Experiment 1

Laboratory Procedures: Safety and Techniques (S-21)

Process Objectives

• To observe proper safety technique with all laboratory equipment.
• To use laboratory apparatus skillfully and efficiently.

Learning Objectives

• To learn the names and functions of all the apparatus in the laboratory.
• To develop a positive approach toward laboratory safety.

Introduction

The best way to become familiar with chemical apparatus is to actually handle the pieces yourself in the laboratory. This activity is divided into several parts in which you will learn how to adjust the gas burner, use a balance, handle solids, measure liquids, filter a mixture, and measure temperature and heat. Great emphasis is placed on safety precautions that should be observed whenever you perform an experiment and use a particular apparatus. You will also be referred to many of the safety precautions and procedures explained in all parts of this activity. It is important that all students develop a positive approach to a safe and healthful environment in the laboratory.

Safety

Take the necessary safety precautions before beginning each part of this experiment. Wear safety goggles and, if desired, a lab apron. Get into the “good habit” of always putting on this standard safety equipment as soon as you enter the lab. It is important that you and your partner observe all safety precautions while conducting experiments. Read all safety cautions noted in your procedures, and discuss them with your teacher if necessary.

Part 1: The Bunsen Burner

Apparatus

heat-resistant surface  (note: some lab counters are heat-resistant surfaces)
burner and tubing                sparker
crucible tongs                   porcelain evaporating dish

Materials

Copper wire, 18 gauge

Recording Your Observations

Record your observations and answer questions in the spaces provided in each part of this activity.

Procedures

1. The Bunsen burner or Tirrill burner is commonly used as a source of heat in the laboratory. Although the details of construction vary among types of burners, each has a gas inlet located in the base, a vertical tube or barrel in which the gas is mixed with air, and adjustable openings or ports in the base of the barrel. These ports admit air to the gas stream. The burner also may have an adjustable needle valve to regulate the flow of gas. In some models the gas flow is regulated simply by adjusting the gas valve on the supply line. The burner is always turned off at the gas valve, never at the needle valve. Look at Figure 1-1 as you examine your burner and locate these parts.

CAUTION: Before you light the burner, check to see that you and your partner have taken the following safety precautions against fires: Wear safety goggles and, if desired, an apron. Confine long hair and loose clothing: Tie long hair at the back of the head and away from the front of the face, roll up long sleeves on shirts, blouses, and sweaters away from the wrists. You should also know the locations of fire extinguishers, fire blankets, and safety showers, and how to use them in case of a fire.
2. In lighting the burner, partially close the air intake port at the base of the barrel, turn the gas full on, hold the sparker about 5 cm above the top of the burner, and proceed to light. The gas flow may then be regulated by adjusting the gas valve until the flame has the desired height. Then open the air intake port more fully until the desired type of flame is attained. If a very low flame is needed, remember that the air intake ports should be partially closed when the gas pressure is reduced. Otherwise the flame may burn inside the base of the barrel. When improperly burning in this way, the barrel will get very hot, and the flame will produce a poisonous gas, carbon monoxide. **CAUTION:** Carbon monoxide is a poisonous gas. If the flame is burning inside the base of the barrel, immediately turn off the gas at the gas valve. Do not touch the barrel, for it is extremely hot! Allow the barrel of the burner to cool off and then proceed as follows:

   Begin again, but first decrease the amount of air admitted to the burner by partially closing the port. Turn the gas full on and then relight the burner. Control the height of the flame by adjusting the gas valve, then adjust the air intake valve to modify the type of flame. By taking these steps, you should acquire a flame that is burning safely and is easily regulated throughout the experiment.

3. Once you have a flame that is burning safely and steadily, you can experiment by completely closing the air intake port at the base of the burner. What is the result?

   __________________________________________________________________________________________
   __________________________________________________________________________________________

   With the air valve still closed, using the crucible tongs, hold a clean evaporating dish in the tip of the flame for about three minutes. Place the dish on a heat-resistant surface, allow the dish to cool, and then examine its underside. Describe the results and suggest a possible explanation.

