<u>Week Two:</u>
Ice
Alum crystals (for seeding)

Safety:

Always wear your safety goggles while in the lab room. Do not dispose of anything in the drain unless specifically directed to by your instructor. Be careful not to cut yourself with the edge of the aluminum when cutting the cans with tin snips. Potassium hydroxide is a strong base, and sulfuric acid is a strong acid. Use cautiously, and notify your instructors of any spills immediately. If either of these chemicals comes into contact with your skin or clothing flush with water immediately and notify your instructor.

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[1] Adapted from Experiments for Chem 30A by Donald A. Pon.

Procedure:

Day 1

1. Using the tin snips provided, cut out approximately 6 x 6 cm^2 from the side your aluminum can. Do not use the top of bottom of the can since these parts are much more thick and will take too long to react! The easiest way to cut into a new can is to smash the sides together, and then cut through the flattened part.
2. Use a piece of sand paper to scrape off some of the plastic labeling on the outside and some of the plastic lining on the inside of the can. Do this over the asbestos-free pad to avoid scratching the lab bench with the sand paper!
3. Weigh the aluminum on the top loading balance and record the mass in the data section. The mass should be around 1 g. If it is greater than 1.50 g, cut some of the aluminum off to adjust the mass. It is okay if the mass is lower than 1.00 g.
4. Cut the aluminum into 4-6 small pieces and place into a 250 mL beaker.
5. Measure approximately 35 mL of 2 M KOH solution into your 50 mL beaker and add the solution to the aluminum pieces in the 250 mL beaker at your lab bench. Avoid inhaling the hydrogen gas that evolves from this reaction!
6. Set up a Bunsen burner and a ring stand with a ring and wire gauze, and heat the reaction gently over a low flame until the aluminum is dissolved. The reaction should not reach a boil. If boiling starts to occur, turn off your Bunsen burner flame immediately and wait for the reaction to subside before heating again. It may take about 20 minutes for your aluminum to dissolve. While one lab partner tends to the heating, the other partner may get the gravity filtration set up for the next step.
7. After the aluminum has dissolved you will probably still see solids in your beaker but they will not be reacting with the KOH solution (that is, there are no bubbles of hydrogen gas forming on the solids). These solids are left over plastics and impurities from the can. Set up a gravity filtration using fast-flow filter paper and a clean 250 mL beaker. Pass the solution through the filter, and make sure that the filtrate is clear. If the filtrate is not clear then you may have a hole in your filter paper. You will need to gravity filter again.
8. After you have poured all of the solution through the filter paper, rinse the used beaker with a small amount of deionized water (about 10 mL), and pour this rinse through the filter as well.
9. Once the filtering process is complete, the filter paper can be placed into the garbage. Remember, the solids are left over plastics and other impurities from the label. Your product is dissolved in the filtrate!
10. Measure approximately 40 mL of 3 M H_2SO_4 into a clean 150 mL beaker and add it to the filtrate at your lab bench.
11. Stir your solution with the glass stir rod, and heat gently over a Bunsen burner flame until the solution is clear and colorless.
12. Continue heating until your clear and colorless solution is approximately 75 mL total. If your solution volume is too low you can add some deionized water instead of heating at this point.
13. Use your beaker tongs to transfer the beaker and solution into your lab drawer. Cover your solution with a paper towel or your watch glass. Gently close your drawer and complete the calculations for Day 1 of the lab before you leave.

Day 2: To be completed on the same day as the "Gas Forming Reaction" lab.

1. Place a full bottle of deionized water into the ice chest (your instructor may have done this already).
2. Open your lab drawer carefully to avoid spilling your solution! You should have alum crystals in your beaker. If you do not, consult your instructor.
3. Set up a gravity filtration using fast-flow filter paper and a 250 mL beaker. Pour the solution and your solid crystals into the filter paper. You will need to use your rubber policeman to get all of the crystals out of the beaker and into the filter paper.
4. Use a small amount of **cold** deionized water (about 10 mL) to rinse the crystals.
5. Dispose of your filtrate in the labeled waste container for sulfuric acid.

