Welcome to Chemistry II Advanced! I am so excited for the coming school year! Be prepared for a lot of laboratory investigation, because hands-on is the best way to learn Chemistry!

The textbook we will be using is Chemistry, the Molecular Nature of Matter and Change (Seventh edition) by Martin S. Silberberg, B.S., and Ph.D. This text is used by many schools preparing for the AP Exam in Chemistry, and is listed as a textbook option by the College Board. Please consider purchasing a used textbook from students who have previously completed this class, or you may be able to find one online. You do not need to purchase a Lab Manual; lab experiments and any supplemental materials will be provided throughout the year.

As we will be discussing during our first class, you are not required to take the AP Exam for the course; however, I highly encourage you to take the exam. Taking this class requires dedication and a lot of hard work. Why not reward your hard work by taking the AP Chemistry Exam in May and getting college credit for this course while still in high school!!

The work I have assigned for summer work covers Chapters 1 through 3 in your textbook. This represents most of what was covered in Chemistry I. **I will be collecting the Summer Assignment on the first day of classes. This assignment will be graded and we will be having a quiz on this material during the second week of classes.**

Summer Assignment:

1. Please read the Preface located immediately following the Table of Contents. This is an excellent way to acquaint yourself with how this book is organized. Also, please note the charts and reference tables located before Chapter 1.
2. Please read and review the following chapters. You are not required to outline chapters in this course, but I highly encourage you to take notes as you read. These will be a valuable resource as you study for course tests and quizzes, and for the AP Chemistry exam.
    a. Chapter 1 - Keys to the Study of Chemistry
    b. Chapter 2 - The Components of Matter
    c. Chapter 3 - Stoichiometry of Formulas and Equations
3. Please complete the attached problem sets and show all work were required.
4. Please read the attached experiment *Working in the Chemistry Laboratory* and complete the prelab Questions (#1-9). We will begin this lab during the first week of classes. This will involve two lab sessions and a lab report. Please note that you will not be working with a lab partner for this lab.

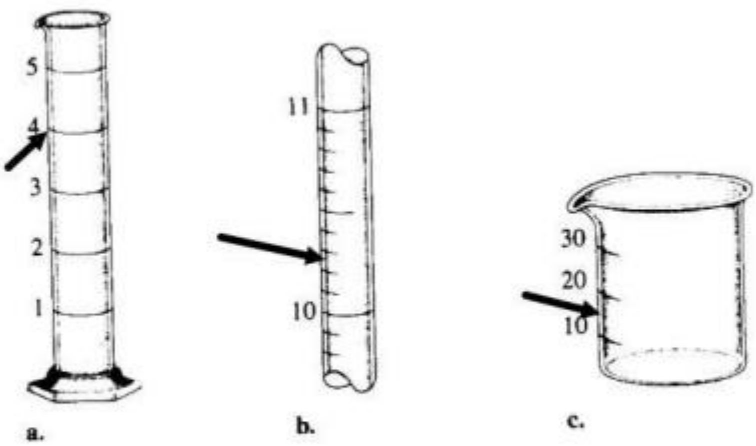
If you have any questions as you work through this assignment, please feel free to reach out to me. My email address is below. I am looking forward to a fantastic school year with lots of fun and laboratory investigation.

Sincerely,

Mrs Kenerson
mkenerson@nda-worc.org

PART 1

1. For each of the following pieces of glassware, provide a sample measurement at arrow and discuss the number of significant figures and uncertainty.



2. A student performed an analysis of a sample for its calcium content and got the following results:

   14.92%, 14.91%, 14.88%, and 14.91%

   The actual amount of calcium in the sample is 15.70%. What conclusion can you draw about the accuracy and precision of these results?

3. Calculate the percent error for the following measurements.
   a. The density of an aluminum block determined in an experiment was 2.64 g/cm3. (Accepted value = 2.70 g/cm3)
   b. The experimental determination of iron in ore was 16.48%. (Accepted value was 16.12%)

4. How many significant figures are in each of the following?
   a. 12
   b. 32.10
   c. 2001
   d. 0.0450
   e. 0.0000101

5. Round of each of the following numbers to two significant figures, and write the answers in scientific notation.
   a. 0.00031254
   b. 31,254,000
   c. 35,900
   d. 0.00000399

6. Solve the following problems. Round your answer to the correct number of sig figs (and use the correct unit on your answer).

   a. 825 cm x 32 cm x 0.248 cm

   b. $\frac{15.68 \text{ g}}{2.885 \text{ mL}}$

7. The world record for the hundred-meter dash is 9.79 s. What is the corresponding speed in units of m/s, km/hr, ft/s, and mi/hr?
   a. At this speed how long would it take to run a mile (5,820 ft)?