   __________________________________________________________________________________________
   __________________________________________________________________________________________
   __________________________________________________________________________________________

   Such a flame is seldom used in the laboratory. For laboratory work, you should adjust the burner so that the flame will be free of yellow color, is non-luminous, and also free from the "roaring" sound caused by admitting too much air.

4. Regulate the flow of gas to give a flame extending roughly 8 cm above the barrel. Now adjust the supply of air until you have a quiet, steady flame with a sharply defined, light blue inner cone. This adjustment gives the highest temperature possible with your burner. Using the tongs, insert a 10-cm piece of copper wire into the flame just above the barrel. Lift the wire slowly up through the flame. Where is the hottest portion of the flame located?

   __________________________________________________________________________________________
   __________________________________________________________________________________________

   Hold the wire in this part of the flame for a few seconds. What is the result?

   __________________________________________________________________________________________
   __________________________________________________________________________________________

5. Shut off the gas burner. Now think about what you have just observed in Procedures 3 and 4. Why is the non-luminous flame preferred over the yellow luminous flame in the laboratory? (Hint: The melting point of copper is 1083°C.)

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6. At the end of each day’s lab activities, all the equipment you store in the lab locker or drawer should be completely cool and clean. It should also be arranged in an orderly fashion for the next lab experiment. Check to see that the valve on the gas jet is completely shut off. Remember that hands should be washed thoroughly with soap at the conclusion of each laboratory period.

**Part 2: Handling Solids**  
*(Read only -- skip the activity unless practice is desired)*

**Apparatus**
- test tube
- scoopula
- index card or plain paper

**Materials**
- sodium chloride

**Procedures**
1. Solids are usually kept in wide-mouthed bottles. A scoopula should be used to dip out the solid. See Figure 1-2.

![Spatula](image1.png)  
![Figure 1-2](image2.png)

CAUTION: Do not touch chemicals with your hands. Some chemical reagents readily pass through the skin barrier into the bloodstream and can cause serious health problems. Some chemicals are extremely corrosive. Always wear safety goggles when handling chemicals. Carefully check the label on the reagent bottle or container before removing any of the contents. Never use more of a chemical than directed. You should also know the locations of the lab shower and eyewash and how to use them in case of an accident.

2. Remove a spoonful of sodium chloride from its reagent bottle or dish. In order to transfer the sodium chloride to a test tube, first place it on a piece of paper about 10 cm square. Fold the paper down the middle and allow the sample to slide into a test tube. When you tap the paper gently, the solid will slide down into the test tube.  

CAUTION: Never try to pour a solid from a bottle into a test tube. **As a precaution against contamination, never pour unused chemicals back into their reagent bottles.**

3. Dispose of the solid sodium chloride and paper as directed by your teacher.

CAUTION: Never discard potentially harmful chemicals or broken glassware in the wastepaper basket. This is an important safety precaution against fires and unwanted exposure by others handling the waste, and it prevents personal injuries (such as hand cuts) to anyone who empties the wastepaper basket.

4. Remember to clean up the lab and wash your hands thoroughly at the end of this part of the experiment.

**Part 3: The Balance**

**Apparatus**
- centigram balance
- scoopula
- small square sheet of plain paper or "weighing boat"
- test tube

**Materials**
- sodium chloride

**Procedures**
1. When a balance is required for determining mass, you will use a centigram balance. See Figure 1-4. The centigram balance is sensitive to 0.01 g. This means that your mass readings should all be recorded to the nearest 0.01 g (or estimate to nearest 0.005 g).
2. Before using the balance, always check to see if the pointer is resting at zero while the pan is empty. If the pointer is not at zero, check the slider weights. If all the slider weights are at zero, turn the zero adjustment knob until the pointer rests at zero. The zero adjust knob is usually located at the far left end of the balance beam. See Figure 1-4. Note: The balance will not adjust to zero if the movable pan has been removed and each pan is unique to its balance. Once the balance is zeroed, the adjustment knob’s setting should not be altered for the remainder of the activity.