6. Dry your crystals with paper towels.
7. Weigh your crystals on the top loading balance. Do not forget to use weighing paper and to tare/zero the balance! Record the mass in the data section.
8. You may discard your alum crystals in the labeled waste container, or you may take them home with you. Since the alum crystals are not purified, they are NOT safe for consumption. Do not use them for pickling! Only take them home if you can be sure that they will not be consumed by anyone.
9. Complete the calculations for Day 2.

Data:

Day 1
Mass of aluminum (g):

Day 2
Mass of alum crystals (g):

Calculations:

Day 1
1. Using your starting mass of aluminum, calculate the theoretical yield of alum. HINT: The mole ratio of Al to alum is 1:1.

Day 2
2. Calculate your percent yield for alum:

Postlab:
Your instructor must check your data and calculations before you leave the lab. Your postlab assignment is due one week after the completion of day 2 of this lab in Mastering Chemistry, or when specified by your instructor.

Name: _______________ **Date:** _______________

Section #: _______________ **Partner:** _______________

Experiment 6: Gas Forming Reaction

Objectives:

- To use the ideal gas law and stoichiometry to calculate the amount of reactants needed to produce a specific volume of gaseous product.
- To practice making measurements and reporting them correctly.

Prelab:

Read chapter 8 from McMurry's "Fundamentals of GOB Chemistry". Complete the online prelab assignment for "Gas Forming Reaction" in Mastering Chemistry BEFORE the start of the lab session. NOTE: Students who do not complete the online prelab assignment will receive zero credit for this lab and the postlab.

You will work in pairs for this experiment.

Discussion:

In a car air bag, a chemical reaction produces a gaseous product that inflates the bag in the event of an accident. If too little gas is produced, the air bag will be under-inflated. If too much gas is produced, the air bag might burst. In order to produce the right amount of gaseous product to inflate the air bag and save lives in an accident, the correct amount of reactants must be combined. This requires stoichiometric calculations.

For the lab today, you will calculate how much sodium bicarbonate and acetic acid solution to mix together in order to produce enough carbon dioxide gas to fill a 1 pint or 1 quart Ziploc baggie. We will assume that the other products and the water from the vinegar solution take up only a negligible amount of space.

Equipment:

Vinegar (5% acetic acid solution)
Baking soda
1 pint and 1 quart Ziploc baggies
twist ties

Safety: Always wear your safety goggles while in the lab room. Do not dispose of anything in the drain unless specifically directed to by your instructor.

Procedure:

1. The first step is to write out a balanced equation for the reaction that occurs when solid sodium bicarbonate and acetic acid are mixed. Do this in the space below. HINT: You are asked to do this in the prelab assignment!

2. Obtain either a 1 pint or a 1 quart Ziploc baggie based on the size assigned by your instructor.

3. Given that 1 L = 1.057 qt and 1 L = 2.114 pt, determine how many liters your Ziploc baggie holds. Your answer gives the volume of carbon dioxide gas you are trying to produce. Show your work in the calculations section and write your final answer **in liters** in the data section.
4. Use your thermometer to measure the room temperature in Celsius. Be careful not to touch the bulb with your hand! Record the temperature **in Kelvin** in the data section.
5. Use the barometer hanging on the wall to determine the atmospheric pressure in cmHg. In the calculations sections, convert to atm, and write your final answer **in atm** in the data section.
6. Use the ideal gas equation to calculate the number of moles of carbon dioxide gas that would be needed to fill the volume of your Ziploc baggie at the determined temperature and pressure. Show your work in the calculations section.
7. Next, determine the number of grams of sodium bicarbonate required to produce this quantity of carbon dioxide. Show your work in the calculations section.
8. Next, determine the number of milliliters of vinegar required to fully react. HINT: The vinegar is 5% w/v acetic acid, meaning 5 g of acetic acid per 100 mL of solution. Show your work in the calculations section.
9. Once your calculations are completed, measure the desired volume of vinegar in a graduated cylinder. You should get within +/- 1 mL of your calculated volume.
10. Next, measure the desired mass of sodium bicarbonate using the top loading balance. You should get within +/- 0.1 g of your calculated mass.
11. Place the sodium bicarbonate into the bottom corner of your Ziploc bag and use your twist tie to hold it in place.
12. Carefully pour the vinegar solution into the other bottom corner. The two reactants should not be mixing yet.
13. Press out as much air as you can before zipping the baggie closed.
14. Remove the twist tie, and shake gently to completely mix the reactants.
15. Wait for the reaction to subside.
16. Record your observations in the data section. Be sure to note whether your baggie is inflated properly.
17. Carefully open your Ziploc baggie, and pour the solution into the labeled waste container in the hood.

