

Experiment 10: Open Ended Projects I

Introduction

Science is an exploratory endeavor which attempts to elucidate the unknown through experimentation. The scientific method involves designing and performing experiments wherein observations are made and data obtained, the data analyzed and the results interpreted. For the next two weeks, you will work on a project which is open-ended in nature. You will establish a goal that requires you to design experiments, carry them out and interpret the results in order to reach some conclusions.

Working in groups

For this project, your Teaching Assistant will assign you to work in a group. Two weeks before the start of the open-ended sessions, each group will have an opportunity to choose the project they wish to pursue based on the descriptions provided on pp 9-17. Group members will then work together to design the experiments for the project and will present an experimental design and a list of necessary materials to the TA one week before the open-ended sessions start. In designing the experiments for the project, refer to experiments that you performed this semester as well as to the Techniques section of the manual/notebook. Use the knowledge and lab techniques that you have gained throughout the semester to complete the project.

Each student will be evaluated individually on his or her contribution to the project. Working as a team does **not** mean that one student performs an experiment while the others watch. Each member of the group should be assigned a task or tasks to pursue during each lab period so that everyone is occupied most of the time. This may involve students performing duplicate experiments, similar experiments under different conditions or completely different experiments.

One of the purposes of this project is to help you develop both problem solving and interpersonal skills. You may find that you and your teammates are unsure of how to proceed initially with the project and spend some time “floundering”. Don't panic! This is a natural part of the process. Listen to each others' ideas and work together to devise and modify your plan of attack. There is no “right answer” to any of the projects. You will be evaluated on how you plan and carry out your experiments, how you analyze and interpret your results and on the quality of the written reports.

Tips for working in a group

- Everyone contributes to the group effort (ask questions, clarify concepts, suggest procedures, modify plans, etc.).
- Everyone is prepared for meetings and lab periods (read material beforehand, work on calculations, etc.).
- Everyone is allowed to express their ideas or opinions.
- Everyone meets when planned (let members of the group know if you cannot attend).
- No one person dominates the group.
- No one distracts others from the task at hand.

- Everyone follows through on tasks which they agree to complete.

Schedule and assignments for the open-ended sessions

Projects will be assigned to the groups based on lists of preferences submitted by each group to the TA. Group members will then meet to devise an experimental plan for the project. The experimental plan, plus two copies of a list of materials needed (p. 7), will be submitted to the TA one week before work on the project is to begin.

At the beginning of the first open-ended lab period, you will be given a cumulative quiz on laboratory techniques. It will include four or five questions which cover all of the techniques that you have learned over the course of the semester. Questions covering knowledge of lab hazards and safety precautions may be included as well.

As usual, your TA will collect the carbon copies of your data and observations sheets at the end of each lab period during the open-ended sessions. In addition, after each lab period, *each student* will write a “progress report”. The final lab report is due on the last lab period of the semester and *each student* will write his or her own final report.

You may find as you work on the project that modifications to the original procedure must be made. If you require additional items for the second lab period that were not listed in the initial request for chemicals and equipment, submit a new request to your TA before the second lab period.

Schedule for the Open-Ended Sessions

2 weeks prior to Session 1	Choose project
1 week prior to Session 1	Submit list of materials needed Submit project design
Session 1	Cumulative quiz Assign tasks to group members and begin work
Session 2	Each student submits progress report for Session 1 Work on project continues
Session 3	Each student submits progress report for Session 2 Each student submits final written report

Grading policies

The open ended project will be worth a total of 10 points, two times that of a regular laboratory report. The distribution of the weighting factors will be as follows:

Project design	0.2
Progress reports	
for Session 1	0.4
for Session 2	0.4

Final report

Introduction.....	0.2
Data analysis	0.3
Discussion	0.5
Total	2.0

For most sections of the report, students will be graded on an individual basis. The exception is the grade for the “Project design” which will be a “group” grade. All members of a group will receive the same grade for this section.

As usual, the TA will give a numerical score from 1-5 for each section, and each section of the report will be multiplied by the appropriate weighting factor according to the numbers listed above. Thus, a final numerical grade out of 10 (2.0 x 5) for the project will be calculated based on the section scores and their weighting factors.

Performance grade

The final performance grade for the semester will be based on your performance during the weeks of the open-ended project. This grade will be arrived at through *peer evaluation* by the members of your group. The contribution of each group member will be rated by every other member of the group using the sheet on p. 8. These ratings should be based on a student's effort and cooperation in the group, creativity and contribution to the project, effort outside of the laboratory and attendance at meetings. This peer evaluation will be strictly confidential. Fill out and bring p. 8 to the last period and hand it in to your TA. The TA will arrive at a final performance grade for each student based on these peer evaluations as well as his/her own insight on a student's performance.