Whenever weighing chemicals, always use weighing paper, a weigh boat, or a glass container. Never place chemicals or hot objects directly on the balance pan. They can permanently damage the surface of the balance pan and affect the mass weighing.

3. In many experiments you will be asked to weigh out a specified amount of a chemical solid.
   CAUTION: Do not touch chemicals with your hands. Always wear safety goggles when handling chemicals. Carefully check the label on the reagent bottle or container before removing any of the contents. Never use more of a chemical than directed. You should know the locations of the safety shower and eyewash and how to use them in case of an accident.

Use the following procedures to obtain approximately 13 grams of sodium chloride.
   a. Make sure the pointer on the balance is set at zero. Obtain a piece of weighing paper (or use a weighing boat) and place it on the balance pan. Determine the mass of the paper by adjusting the weights on the various scales. Record the mass of the weighing paper to the nearest 0.01 g.
      Mass of paper (or weighing boat): _____________________________
   b. Add 13 grams to the balance by sliding over the weight of the 10-gram scale to “10” and the weight of the 1-gram scale to “3 + current value”.
   c. Using a scoopula, obtain a quantity of sodium chloride from a reagent bottle or dish and place it in a clean, dry test tube.
   d. Now slowly pour the sodium chloride from the test tube onto the weighing paper/boat in the balance pan, until the pointer once again comes to zero. In most cases, you will only have to be close to the specified value. Do not waste time by trying to obtain exactly 13.00 g. Instead, determine the mass of your sample when the pointer swings close to zero. For example, suppose you slightly overshot the zero point. Adjust the front slider weight until the pointer is at zero and read the value. The mass might be 13.18 g. This value would be just as satisfactory as 13.00 g. Record your mass of sodium chloride to the nearest 0.01 g.
      Mass of boat + salt: __________________________________________________________________________
      Mass of salt: _________________________________________________________________________________

4. THIS TIME ONLY …. Do not throw the sodium chloride away! The dry sample is to be returned to its container for reuse. The following is the normal rule.
   CAUTION: Never discard chemicals, weighing papers, broken glassware, matches or the like in the wastepaper basket. This is an important safety precaution against fires and chemical exposure, and it prevents personal injuries (such as hand cuts) to anyone who empties the wastepaper basket. As a precaution against contamination, never pour unused chemicals back into their reagent bottles.

5. Hands should be washed thoroughly with soap and water at the conclusion of this part of the experiment.

Part 4: Measuring Liquids
Section A -- Learning the Basics

Apparatus
- graduated cylinders (2 sizes)
- buret clamp
- buret
- green pipet pump and 5-ml plastic pipet
- ring stand
- two beakers, 250 mL

Materials
- water
Procedures

1. For approximate measurements of liquids, a graduated cylinder such as the one shown in figure at the right is generally used. These cylinders are usually graduated in milliliters (mL). Such a graduated cylinder may read from 0 to 10 mL, 0 to 25 mL, or more, from bottom to top. It may also have a second row of graduations reading from top to bottom. Examine your cylinder for these markings. Observation: (Capacity and increments -- use decimal fractions in answers):
   Cylinder #1 _______________________
   Cylinder #2 _______________________

2. A pipet or a buret is used for more accurate measurements. Pipets are made in many sizes and are used to deliver measured volumes of liquids. A pipet is fitted with a hand-held pump which is used to withdraw air from the pipet while drawing up the liquid to be measured. Always use the pipet pump. NEVER pipet by mouth.
   Practice using the pipet by drawing up an amount of water of your choosing, seeing if you can draw up exactly the amount that you selected. Then dispense a lesser amount into another beaker without spilling any. Use the white thumb wheel to draw up and dispense water.