Data:

Volume of carbon dioxide gas (L): __________

Temperature (K): __________

Pressure (atm): __________

Moles of carbon dioxide gas: __________

Grams of sodium bicarbonate: __________

Volume of vinegar solution (mL): __________

Observations:

Calculations:

Show calculations and include all units. Circle your final answers, and be sure to record them in the data section above when necessary.

1. Calculated volume of carbon dioxide gas based on baggie size:

2. Number of moles of carbon dioxide gas needed to fill baggie at determined temperature and pressure:

3. Grams of sodium bicarbonate needed to produce desired amount of carbon dioxide gas:

4. Number of milliliters of vinegar solution needed to produce desired amount of carbon dioxide gas:

Concept Questions:

1. If the pressure were doubled, how would this affect the number of moles of carbon dioxide needed to fill the baggie? That is, would it take more, less or the same amount of carbon dioxide?

2. Describe one procedural error that would cause your baggie to be under-inflated. Assume all calculations are done correctly.

3. Describe one procedural error that would cause your baggie to burst (over-inflate). Assume all calculations are done correctly.

Postlab:

Your instructor must check your data, calculations and concept questions before you leave the lab. Your postlab assignment is due one week after the completion of this lab in Mastering Chemistry, or when specified by your instructor.

Name: _______________ **Date:** _______________

Section #: _______________ **Partner:** _______________

Experiment 7: Titrating to Determine Citric Acid Content in Juice Samples

Objectives:

- To apply techniques and calculations learned in past labs, and to gain more experience with lab equipment.
- To estimate the amount of citric acid in fruit juice via titration with standardized NaOH.

Prelab:

Read chapter 10 from McMurry's "Fundamentals of GOB Chemistry". Complete the online prelab assignment for "Titrating to Determine Citric Acid Content in Juice Samples" in Mastering Chemistry BEFORE the start of the lab session. NOTE: Students who do not complete the online prelab assignment will receive zero credit for this lab and the postlab.

You will work in pairs for this experiment.

Discussion:

Citric acid ($H_3C_6H_5O_7$) contributes to the sour taste of fruits and fruit juices. The acid content will vary depending on the type of juice. Although other acids may be present, we will assume for simplicity that citric acid is the only acid in our fruit juice samples.

Citric acid in our juice samples will react with a base in a neutralization reaction. By reacting a measured volume of juice with a measured volume of base with a known concentration, we can determine the concentration of the acid content in the juice. We can do this using a technique known as acid-base titration, because this particular reaction is between an acid and a base.

Titration is a laboratory technique used to determine the concentration of a solution. It is useful in industry for quality control purposes. In a titration, a buret is used to add the standardized solution (that is the solution with a known concentration) to a measured volume of the solution with an unknown concentration. An indicator is used so that the endpoint of the reaction is obvious. We will use a color-changing indicator known as phenolphthalein to show the endpoint for our acid base neutralization reaction. Phenolphthalein is clear and colorless in acidic and neutral solution, but it turns pink in the presence of a base.