Make-up policy

The Open Ended project cannot be used as a “dropped” grade. If a student misses one or more lab periods during the weeks of the open ended project, the group can decide as a whole how that student's work should be made up. He/she might be assigned to do extra data analysis, computer work, library research or other assignments which may be completed outside of the laboratory. In other cases, she/he may need to come to a different lab period to complete experimental work. If a student needs to make up work during a different lab period, s/he must make arrangements for this through the Laboratory Director, Prof. O'Connell, Merkert 125D.

Project design

The project design should include the following:

1. A statement of the purpose of the project and the chemical principle(s) being studied. You may want to refer to your textbook (Tro).
2. An outline or description of the proposed procedures. You should refer to earlier experiments as well as the Techniques section of the manual/notebook. When designing the experiments, use the following questions as a guide:
 - a. What techniques will be used?
 - b. What independent variables will be manipulated?
 - c. What dependent variables will be observed and measured?

- d. What method(s) will be used to measure the values of the variables?
 - e. In what units will the variables be expressed?
 - f. How often should measurements be obtained?
 - g. How many data points should be obtained?
Note: When trying to observe a trend, two data points is not sufficient.
Obtain three to five data points.
 - h. What variables should be kept constant?
 - i. What should be the sample size and/or concentrations of the solutions?
3. Discuss significant hazards that will be encountered and describe special precautions which will be taken to avoid them. See p. 6 for information regarding safety references.
 4. Fill out and attach 2 copies of the sheet provided on p. 7.

Progress reports

The progress reports will describe the procedures that were carried out and the data and observations that were obtained during each lab period. They should include the following:

1. *Details of the experiments that were performed.* Provide step by step instructions of the procedures that were followed using the past tense and the third person, passive voice. Examples follow:
correct: A 50 mL portion of 6 M hydrochloric acid was added to the solution.
incorrect: I added 50 mL of 6 M hydrochloric acid to the solution.
incorrect: Add 50 mL of 6 M hydrochloric acid to the solution.
2. *Modifications to the procedure.* You may find as you proceed that changes to the original procedure must be made. These modifications and the reasons for them should be noted in the appropriate progress reports.
3. *A summary of the outcome of the experiments (data and observation sheets).* As usual, your TA will collect the carbon copies of your laboratory notebook sheets, and these will constitute part of the progress report. The data on these sheets should be presented in appropriate forms (lists, tables, etc.). Include all observations that were made during the course of the experiments.

Each progress report should be one to two pages in length, not including the data and observation sheets from the notebook. Each student will hand in two progress reports. The progress reports should not attempt to analyze or interpret the data obtained and thus should not unnecessarily repeat information that will be presented in the final report.

Final written report

The final report should include the following three sections. Write the appropriate heading at the beginning of each section (Introduction, Data Analysis or Discussion).

Introduction Introduce the reader to the problem that your group set out to solve. Explain what chemical principles were being investigated. Describe the approach

that your team chose to take in tackling the problem and why this approach was chosen.

Data Analysis Include calculations and graphs to show how the data were analyzed. If appropriate, summarize results in a table.

Discussion Provide an interpretation of the results and draw conclusions. Discuss what the experimental data proved or failed to prove and why. Review the chemical principles involved and explain whether or not your team's results fit the accepted theories. Describe problems encountered in performing the experiments and how these problems may have affected the final results. List any limitations of the experimental procedures and discuss sources of error. Discuss ways in which the procedures could have been improved.

The final report must be typed (calculations may be written by hand). Use double spacing, a one inch margin and a 12 point font size. The length of the Introduction and Discussion sections *together* should not exceed three pages. The final report should not discuss details of the procedures followed in lab and thus should not unnecessarily repeat information which was presented in either of the progress reports.

As with all laboratory reports, the progress and final reports must be written *in your own words*. If identical reports are handed in by two or more members of a group, these reports will be given scores of zero for all the identical sections.

Materials available in the laboratory

The following chemicals and equipment will be available in the labs at all times during the weeks scheduled for the open ended projects. You must dilute these "stock" solutions to prepare solutions of varying concentrations.

1 M HCl soln	1 M HNO ₃ soln	spectrophotometers	plastic pipets
1 M NaOH soln	1 M NH ₃ soln	plastic cuvetts	weighing paper
1 M acetic acid soln	solid NaHCO ₃	red litmus paper	filter paper
1 M H ₂ SO ₄ soln	solid NaCl	blue litmus paper	

If you require a solution that is more concentrated than 1 M, you may request it on your "Materials needed" sheet.