3. Burets, fitted with a stopcock, are used for delivering any desired quantity of liquid up to the capacity of the buret. Many burets are graduated in tenths of milliliters. See Figure below. When using a buret, follow these steps:
   a. Clamp the buret in position on a ring stand.
   b. Place a medium-sized beaker at the bottom of the buret. The beaker serves to catch any liquid that will be drawn off.
   c. Pour into a second beaker a quantity of the liquid you want to measure from the liquid’s reagent bottle. (NOTE: In this first trial you will be using water.) Remember to carefully check the label of the reagent bottle before removing any liquid.
   CAUTION: Safety goggles should be worn whenever you measure chemicals. Never pour a liquid directly from its reagent bottle into the buret. You should first pour the liquid into a small beaker (e.g., 100-mL) that is easy to handle, then pour the liquid from the small beaker into the buret. This simple method will prevent unnecessary spillage. Never pour any unused liquid back into the reagent bottle.
   d. Fill the buret with the liquid and then draw off enough liquid to fill the tip below the stopcock (i.e., bleed off the air in tip) and bring the level of the liquid down into the graduated region. The height at which the liquid stands is then read accurately. Practice this procedure several times by pouring water into the buret and emptying it through the stopcock.

   Observation: (Capacity and increments -- use decimal fractions in answers):

5. After you have taken your first buret reading, as directed, open the stopcock and draw off as many milliliters of the liquid as you wish. The exact amount drawn off is equal to the difference between your first and final buret readings. Practice controlling the flow rate: steady stream, fast drops, and then slow drops.

6. At the end of each day’s lab activities, all the equipment you store in the lab locker or drawer should be completely cool and clean. It should also be arranged in an orderly fashion for the next lab experiment. Check to see that the valve on the gas jet is completely shut off. Remember that hands should be washed thoroughly with soap at the conclusion of each laboratory period.

   CAUTION: In many experiments you will have to dispose of a liquid chemical at the end of a lab. Always ask your teacher for the correct method of disposal. In many instances liquid chemicals can be washed down the sink’s drain by diluting them with plenty of tap water. Very toxic chemicals should be handled only by your teacher. All apparatus should be washed and rinsed with tap water.
Section B -- Applying your skills

Apparatus
buret
buret clamp
ring stand
digital balance
5-ml pipet
pipet pump
small beaker
small weigh boat

1. Fill buret at least halfway with tap water. Bleed tip. Record INITIAL volume to nearest 0.1 ml in Table 1.

2. **Tare empty weigh boat** on digital balance. (To **tare**, with the balance ON, place the empty container on the balance pan. Press the ON button again so that the readout is once again displaying ZERO grams.)
   Position the ring stand so that the buret is DIRECTLY above the weigh boat on balance.

3. Adjust buret height so that the nozzle tip is approximately one inch above the weigh boat.
   Slowly turn the stopcock and dispense 3-4 ml (YOU decide how much) of water into the weigh boat. Record the FINAL volume to nearest 0.1 ml.
   Subtract to determine volume of water added to nearest 0.1 ml, and record calculated volume in Table 1.

4. Record the mass of the water in weigh boat to the nearest 0.01 gram.

5. Dump the water from weigh boat, place it on the balance, and **tare the balance**.

6. Fill a beaker part way with tap water. Secure pipet to pipet pump. Carefully draw up tap water to upper "0" mark on pipet.
   Position the pipet just above the weigh boat. Using the white thumb wheel, slowly dispense water into the weigh boat so that you add EXACTLY the same volume of water that you dispensed with the buret.

7. Record the mass of water in weigh boat to the nearest 0.01 gram.

**Q.** Did you record the exact same masses of water each time? ______________
If not, try to explain the cause(s) of the discrepancy. Be SPECIFIC.

| Table 1 |
|---------|---------|
| **Final Volume (buret)** | ml |
| **Initial Volume (buret)** | ml |
| **Volume of water added to weigh boat** | ml |
| **Mass of water — using buret** | g |
| **Mass of water — using pipet** | g |

Part 5: Filtration

Apparatus
ring stand
stirring rod
ceramic-centered wire gauze
evaporating dish
sparkler
wash bottle
funnel tongs
filter paper (correct size for your funnel)
iron ring
burner and tubing
two beakers, 250 mL
funnel
pyrex watch glass
funnel clamp
Materials
sodium chloride fine sand
water

Procedures

1. Sometimes liquids contain particles of insoluble solids, present either as impurities or as precipitates formed by the interaction of the chemicals used in the experiment. If the particles are denser than water, they soon sink to the bottom. Most of the clear, supernatant (floating above) liquid may be poured off without disturbing the precipitate. Such a method of separation is known as *decantation*. Your teacher will demonstrate the proper techniques.