8. A cube of ruthenium metal 1.5 cm on a side has a mass of 42.0 g. What is the density in g/cm^3? Will ruthenium metal float on water?

9. The density of bismuth metal is 9.8 g/cm^3. What is the mass of a sample of bismuth that displaces 65.8 mL of water?

10. A person has a temperature of 102.5 F. What is this temperature on the Celsius scale? On the Kelvin scale?

11. Two spherical objects have the same mass. One floats on water; the other sinks. Which object has the greater diameter? Explain your answer.

12. What are some of the differences between a solid, a liquid, and a gas?

13. Classify each of the following as homogeneous or heterogeneous.
    a. soil
    b. the atmosphere
    c. a carbonated soft drink
    d. gold
    e. a solution of ethanol and water

14. Classify each of the following as a mixture or a pure substance. Of the pure substances, which are elements and which are compounds?
    a. Water
    b. Blood
    c. The oceans
    d. Iron
    e. Brass
    f. Uranium
    g. Table salt (NaCl)

15. List some differences between physical and chemical changes.

16. List four indications that a chemical change has occurred.

17. If you place a glass rod over a burning candle, the glass appears to turn black. What is happening to each of the following (physical change, chemical change, both, or neither) as the candle burns? Explain each answer
    a. the wax
    b. the wick
    c. the glass rod

18. The properties of a mixture are typically averages of the properties of its components. The properties of a compound may differ dramatically from the properties of the elements that combine to produce the compound. For each process described below, state whether the material being discussed is most likely a mixture or a compound, and state whether the process is a chemical change or a physical change.
    a. An orange liquid is distilled, resulting in the collection of a yellow liquid and a red solid.
    b. A colorless, crystalline solid is decomposed, yielding a pale yellow-green gas and a soft, shiny metal.
    c. A cup of tea becomes sweeter as sugar is added to it.

PART 2

1. Describe Dalton's atomic theory.

2. What discoveries were made by J.J. Thomson, Henri Becquerel, and Lord Rutherford? How did Dalton's model of the atom have to be modified to account for these discoveries?

3. What is the distinction between atomic number and mass number?

4. What is an isotope?

5. How many protons and neutrons are contained in the nucleus of each of the following atoms?
    a. ${}_{22}Ti^{42}$
    b. ${}_{30}Zn^{64}$
    c. ${}_{32}Ge^{76}$

6. Write the isotopic symbol for each of the isotopes below.
    a. Atomic number = 8, number of neutrons = 9
    b. The isotope of chlorine in which mass = 37
    c. Atomic number = 27, mass = 60

7. Distinguish between the terms family and period in connection to the periodic table. For which of these terms is the term group also used?

8. In the periodic table, what is the name of the following groups
   a. Group (2)
   b. Group (18)

9. An ion contains 50 protons, 68 neutrons, and 48 electrons. What is its symbol and charge?

10. Which of the following sets of elements are all in the same group in the periodic table?
    a. N, P, O
    b. C, Si, Ge
    c. Rb, Sn
    d. Mg, Ca

11. Identify each of the following elements:
    a. A member of the same family as oxygen whose most stable ion contains 54 electrons
    b. A member of the alkali metal family whose most stable ion contains 36 electrons
    c. A noble gas with 18 protons in the nucleus
    d. A halogen with 85 protons and 85 electrons

12. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?
    a. Na
    b. Sr
    c. P
    d. Ba
    e. I
    f. O
    g. Al
    h. S

13. For each of the following ions, indicate the total number of protons and electrons in the ion. For the positive ions, predict the formula of the simplest compound formed between itself and oxide. For the negative ions predict the simplest compound formed between itself and aluminum.
    a. Fe^{+2}
    b. Fe^{+3}
    c. Ba^{+2}
    d. S^{-2}
    e. P^{-3}
    f. N^{-3}

14. An element's most stable ion forms an ionic compound with bromine, having the formula XBr_2. If the ion of element X has a mass number of 230 and 86 electrons, what is the identity of the element, and how many neutrons does it have?

15. Name each of the following compounds:
    a. $NaCl$
    b. $FeBr_3$
    c. Cr_2O_3
    d. $CaBr_2$
    e. Ag_2S
    f. $KClO_4$
    g. $Al_2(SO_4)_3$
    h. $KMnO_4$
    i. Sr_3P_2
    j. $NaNO_2$

16. Name each of the following compounds:
    a. SO_2
    b. ICl_3
    c. HCl
    d. H_3PO_4
    e. HNO_2
    f. H_2SO_3
    g. S_3N_4
    h. SF_6