At first, when the base is added to your acidic juice solution it will be completely neutralized and the indicator will remain colorless. Eventually, you will add enough base to fully consume the acid in your juice sample. This is known as the **equivalence point** of the titration because the H+ from the acid and the OH- from the base are present in equal amounts. One additional drop of base past the equivalence point cannot be neutralized, and the solution becomes basic causing the indicator to turn pink. This is known as the **endpoint** of the titration. Once the endpoint is reached the titration is stopped, and the amount of standardized solution required for the reaction is measured from the buret. The concentration of the unknown solution is determined through stoichiometric calculations.

In the lab today, we will use a standardized solution of NaOH to titrate the acid in our fruit juice samples. Remember that we will assume citric acid is the only acid present in our juice. The concentration of the base is written on the bottle. Be sure to record it in the data section since you will need it in your calculations. We will express our final concentration of citric acid in our fruit juice sample in % w/v and M.

Equipment:
Fruit juice with little or no coloring
0.1 M standardized NaOH
50 mL burets (checked out from the stockroom)
phenolphthalein

Safety: Always wear your safety goggles while in the lab room. Do not dispose of anything in the drain unless specifically directed to by your instructor. Sodium hydroxide is corrosive. Notify your instructor of any spills immediately. If sodium hydroxide contacts your skin or clothing, rinse immediately with copious amounts of water and notify your instructor.

Procedure:

1. Write a balanced equation for the reaction you are about to perform:

2. Place your largest beaker onto the lab bench for the collection of waste throughout the lab. The contents will go into the labeled waste container at the end of the lab session.
3. Send one lab partner to the stockroom to check out a 50 mL plastic buret. Rinse it with deionized water, and set it up on a buret clamp and ring stand as demonstrated by your instructor.
4. Measure approximately 50 mL of fruit juice into a clean, dry 150 mL beaker and take it back to your lab bench.
5. Measure about 20 mL of the juice in a large graduated cylinder, and then record the precise volume to the tenth of a mL in the data section. NOTE: It is not critical that you start with 20.0 mL of juice. It is critical that you know the volume of your sample of juice to the tenth of a mL!
6. Add the measured juice sample to a clean 150 mL Erlenmeyer flask. Rinse the graduated cylinder with a small amount of deionized water, and pour this rinse into the same Erlenmeyer flask. NOTE: Adding deionized water will NOT affect the number of moles of acid in your sample! Think about this.
7. Add 3-4 drops of phenolphthalein indicator to the solution in the Erlenmeyer flask, and swirl to mix.
8. Measure approximately 75 mL of standardized NaOH into a clean, dry 150 mL beaker and take it back to your lab bench.
9. Using your funnel to avoid spilling the solution, add 5-10 mL of NaOH solution to the buret. Make sure the stopcock is closed first! Remove the buret from the buret clamp and roll the solution around to rinse the buret. This technique is very important, and will be discussed/demonstrated in the prelab lecture by your instructor.
10. Discard the rinse into your waste beaker, and repeat with a fresh 5-10 mL sample of the standardized solution. Discard this rinse in the waste beaker as well.
11. Add the standardized NaOH to the buret until the volume is near the 0 mark at the top. Place a watch glass over your remaining NaOH solution in the beaker.
12. Open the stopcock and allow some solution to flow into the waste beaker. This will ensure that you do not have any air bubbles in your stopcock before starting the titration.
13. Read the volume from the buret to the **hundredth of a mL**, and record this in the data section under "Initial Volume of NaOH" for Trial 1.
14. Place the Erlenmeyer flask with the juice and indicator under the buret tip and open the stopcock to allow the base to mix with the juice (acid) solution. You should swirl the flask as the base flows from the buret. Remember that you are looking for the endpoint of the reaction. That is, the point

when enough base has been added to fully neutralize the acid in the juice. One drop of base added after that point will cause the solution to turn slightly basic and the color will change. Initially, you will see the color change briefly and then return to the original color. As the titration progresses, you will see the color change persist for longer. At this point, you need to add the base very slowly because you are close to the endpoint! The endpoint occurs when the color change persists even after swirling the flask.