2. Fine particles, or particles that settle slowly are often separated from a liquid by *filtration*. Support a funnel with a funnel clamp on the ring stand as shown by your teacher. Use a beaker to collect the *filtrate*. Adjust the funnel so that the stem of the funnel just touches the inside wall of the beaker.

3. Fold a circular piece of filter paper along its diameter, and then fold it again to form a quadrant as demonstrated. Separate the folds of the filter, with three thicknesses on one side and one on the other (forming a “snow cone holder”), then place in the funnel. The funnel should be wet before the paper is added. Use your plastic wash bottle containing distilled water. Then wet the filter paper with a little water and press the edges firmly against the sides of the funnel so no air can get between the funnel and the filter paper while the liquid is being filtered. **EXCEPTION**: A filter should not be wet with water when the liquid to be filtered does not mix with water. Why?

4. Dissolve 2-3 scoopfuls of salt in a beaker containing approximately 50 mL of tap water, and stir into the solution 1 scoopful of fine sand. Then filter out the sand by pouring the mixture into the filter, observing the following suggestions:
   a. The filter paper should not extend above the edge of the funnel. It is better to use a filter disc that leaves about 1 cm of the funnel exposed.
   b. Do not fill the filter. It must never overflow.
   c. Try to establish a water column in the stem of the funnel, thus excluding air bubbles, and then add the liquid just fast enough to keep the level about 1 cm from the top of the filter.
   d. When a liquid is poured from a beaker or other container, it may adhere to the glass and run down the outside wall. This may be avoided by holding a stirring rod against the lip of the beaker, as shown in Figure 1-12. The liquid will run down the rod and drop off into the funnel without running down the side of the beaker.
   e. Never poke the wet filter paper with your stirring rod, as it might puncture the paper barrier.

   The sand is retained on the filter paper. What property of the sand enables it to be separated from the water by *filtration*?

   Answer:

   What does the *filtrate* contain?

   Answer:

5. The salt can be recovered from the filtrate by pouring the filtrate into an evaporating dish and evaporating it nearly to dryness. Your instructor will demonstrate the correct setup. This is based on the separation technique known as *distillation*.

   **CAUTION**: When using the burner, make certain that you confine loose clothing and that long hair is securely tied back. Wear your safety goggles!

6. Reduce the flame as soon as the liquid begins to spatter. Shut off the gas burner once all of the water has boiled away.

   What property of salt prevented it from being separated from the water by *filtration*?

   What property of salt allows us to separate it from water during *distillation*?

   Q1:

   Q2:

   Make an observation about the contents of your dish after all of the water has been distilled away:
7. At the end of this part of the experiment, all equipment you store in the lab locker or drawer should be completely cool, clean, and arranged in an orderly fashion for the next lab experiment. Check to see that the valve on the gas jet is completely turned off. Make certain that the filter papers and sand are thrown into waste jars or containers and not down the sink! Wash your hands thoroughly before leaving the lab.

Part 6: Endothermic and Exothermic Reactions

Many chemical reactions give off energy. Chemical reactions that release energy are called exothermic reactions. Some chemical reactions absorb energy and are called endothermic reactions. You will study one exothermic and one endothermic reaction in this experiment.