17. Write the formula for each of the following compounds:
    a. Barium sulfate
    b. Chlorine trifluoride
    c. Sulfur difluoride
    d. Sulfur hexafluoride
    e. Ammonium acetate
    f. Copper (II) nitrate
    g. Silicon tetrafluoride
    h. Lead (II) sulfide
    i. Perchloric acid
    j. Silicon dioxide

Part III

1. Balance the following and equations and tell what type of reaction it is (synthesis, decomposition, single replacement, double replacement, or combustion)
   a. ___ $KNO3 \rightarrow$ ___ KNO2 + ___ O2 Type: ___________
   b. ___ AgNO3 + ___ $K2SO4 \rightarrow$ ___ Ag2SO4 + ___ KNO3 Type: ___________
   c. ___ CH3NH2 + ___ $O2 \rightarrow$ ___ CO2 + ___H2O + ___ N2 Type: ___________
   d. ___ N2O5 + ___ $H2O \rightarrow$ ___HNO3 Type: ___________
   e. ___ Na + ___ $Zn(NO3)2 \rightarrow$ ___ Zn + ___ NaNO3 Type: ___________

2. What are diatomic molecules? List the 7.

3. Magnesium consists of 3 naturally occurring isotopes with the masses 23.98504, 24.98584, and 25.98259 amu. The relative abundances of these three isotopes are 78.70%, 10.13 %, and 11.17% respectively. Calculate the average atomic mass.

4. Calculate the percent composition of $C_{12}H_{22}O_{11}$ (sugar). (Give Percent of each element.) Show all work.

5. Calculate the number of moles of the following:

   a. 42.8 g of KNO_3
   b. 155.7 L of CO_2 at STP
   c. 9.25 x 10^{26} molecules of $CaCl_2$

6. Using the following equation: $2\ NaOH + H_2SO_4 \rightarrow 2\ H_2O + Na_2SO_4$ How many grams of sodium sulfate will be formed if you start with 200 grams of sodium hydroxide and you have an excess of sulfuric acid?

7. Using the following equation: $Pb(SO_4)_2 + 4\ LiNO_3 \rightarrow Pb(NO_3)_4 + 2\ Li_2SO_4$ How many grams of lithium nitrate will be needed to make 250 grams of lithium sulfate, assuming that you have an adequate amount of lead (IV) sulfate to do the reaction?

8. Using the following equation: $Fe_2O_3 + 3\ H_2 \rightarrow 2\ Fe + 3\ H_2O$ Calculate how many grams of iron can be made from 16.5 grams of Fe2O3.

9. Determine the grams of sodium chloride produced when 10.0 g of sodium react with 10.0 g of chlorine gas according to the equation: $2\ Na + Cl_2 \rightarrow 2\ NaCl$

10. Determine the mass of lithium hydroxide produced when 50.0g of lithium are reacted with 45.0g of water according to the equation: $2\ Li + 2\ H_2O \rightarrow 2\ LiOH + H_2$

11. Determine the percent yield of water produced when 68.3 g of hydrogen reacts with 85.4g of oxygen and 86.4g of water are collected. $2\ H2 + O2 \rightarrow 2\ H_2O$

Experiment 1-1

Working in the Chemistry Laboratory

One of the most important components of your chemistry course is the laboratory experience. Although you may have performed experiments in other science courses and may be familiar with some of the laboratory equipment, there is, nevertheless, a great deal more to be learned about the equipment and the safety procedures that are used in a chemistry laboratory.

A number of important procedures need to be mastered in order for you to perform the experiments in this course successfully. You will need to know how to use a Bunsen burner, how to filter liquids, how to manipulate glass tubing, how to handle solid chemicals and solutions, and how to heat materials safely. It is important to learn how to make accurate measurements by using graduated cylinders, thermometers, and balances. In addition, you need to learn how to take necessary precautions so that you can work safely in a laboratory.

In this introductory experiment, you will have a chance to learn these laboratory techniques as you peform an experiment involving a water solution of calcium hydroxide, $Ca(OH)_2$, commonly called limewater. Limewater is used as a test for the presence of carbon dioxide, CO_2, an important product of animal respiration. When carbon dioxide is bubbled through limewater, a cloudy appearance is noted. This cloudiness is called a *precipitate*.

Objectives

1. ***Demonstrate*** mastery of essential laboratory techniques and procedures, as well as a familiarity with laboratory equipment.
2. ***Apply*** safety precautions to laboratory procedures.
3. ***Observe*** the reaction between limewater and carbon dioxide.
4. ***Interpret*** the results of two chemical reactions.