15. Once the color change persists, read the final volume from the buret and record it in the data section under "Final Volume of NaOH" for Trial 1.
16. Refill your buret with standardized NaOH until the volume is near the 0 mark at the top.
17. Set your titrated sample aside, and measure another 20 mL juice sample using a large graduated cylinder. Record the precise volume to the tenth of a mL in the data section under Trial 2.
18. Add the measured juice sample to another clean 150 mL Erlenmeyer flask. Rinse the graduated cylinder with a small amount of deionized water, and pour this rinse into the same Erlenmeyer flask.
19. Add 3-4 drops of phenolphthalein indicator to the solution in the Erlenmeyer flask, and swirl to mix.
20. Repeat steps 11-15 to titrate your second juice sample, and record your data under Trial 2.
21. Complete all data, calculations and concept questions BEFORE cleaning up your lab bench. If your results are too varied you will need to perform a third titration and record your data under Trial 3. It will be quicker and easier to do this if you have your equipment still set up!

Data:

	Trial 1	**Trial 2**	**Trial 3**
Volume of juice (acid) (mL)			
Initial volume from buret (mL)			
Final volume from buret (mL)			
Volume of base used (mL)			
Ratio of acid/base (unitless)			

Instructor Sign Off: _______________

Calculations:

Show calculations and include all units. Circle your final answers, and be sure to record them in the data section above when necessary.

1. Calculate the volume of based used for each trial, and record your final answers in the data section.

2. Calculate the ratio of acid to base used in each trial by dividing the mL of acid by the mL of base. Record your final answers in the data section, and get approval from your instructor BEFORE proceeding with the next calculations.

3. Calculate the number of moles of base used in each trial. HINT: You need the base concentration for this step!

4. Calculate the number of moles of acid titrated in each trial. HINT: You need a balanced equation for this step!

5. Calculate the number of grams of acid titrated in each trial.

6. Calculate the concentration of acid in your juice sample in % w/v citric acid.

7. Calculate the concentration of acid in your juice sample in M.

8. Calculate the average concentration in % w/v and M based on your two best trials.

Concept Questions:

1. Write a balanced equation to show the reaction that will occur when acetic acid and barium hydroxide are mixed.

2. If 23.55 mL of 1.235 M barium hydroxide is required to fully neutralize a 25.6 mL solution of acetic acid, what is the concentration of the acid solution in M? HINT: You will need to refer to your answer in #1!

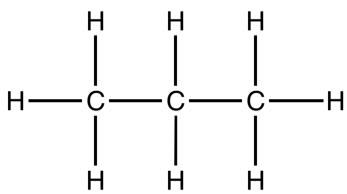
Postlab:

Your instructor must check your data, calculations and concept questions before you leave the lab. Your postlab assignment is due one week after the completion of this lab in Mastering Chemistry, or when specified by your instructor.

Organic Nomenclature and Modeling

Organic chemistry is the branch of chemistry that deals with the study of carbon-based compounds. An understanding of basic organic nomenclature is important for anyone entering into the health field because organic chemistry is integral to the study of the human body, pharmaceuticals, the environment, and much more. In Chemistry 30A we will focus on naming organic compounds using the International Union of Pure and Applied Chemistry (IUPAC) system. We will also learn how to draw organic compounds in the expanded, condensed, and line forms. In Chemistry 30B we will study the chemistry of organic compounds, so it will be crucial for you to have a good foundation of the IUPAC nomenclature system and the structures of organic molecules prior to entering 30B. A summary for how to name and draw simple hydrocarbons is given below. To receive credit for this lab session your entire group MUST complete this worksheet and get checked off by the instructor.

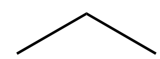
1. Representing Organic Molecules: Organic molecules can be represented as expanded, condensed or line structures. Examples of each form are depicted below for the three carbon molecule known as propane. In the line structure, notice that each corner or point represents one carbon, and the hydrogen atoms are just assumed for octet.