In Part I, you will study the reaction between citric acid solution and baking soda. An equation for the reaction is:

\[
\text{H}_3\text{C}_6\text{H}_5\text{O}_7(\text{aq}) + 3 \text{ NaHCO}_3(\text{s}) \rightarrow 3 \text{ CO}_2(\text{g}) + 3 \text{ H}_2\text{O}(\text{l}) + \text{ Na}_3\text{C}_6\text{H}_5\text{O}_7(\text{aq})
\]

In Part II, you will study the reaction between magnesium metal and hydrochloric acid. An equation for this reaction is:

\[
\text{Mg}(\text{s}) + 2 \text{ HCl}(\text{aq}) \rightarrow \text{ H}_2(\text{g}) + \text{ MgCl}_2(\text{aq})
\]

Another objective of this experiment is for you to become familiar with Vernier temperature probes and Logger Pro, a software program. In this experiment, you will use Logger Pro to collect and display data as a graph or table, analyze your experimental data values, and print a graph or data table.

MATERIALS

- Macintosh or Windows-based computer
- Lab Pro or Go-Link hardware interface
- Logger Pro
- Vernier temperature probe
- 25 or 50-mL graduated cylinder
- centigram balance
- weighing paper
- styrofoam cup (small)
- 250-mL beaker
- citric acid, H\(_3\)C\(_6\)H\(_5\)O\(_7\), solution
- baking soda, NaHCO\(_3\)
- hydrochloric acid, HCl, solution
- magnesium strip, Mg
- chemical splash goggles

PROCEDURE

1. Obtain and wear goggles.

Part I Citric Acid + Baking Soda

2. Place a styrofoam cup into a 250-mL beaker as shown in Figure 1. Measure out 30 mL of citric acid solution into the styrofoam cup. Place a temperature probe into the citric acid solution.

3. Prepare the computer for data collection by opening the file named “Lab Techniques” within the Logger Pro folder inside the Chem Files folder on your computer’s desktop. The vertical axis has temperature scaled from -10 to 40°C. The horizontal axis has time scaled from 0 to 300 seconds.

4. Weigh out approximately 6.0 g of solid baking soda on a piece of weighing paper.

5. The temperature probe must be in the citric acid solution for at least 45 seconds before this next step. Begin data collection by clicking the green “Collect” arrow. After about 20 seconds have elapsed, add the baking soda to the citric acid solution. Gently stir the solution with the temperature probe to ensure good mixing. Record your observations regarding the reaction in your cup. Collect data until a minimum temperature has been reached and temperature readings plateau or begin to increase. Click on the red “Stop” button to end data collection.
6. Dispose of the reaction products as directed by your teacher. Rinse the cup, graduated cylinder, and probe with tap water before beginning Part II.

7. To analyze and print your data:
   - Click the Statistics button (icon shows the word “Stat”). In the statistics box that appears on the graph, several statistical values are displayed for Temp 1, including minimum and maximum. In your data table, record the maximum as the initial temperature and the minimum as the final temperature. DO NOT ROUND OFF YOUR MEASUREMENTS! Close the statistics box by clicking the upper-left corner of the box.
   - To confirm the minimum and maximum temperatures, use the scroll bars in the Table window to scroll through the table to examine the data. Compare the minimum and maximum data points to those you recorded in the previous step.
   - Go to “Printing Options” under the File pulldown menu. Click on “Footer” and enter your name(s) and period number. Print a copy of the Table window by choosing “Print Data Table”, and print a copy of the data table for each person in your lab group.
     - You will often want to change the scale of either axis of the graph. There are several ways to do this. To scale the temperature axis from 0 to 25°C instead of the present scaling, click the mouse on the “40” tick mark at the top of the axis. In place of the “40”, type in “25” and press the Enter key. Notice that the entire axis readjusts to the change you made. Use the same method to change the “-10” tick mark to “0”. Note: A second option is to click the Autoscale button (icon with “capital A”). The computer will automatically rescale the axes for you.
     - You can also expand any portion of the graph by zooming in on it. Select the area you want to zoom in on. Do this by moving the mouse pointer to the beginning of this section of data — press the mouse button and hold it down as you drag across the curve, leaving a rectangle. Then click the Zoom In button (icon with positive magnifier). The computer will now create a new, full-size graph that includes just the region inside the rectangle. You can reverse this action by clicking the Undo Zoom button.
     - When you again collect data in Part II of this experiment, the data will be collected as Latest run, the most recent set of data you have collected. The original Latest run will be lost if it is not saved or stored. Choose Store Latest Run from the Experiment pulldown menu to store Latest as Run 1. Note that the line for Run 1 is thinner than it was for Latest. (To hide the curve of your first data run, click the Temperature vertical-axis label of the graph, and uncheck Run 1.)