Materials

Apparatus

Bunsen burner
centigram balance
flame spreader
funnel
filter paper
stirring rod
6-mm glass tubing
2 125-mL Erlenmeyer flasks
one-hole stopper to fit flasks
two-hole stopper to fit flasks
rubber or plastic tubing
ring stand and ring
wire gauze
thermometer
2 250-mL beakers
spark lighter or matches
triangular file
100-mL graduated cylinder
metric ruler
marking pen
cloth gloves
funnel holder (or cooled ring from ring stand)
folded cloths or towels
glycerin
laboratory apron
safety goggles

Reagents

0.5*M* hydrochloric acid, HCl
magnesium ribbon
sodium carbonate
calcium hydroxide
distilled water

Prelab

1. Read the introduction and procedure before you begin.
2. Answer prelab questions 1–9 on the Report Sheet.

Procedure

Part 1

1. Put on your safety goggles and laboratory apron. Before you begin to work with your Bunsen burner, compare it to the pictures of the two common lab burners in Figure A.

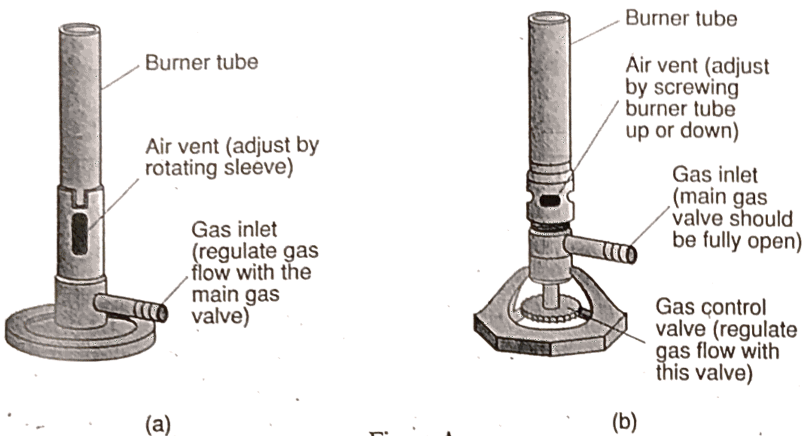
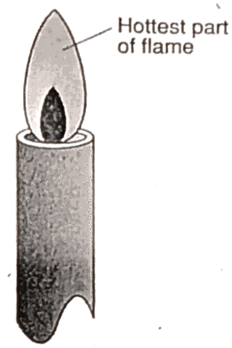


Figure A



The hottest part of the flame produced by a laboratory burner is just above the tip of the inner (blue) cone

Figure B

2. Most Bunsen burners are constructed in a similar fashion. There is an inlet for the gas, an adjustment for the flow of gas, and an adjustment for the flow of air. A proper mix of air and gas will yield a faint blue flame for maximum heat and minimum soot. Identify the gas adjustment and the air adjustment on your burner. Before you light the burner, turn the air adjustment to allow as little air as possible.

3. Before you light the burner, check to make sure that all students nearby are wearing their safety goggles. Lighting the Bunsen burner is a one-person job. Have a match or spark lighter ready before you turn on the gas. Light the burner by turning on the gas and holding the spark lighter or lighted match above the barrel of the burner.
4. Adjust the flame to a blue color by changing the flow of air and the flow of gas. Look at Figure B to help identify the hottest part of the flame.
5. Turn off the burner and go on to the next part of the experiment.

Part 2

1. In order to make the limewater solution, you must be able to use a lab balance. A picture of one common balance is shown in Figure C.

   A balance must be zeroed before it is used to find masses. Place the balance on a level table and find the zero-adjusting screw. Adjust the balance to the zero point. The balance you are using probably has three beams. In order to properly record the mass, you must add up the masses indicated by the riders on the three beams.
2. Chemicals are measured in a container or on paper, never directly on the pan or platform of a balance. Place a clean, dry 250-ml beaker on the pan of the balance and determine the mass of the beaker. Record the mass on the Report Sheet.
3. Place approximately 3 g of calcium hydroxide in the beaker and find the mass of the beaker plus the calcium hydroxide. Record this mass on the Report Sheet.

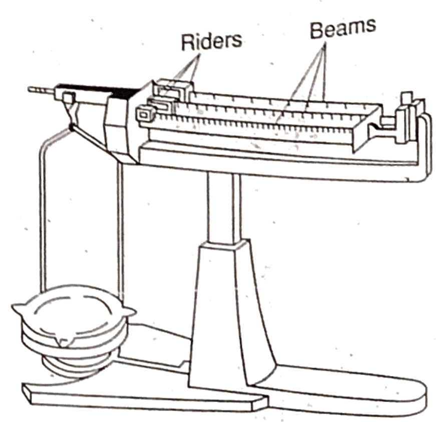


Figure C

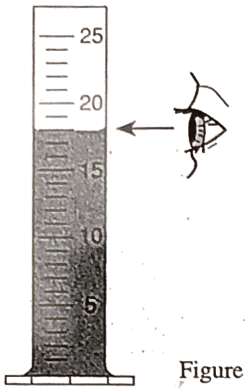


Figure D

CAUTION: The beaker will be hot. Use a thick, folded cloth as a hot pad to protect your fingers. The wire gauze and iron ring will also be hot; do not touch them until they have cooled.