Expanded

$CH_3CH_2CH_3$

Condensed



Line

2. Naming and Drawing Straight Chained Hydrocarbons:

A. A prefix is used to express the number of carbon atoms in the chain.

Prefix	**Number of Carbon**
Meth-	1
Eth-	2
Prop-	3
But-	4
Pent-	5
Hex-	6
Hept-	7
Oct-	8
Non-	9
Dec-	10

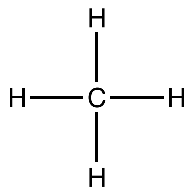
B. A suffix is used to express whether the hydrocarbon is an alkane, alkene or an alkyne.

Suffix	Hydrocarbon Type
-ane	Alkane
-ene	Alkene
-yne	Alkyne

C. For alkenes and alkynes with more than three carbons, you must specify the location of the double or triple bond with a number followed by a hyphen.

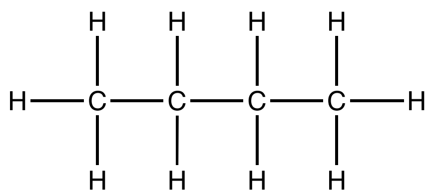
Examples:

1.



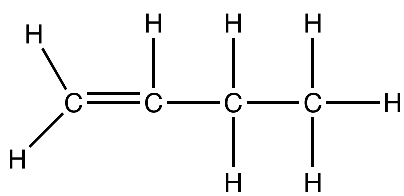
= Methane

2.



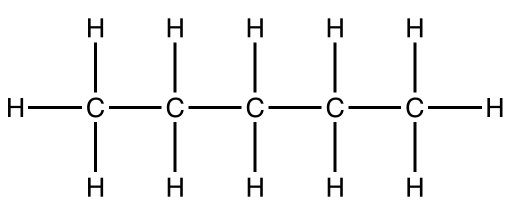
= Butane

3.



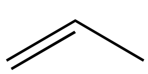
= 1-butene

Practice: Write the name for each straight-chained hydrocarbon drawn below.



____

$CH_3CH_2CH_2CH_2CH_2CH_3$ ________________________



____

Practice: Draw an expanded, condensed and line structure for each name given below.

Name	**Expanded**	**Condensed**	**Line**
1-butyne			
1-hexene			

3. Naming and Drawing Branched Hydrocarbons:

A. Branched alkanes are named by using the following steps:

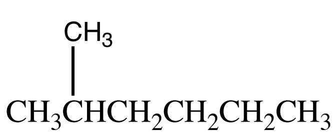
1. Name the longest chain
2. Number the main chain giving the lowest number priority to any branched groups
3. Name the branched groups and identify their position by the number in the chain
4. Write the full name as a single word
   –use hyphens to separate numbers from prefixes
   –use commas to separate numbers from numbers
   –use alphabetical order for branched groups
   –use di-, tri-, or tetra- prefixes if there are multiples of the same branch group

B. Branched alkenes and alkynes are named by using the following steps:

1. Name the parent chain (the longest chain containing the double or triple bond)
2. Number the chain giving the lowest priority to the double or triple bond
3. Assign a name and number to the branched groups
4. Write the full name as one word
   –use hyphens to separate numbers from prefixes
   –use commas to separate numbers from numbers
   –use alphabetical order for branched groups
   –use di-, tri-, or tetra- prefixes if there are multiples of the same branch group
   –if it is an alkene, determine if cis-trans isomers apply

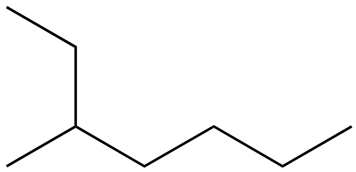
Examples:

1.



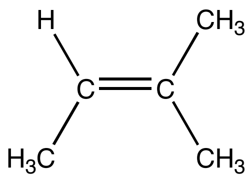
= 2-methylhexane

2.