**Part II Hydrochloric Acid + Magnesium**

8. Manually rescale the vertical axis to the temperature scale of 5 to 60°C. To do so, click the mouse on the bottom tick mark and type in “5”. Then click on the top tick mark and type in “60”.

9. Measure out 30 mL of HCl solution into the styrofoam cup. Place the temperature probe into the HCl solution. Note: The temperature probe must be in the HCl solution for at least 45 seconds before doing Step 11. CAUTION: Hydrochloric acid is caustic. Avoid spilling it on your skin or clothing. Wear chemical splash goggles at all times. Notify your teacher in the event of an accident.

10. Obtain a piece of magnesium metal from the teacher. Loosely coil the metal strip.

11. Begin data collection by clicking . After about 20 seconds have elapsed, add the Mg to the HCl solution. Gently stir the solution with the temperature probe to ensure good mixing. CAUTION: Do not breathe the vapors! Record your observations. Collect data until a maximum temperature has been reached and the temperature readings plateau or begin to decrease.

12. Dispose of the reaction products as directed by your teacher. Rinse your cup, cylinder, and probe.

13. To analyze your Part II data:
   - Change the appearance of the graph by double-clicking anywhere on the graph bring up the Graph Options dialog. Check the box in front of Point Symbol — a point protector will now outline each data point on the graph. Click “Done”. Reduce range of x-axis to 30 seconds in order to observe the individual data points. Then change x-axis to a larger value so that both complete curves are displayed.
   - Instead of scrolling through the Table window in this trial, click the Examine button (icon with “X =”). The cursor will become a vertical line. As you move the mouse pointer across the screen, the temperature and time values corresponding to its position will be displayed in the box at the upper-left corner of the graph. Scroll across the initial 3-4 points to determine the initial temperature. Record the initial temperature in the data table. Move the mouse pointer across the peak of the temperature curve to determine the
maximum temperature, and record it as the final temperature in your data table. To remove the examine box, click the upper-left
corner of the box.

- It is also possible to calculate statistics just for a portion of your collected data. To do so, you must first select the data you are
interested in. For example, you might want to find the average (or mean) of the first few data points to use as an initial temperature,
instead of using the minimum value. Select the flat portion of the curve — move the mouse pointer to time 0 and drag across the flat
part of the curve. Now click the Statistics button, and note the mean temperature value in the statistics box on the graph. This value
is the mean of only the selected data points. When you are done, click on the upper-left corner of the statistics box to remove it.

14. To print a graph of temperature vs. time showing both data runs:

- Go to Graph Options by double-clicking on the graph. Go to the Axis Options tab. To display both temperature runs, check the
Run 1 and Latest temperature boxes. Click “Done”. Display “Statistics” boxes for each curve, making sure that the box does not
obscure the actual data plot.
- Label both curves by choosing Text Annotation from the Insert pulldown menu, and typing “Endothermic” (or “Exothermic”) in the
edit box. Then use the Hand Tool mouse icon to drag each box to a position near its respective curve.
- Print a copy of the Graph window for each person in your lab group. (Your names should still be present as a footer, otherwise go
back to Printing Options to add your names.) Make sure that the classroom printer is selected prior to actually printing.
Do NOT save the file, but be sure your printed copies are satisfactory before closing the program.