4. Use the graduated cylinder to measure 175 mL of distilled water and add the water to the calcium hydroxide in the beaker. For this experiment, it is not important to know the exact amount of liquid, so you do not have to measure exactly. Look at Figure D to see how the volume is read on a graduated cylinder when the exact volume is required.

5. Stir the solution with a stirring rod. Calcium hydroxide is difficult to dissolve. Heating the solution will speed the process. Set up a ring stand with a ring and a wire gauze as shown in Figure E. Heat the solution gently, stirring constantly for approximately 5 to 10 minutes. Not all of the solid will have dissolved, even after heating. Turn off the burner. Remove the beaker from the ring stand and place it on the lab table. Let the solution cool and settle while you set up a funnel to filter the solution.

6. The filtration apparatus is shown in Figure G. Filter paper is normally in the shape of a circle. Fold it carefully in half and then in quarters. Open the paper so that it forms a cone and place it in the funnel as shown in Figure F. Moisten the filter paper with a few drops of distilled water. The filter paper should fit snugly and adhere to the funnel.

7. Pour the solution down your stirring rod into the funnel as shown in Figure G. Allow the clear solution to filter into the beaker below. You will use the clear limewater for Parts 4 and 5. Put the filter paper and any solid it may contain into the place designated by your teacher.

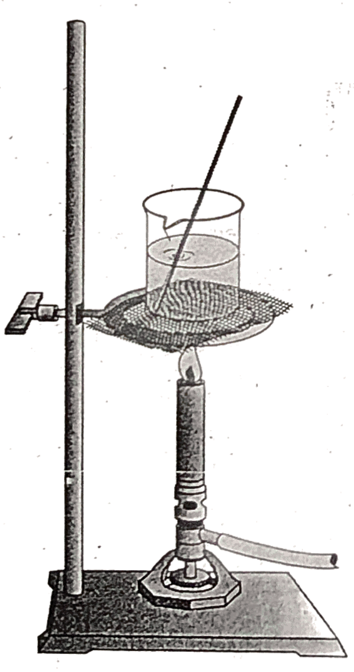


Figure E

(a) Folding filter paper. (b) Fitting a moistened filter paper cone to a funnel.

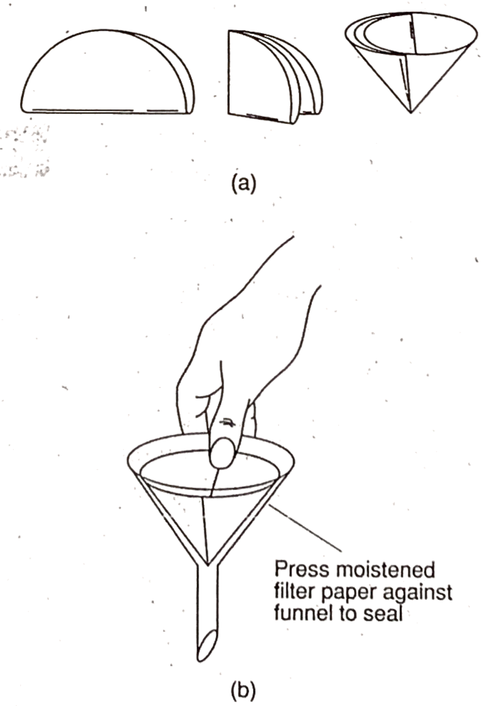


Figure F

When filtering, use a glass stirring rod to control the flow of the solution into the funnel. If the stem of the funnel touches the side of the beaker, the liquid flows more smoothy into the beaker.