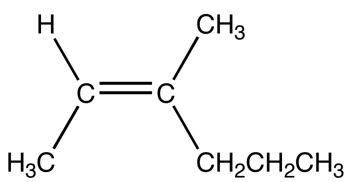
= 3-methylheptane

3.



= 2-methyl-2-butene

Practice: Write the name for each branched hydrocarbon drawn below.



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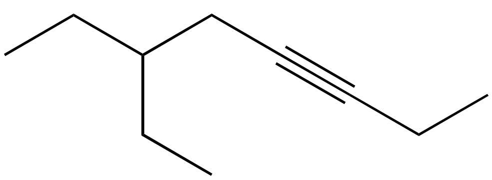

____

Practice: Draw an expanded, condensed and line structure for each name given below.

Name	Expanded	Condensed	Line
methylpropene			
4-ethyloctane			

Name: ____________________

Group #: ____________________

Organic Nomenclature and Modeling Worksheet

Check out a molecular modeling kit from the stockroom for every pair of students in your group. The black sphere with four holes (tetrahedral geometry) is the correct representation for a carbon atom. The smallest grey spheres represent hydrogen atoms. Since we are only considering hydrocarbons in this lab, you do not need any of the other spheres today.

1. Methane

Build a molecular model for methane, draw a 3-D ball and stick representation of it below, and answer the following questions.

a. Why are there no molecules known as methene and methyne?

b. What is the molecular geometry about the central atom in methane?

c. Do you expect all of the bond angles in methane to be equivalent?

2. 2-butene

Build a molecular model for 2-butene, draw a 3-D ball and stick representation of it below, and answer the following questions.

a. Does this molecule have any constitutional isomers? If so, name and draw one.

b. Does this molecule exist as a pair of cis-trans isomers? If so, which isomer did you build?

c. What is the molecular geometry about each carbon atom in 2-butene?

d. What is the smallest bond angle in 2-butene?

3. 2-methylpentane

Build a molecular model for 2-methylpentane, draw a 3-D ball and stick representation of it below, and answer the following questions.

a. How many C atoms are in the molecule?

b. How many H atoms are in the molecule?

c. Write the molecular formula for 2-methylpentane using the form C_xH_y.

d. Based on what you know about alkanes, does the molecular formula from part C make sense to you? Explain.

e. There are five isomers for this formula. You have one drawn above. Name and draw the other four.

f. What is the molecular geometry about each carbon atom in 2-methylpentane?

4. dimethylpropane

Build a molecular model for dimethylpropane, draw a 3-D ball and stick representation of it below, and answer the following questions.

a. How many C atoms are in the molecule?

b. How many H atoms are in the molecule?

c. Write the molecular formula using the form C_xH_y.

d. Does 2,3-dimethylpropane exist? If so, draw it below.

5. 4-methyl-2-pentyne

Build a molecular model for 4-methyl-2-pentyne, draw a 3-D ball and stick representation of it below, and answer the following questions.

a. How many C atoms are in the molecule?

b. How many H atoms are in the molecule?

c. Write the molecular formula for 4-methyl-2-pentyne using the form C_xH_y.

d. Based on what you know about alkynes, does the molecular formula from part C make sense to you? Explain.

e. Does this molecule exist as a pair of cis-trans isomers? If so, which isomer did you build?

f. What is the molecular geometry for each carbon in the molecule?

Appendix A: Reporting Measurements

You will recall from your textbook and lecture sessions that all measurements are inexact. Measurements should be reported to reflect the precision of the measuring device. To indicate the precision of a particular piece of equipment, the value recorded should use all digits known with certainty plus one additional digit that had to be estimated. The last recorded digit of any measured quantity is assumed to be the estimated (uncertain) digit. The following guidelines will help you to determine which decimal place to round your measurements when using common laboratory equipment in Chemistry 30A.

1. Beakers: Report to the whole milliliter

The beakers in your lab drawer have measured increments for every 10 milliliter (mL). Look at your 150 mL beaker. Find the increment for 40 mL. What volume is the next increment showing? It should be 50 mL. Since increments are given for every 10 mL, this means that you should estimate to the whole milliliter when using a beaker to measure volume. The following reported measurements for volume are acceptable when using a beaker: 45 mL, 51 mL and 88 mL.