DATA AND CALCULATIONS

<table>
<thead>
<tr>
<th></th>
<th>Part I</th>
<th>Part II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final temperature, $T_2$</td>
<td>______°C</td>
<td>______°C</td>
</tr>
<tr>
<td>Initial temperature, $T_1$</td>
<td>______°C</td>
<td>______°C</td>
</tr>
<tr>
<td>Temperature change, $\Delta T$</td>
<td>______°C</td>
<td>______°C</td>
</tr>
</tbody>
</table>

OBSERVATIONS

Exp. 1:

Exp. 2:

PROCESSING THE DATA

1. Calculate the temperature change, $\Delta T$, for each reaction by subtracting the final temperature, $T_2$, from the initial temperature, $T_1$
i.e., $\Delta T = T_1 - T_2$.

2. Tell which reaction is endothermic. Explain.

3. Which reaction had a negative $\Delta T$ value? Is this reaction endothermic or exothermic? Explain.

4. For each reaction, describe three ways you could tell a chemical reaction was taking place.

5. Which reaction took place at a greater rate? Explain your answer.
General Questions

Answer the following questions in complete sentences.

1. As soon as you enter the lab, what safety equipment should you put on immediately?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

2. Before doing an experiment, what should you read and discuss with your teacher?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

3. Before you light a burner, what safety precautions should always be followed?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

4. What immediate action should you take when the flame of your burner is burning inside the base of the barrel?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

5. What type of flame is preferred for laboratory work and why?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

6. What is a common cause of fires in lab drawers or lockers?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

7. Why are broken glassware, chemicals, matches, etc. never thrown into a wastepaper basket?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

8. Why should you never touch chemicals with your hands?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

9. What precaution can you take against chemical contamination in reagent bottles?

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
10. Why are chemicals and hot objects never placed directly on a balance pan?  
__________________________________________________________________________________  
__________________________________________________________________________________  
__________________________________________________________________________________

11. List three instruments used in the laboratory for measuring small quantities of liquids. What precautions should be taken when filling a buret with liquid?  
__________________________________________________________________________________  
__________________________________________________________________________________  
__________________________________________________________________________________

12. What is the rule about the size of filter paper to be used with a funnel?  
__________________________________________________________________________________  
__________________________________________________________________________________  
__________________________________________________________________________________

13. How can a liquid be transferred from a beaker to a funnel without spattering and without running down the outside wall of the beaker?  
__________________________________________________________________________________  
__________________________________________________________________________________  
__________________________________________________________________________________

14. In what condition should all lab equipment be stored at the end of an experiment? What else should be checked?  
__________________________________________________________________________________  
__________________________________________________________________________________  
__________________________________________________________________________________
True or False

Read the following statements and indicate whether they are true or false. Place your answer in the space next to the statement.

1. Never work alone in the Laboratory. ___ 1.
2. Never lay the stopper of reagent bottle on the lab table. ___ 2.
3. At the end of an experiment, in order to save the school’s money, save all excess chemicals and pour them back into their stock bottles. ___ 3.
4. The quickest and safest way to heat a material in a test tube is by concentrating the flame on the bottom of the test tube. ___ 4.
5. Use care in selecting glassware for high temperature heating. Glassware should be Pyrex or a similar heat-treated type. ___ 5.
6. A mortar and pestle should be used for grinding only one substance at a time. ___ 6.
7. Safety goggles protect your eyes from particle and chemical injuries. It is completely safe to wear contact lenses under them while performing experiments. ___ 7.
8. Never use the wastepaper basket for disposal of chemicals. ___ 8.
9. First Aid Kits may be used by anyone to give emergency treatment after an accident. ___ 9.
10. Eye and face wash fountains and safety showers should be checked daily for proper operation. ___ 10.

Chemical Apparatus

Identify each piece of apparatus. Place your answers in the spaces provided.

a. ___________________  
g. ___________________

b. ___________________  
h. ___________________

c. ___________________  
i. ___________________

d. ___________________  
j. ___________________

e. ___________________  
k. ___________________

f. ___________________  
l. ___________________