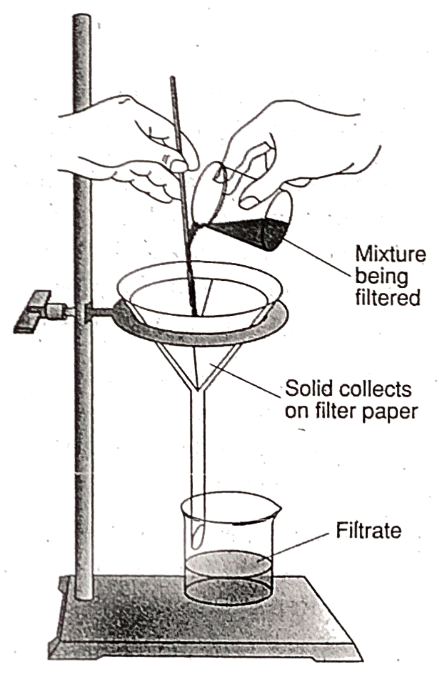


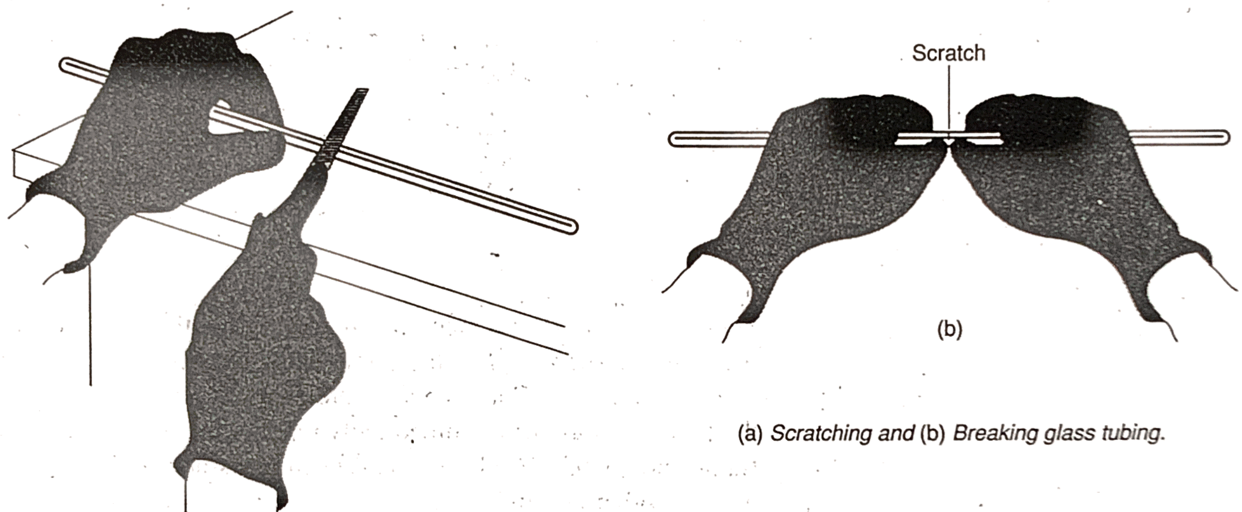
Figure G

Part 3

1. Obtain a piece of glass tubing 50 cm long. Use a metric ruler and a marking pen to mark the tubing where it is to be cut into two 20-cm pieces and one 10-cm piece.

2. Place the tubing on a firm surface as shown in Figure H. Use a triangular file and make a single firm stroke across the tube to scratch it at the place where you want to cut the glass tubing. Put one or two drops of water on the scratch. Then hold the tube with the scratch away from you, with both thumbs behind, one on each side of the scratch. Place your elbows against your sides; push with your thumbs against the tube while twisting your wrists outward. The glass should break cleanly at the scratch.

CAUTION: To avoid cuts, wear cloth gloves when you break glass tubing.



(a) *Scratching and* (b) *Breaking glass tubing.*

(a)

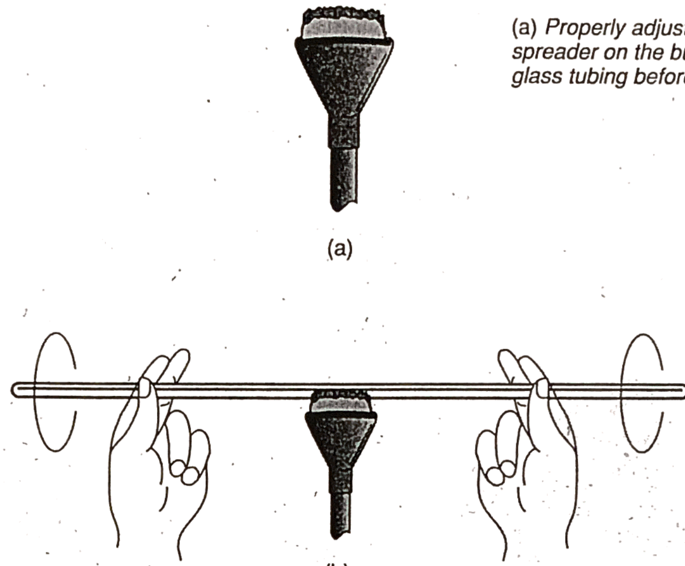
Figure H

3. Repeat this process at the other mark on your tubing. You should now have two 20-cm pieces and one 10-cm piece.

4. To smooth the ends of the glass tubing, a technique called *fire polishing* is used. Light the burner and adjust the air to get a blue flame with an inner core. Place the end of one piece of tubing in the flame at the very top. Rotate the tubing slowly and continuously so that the heating is even. While rotating the tubing, lower the end slowly until it is just above the tip of the inner core. You will quickly notice the end of the tubing soften and become smooth. Do not leave the glass in the flame too long or the end of the tube will close. Fire polish the ends of each piece of tubing.