NOTE: Beakers are not as precise as the graduated cylinders in your lab drawer. Beakers should only be used when measuring an approximate volume. If you need to measure the volume of a substance more precisely you should use a graduated cylinder.

2. Large Graduated Cylinder: Report to the tenth of a milliliter

The large cylinder in your drawer has increments for every milliliter. Looking at your large graduated cylinder, find the increment for 10 mL. What volume is the next increment showing? It should be 11 mL. Since increments are given for every 1 mL, this means that you should estimate to the tenth (0.1) of a milliliter when using the large graduated cylinder to measure volume. The following reported measurements for volume are acceptable when using your large graduated cylinder: 45.0 mL, 60.1 mL, and 88.5 mL.

3. Small Graduated Cylinder: Report to the hundredth of a milliliter

The small cylinder in your drawer has increments for even tenth (0.1) of a milliliter. Looking at your small graduated cylinder, find the increment for 2.5 mL. What volume is the next increment showing? It should be 2.6 mL. Since increments are given for every 0.1 mL, this means that you should estimate to the hundredth (0.01) of a milliliter when using the small graduated cylinder to measure volume. The following reported measurements for volume are acceptable when using your small graduated cylinder: 2.50 mL, 3.00 mL, 9.95 mL.

NOTE: Some small graduated cylinders may have increments given in 0.2 mL instead of 0.1 mL. Look carefully at your cylinder and determine if your increments are in 0.2 mL or 0.1 mL. This is crucial to making correct measurements with your small cylinder!

4. Top Loading Balance: Report all digits given in the digital display

For Chem 30A we will use centigram balances. The digital readout will always display mass (in grams) to the hundredth decimal place (centigram). Record all digits given in the digital display. If the digital display reads 2.00 g, you must report both zeroes in your recorded measurement for mass. Recording a mass of 2.00 g in your notebook as 2 g or 2.0 g is ***not correct*** as it does not indicate the precision of the top loading balance to measure to the hundredth decimal place!

5. Additional Information

Sometimes the smallest increment on a scale is too small for you to realistically estimate to the tenth. In this case, if the measurement is between increments you will consider it 0.5 of the smallest increment. This rule is useful with equipment such as your thermometer and ruler. The thermometer has increments for every whole degree Celsius. The increments are very close together, so a measurement that falls between 22°C and 23°C can be estimated as 22.5°C. The ruler has markings for every tenth of a centimeter (millimeters). Since estimating a tenth of a millimeter is difficult, a measurement between the 1.2 cm mark and the 1.3 cm mark can be estimated as 1.25 cm.

Appendix B: Laboratory Safety Worksheet
To accompany the video "Starting with Safety" by Flinn Scientific

Lab is a Privilege:

1. Who is responsible for safety in the lab?

Be Prepared for Lab:

1. What type of shoe is acceptable to wear in the lab?
2. What type of clothing is acceptable to wear in the lab?
3. How should long hair be worn in the lab?
4. How are your eyes protected in the lab?
5. What items can you have out on the lab bench?

Act Responsibly:

1. Why is eating and drinking not allowed in the lab?

Follow Lab Instructions:

1. What should you do if you do not understand the directions given in the lab manual?

Important Safety Equipment:

1. List three items classified as personal safety equipment?
2. List five items classified as classroom safety equipment?
3. How long should a person rinse their eyes in the eye wash fountain?
4. What does PASS stand for?

Handling Substances Carefully:

1. How do you safely smell a chemical?

2. Why should flammable liquids be kept away from open flames?

3. Do all chemicals go down the drain at the end of lab?

Handling Glassware and Equipment Carefully:

1. How should broken glassware be cleaned up?

Using Heat Carefully:

1. Explain the correct color and shape of a Bunsen burner flame.