CAUTION: Be careful with hot glass tubing. It looks the same when it is hot as when it is cool. Place the hot end of the tube on a wire gauze or other fireproof material and wait for the tubing to cool.

5. Turn off the burner and place the flame spreader on the top of the burner, as shown in Figure I. The flame spreader allows you to evenly heat a longer section of glass and bend the glass tubing more easily.



(a) Properly adjusted flame with a flame spreader on the burner. (b) How to heat glass tubing before bending.

(a)

(b)

Figure I

6. Hold one of the 20-cm pieces of tubing with both hands and place the center of the tubing in the flame while rotating the tubing as shown in Figure I. Continue to rotate the tubing until you notice that the tubing is softening. Immediately remove the tubing from the flame and quickly bend it 90 degrees in one smooth motion. Repeat with the other 20-cm piece.

7. - Allow the bends to cool. Slide one of the 20-cm pieces and the 10-cm piece of tubing through the holes of the two-hole stopper as shown in Figure J. Put the other 20-cm piece into the one-hole stopper, again using glycerin. Save both stoppers fitted with glass tubing for Parts 4 and 5.

CAUTION: Always protect both your hands with thick, folded cloth pads when inserting glass tubing into the hole in a stopper. Use glycerin as a lubricant. NEVER force the tube into the hole; if it does not slide easily, call your teacher. If you have to adjust the tube later to slide it up or down in the stopper hole or if you wish to remove the tube, be sure to protect your hands with thick, folded cloth pads. Call your teacher if the stopper does not move easily

Two-hole stopper with glass tubing, inserted in a flask for use in Parts IV and V.

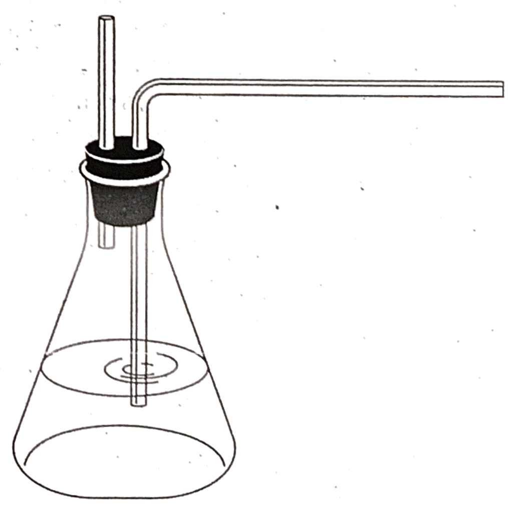


Figure J

Part 4

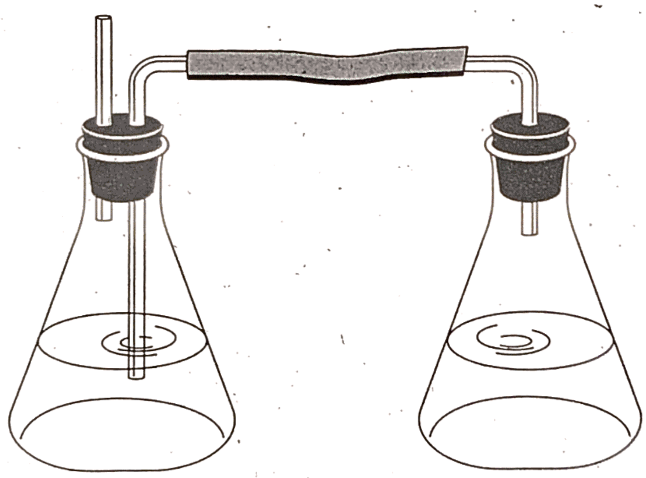
1. Place just enough clear limewater into a 125-mL Erlenmeyer flask so that the end of the glass tubing is just below the surface of the liquid when a two-hole stopper is inserted into the flask. Put the stopper on the flask tightly.
2. Gently blow into the end of the bent tubing. You exhale carbon dioxide (among other gases). Continue to exhale into the tube until you observe a change. Record your observations on the Report Sheet.
3. Pour the cloudy limewater into the container designated by your teacher.

Part 5

1. Attach a short piece of rubber or plastic tubing to the ends of both 90 degree bends and set up your two flasks as shown in Figure K.
2. Rinse the flask you used in Part 4 and fill it with fresh, *clear* limewater to the same level as before—just above the end of the bent tubing as shown in Figure K.

Setup for testing gases with limewater.

Figure K



3. In the other flask, place about 35 mL of 0.5*M* hydrochloric acid.
4. Using a thermometer, measure the temperature of the acid and record it on the Report Sheet. Rinse the end of the thermometer with water after removing it from the acid.
5. Obtain a piece of magnesium ribbon from your instructor. Carefully drop the magnesium into the acid and *quickly* place the stopper on the top of the flask. Record your observations on the Report Sheet.
6. As soon as the reaction stops, remove the stopper and measure the temperature of the acid. Record it on the Report Sheet.

7. Rinse all glassware and repeat steps 2, 3, and 4. Record the temperature on the Report Sheet. Pour the acid and limewater into containers designated by your teacher and dispose of any leftover magnesium as directed.

8. Obtain about 2 grams of sodium carbonate. Carefully transfer the sodium carbonate into the flask and *quickly* put the stopper on the flask. Record your observations on the Report Sheet.

9. As soon as the reaction stops, remove the stopper and measure the temperature of the acid. Record it on the Report Sheet. Dispose of any leftover acid, limewater, and sodium carbonate as directed by your teacher.

10. Before leaving the laboratory, clean up all materials and wash your hands.

Name ____________________

Class ____________________

Date ____________________

Report Sheet

Working in the Chemistry Laboratory

Prelab Questions

1. What is the purpose of mixing air with the gas when using a Bunsen burner?

____

____

2. Describe how glass tubing is cut in the chemistry lab.

____

____

3. What is fire polishing?

____

____

4. What is the purpose of using glycerin when inserting glass tubing into a rubber stopper?

____

____

5. Read the mass shown on the balance diagram in Figure L. Record to the nearest 0.01 g. ____________

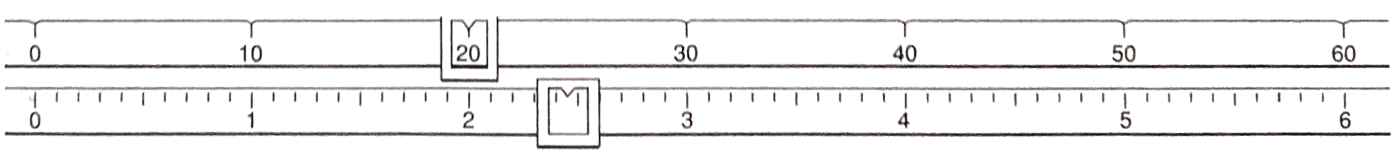


Figure L

6. Read the temperature shown on the Celsius thermometer in Figure M. Record to the nearest 0.5°C. ______

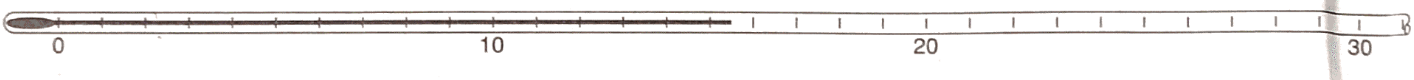


Figure M

7. Read the graduated cylinder shown in Figure N. Record the liquid volume to the nearest 0.5 mL. __________

Figure N

8. What is a precipitate?

____

____

9. In your own words, write the purpose of this experiment.

____

____

____

____

____

Data and Observations

Part 2

Data Table

Mass of beaker	
Mass of beaker + calcium hydroxide	
Mass of calcium hydroxide alone	

Part 4

Observation from step 2

____

____

Part 5

Data Table

	Hydrochloric Acid/Magnesium Reaction	Hydrochloric Acid/Sodium Carbonate Reaction
Temperature before		
Temperature after		
What happens in the reaction?		
What happens to the limewater?		

Analysis and Conclusions

1. In Part 5, was carbon dioxide produced in either of the reactions?

   How do you know?

   ____

   ____

   ____

2. What observations in Part 5 lead you to believe that chemical reactions occurred?

   ____

   ____

   ____

3. Why was the limewater solution you made in Part 2 cloudy? Why was it necessary to filter the limewater before using it in Parts 4 and 5?

4. Why is it necessary to use a beaker or some other container when you find the mass of solids?

Synthesis

1. If you were to find the mass of the hydrochloric acid and the mass of the magnesium strip before the reaction, how would that mass compare with the mass of the material remaining in the flask after the reaction was complete?

   If you were able to contain the gas produced (rather than let it escape as you did), how would that procedure affect the masses before and after the reaction?

2. A number of SI units were used in this experiment. Review the procedure and make a list of all of the units that you used in the measurements.

3. Matter in three different phases was observed in this experiment. Give two examples from the experiment of each phase.

   solid

   liquid

   gas

4. Many antacids are carbonate or bicarbonate compounds. One manufacturer used to refer to the "burp of relief" when a person took the antacid. Explain what happens when a person takes such an antacid.