Standardizing acids and bases

Note that the concentrations given for the above solutions contain only one significant figure. If you need to know the concentration of a particular solution more precisely, you will have to standardize the solution. Any solution that is to be standardized must have a concentration which is less than 1 M in order for the result to be accurate. Dilute the stock solution to the desired concentration *before* performing the standardization. The concentrations of the stock solutions may change slightly from one week to the next. For this reason, once a solution has been standardized, pour as much as you think might be needed into a bottle, label it (include the names of the group members) and store it in one of the lab cabinets until the next week. Bottles will be provided for this purpose, if requested.

Use potassium acid phthalate and the technique in Experiment 7 to standardize a base solution. To standardize an acid solution, sodium carbonate should be used. You should request *dried* sodium carbonate for this purpose. Use methyl red indicator and

titrate until the solution just begins to change from a yellow to a red color. Boil the solution gently for 2-3 minutes; the solution should become yellow again. Cool to room temperature (you may use an ice bath), continue to titrate until the color again changes to red at which point the endpoint has been reached and the volume may be recorded. Note that at the endpoint of the titration, *two* moles of protons are neutralized for every *one* mole of sodium carbonate reacted.

Safety precautions

1. Know the hazards of the chemicals that you are using. Look them up in the resource material listed below.
2. Perform all chemical reactions on a *small scale* first (1-2 mL of liquids and 10-20 mg of solids). If the reaction appears to be very vigorous, do not perform it on a large scale.
3. The “common” chemicals that are provided during these lab periods (see list on previous page) may be disposed of down the sink. Certain chemicals must be disposed of in an appropriate **Laboratory Byproducts** jar. The following Byproducts jars will be available:

Organic liquids
Organic solids
Metal pieces
Copper solids and solutions

Check with your TA if you are unsure of the proper way to dispose of any chemicals that you choose to use in your project.

Safety references

A vendor is required by law to provide a Material Safety Data Sheet (MSDS) for every chemical sold. These sheets impart information regarding the hazards associated with a chemical, the precautions to take when working with the chemical, as well as some physical data. You will find a list of sites with MSDS's on the following webpage:

<http://www.ilpi.com/msds/#Internet>

You should check the MSDS's for a few chemicals with which you are familiar to get an idea of the kind of information that is provided. For instance, find the MSDS's for sodium chloride, hydrochloric acid and acetone.

The Boston College library has created a Chemical Laboratory Safety and Methods website:

<http://libguides.bc.edu/labsafety>

as well as a page for Chemical and Physical Property Data:

<http://libguides.bc.edu/chemdata>

Names of group members _____

Lab period _____ TA _____

Materials needed for the project

List the reagents and solutions needed.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

List the equipment that you will require (other than equipment provided in your drawers).

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Each group must hand in two copies of this list to their instructor.

Peer Evaluation Form for the Performance Grade

Allocate 100 points among the members of your group in proportion to their contribution. Include yourself in the list. **This form will be kept strictly confidential and will not be shown to any members of your group.** Bring this sheet with you to the last lab period of the semester and give it to your TA.

	Points
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
Total	100 points

----- Fold here and staple or tape closed.-----

Open-Ended Project Topics

The titles of the open-ended projects are:

1. Heat Changes Involved in Neutralizing Acids and Bases
2. Heat Changes Associated with Recovering Elemental Metals from Metal Salts
3. Heat Changes Associated with the Preparation of Electrolyte Solutions
4. The Influence of Varying Atmospheric Conditions on Gases
5. The Effect of Temperature on the Water Solubility of Carbon Dioxide, a "Greenhouse" Gas
6. Identification and Separation of a Base and an Organic Substance
7. Identification and Separation of a Metal Chloride and an Organic Substance

Background information and hints for these projects are provided on the following pages. Each group in a laboratory will work on a different project. For this reason, the TA will obtain from each group a list of the top three topics that they wish to pursue in order of preference. After reviewing the lists, the TA will assign the topics.

Projects 1, 2 and 3: Heat Changes

Project 1: Heat Changes Involved in Neutralizing Acids and Bases

You work for a pharmaceutical manufacturing plant that produces a variety of therapeutic chemicals. An unfortunate byproduct of the processes that are used to synthesize these drugs is the generation of a large amount of liquid waste. Some of the reactions and processes carried out in the plant alter the pH of the solutions and result in waste that is either acidic or basic. This waste contains only very small concentrations of low hazard compounds. The Water Resources Authority has indicated that the plant's liquid waste is innocuous enough that it can be released directly into the sewerage system as long as it is neutralized (adjusted so that it is neither basic nor acidic) before it is released. You and the other plant engineers realize that some heat will be generated when the liquid is neutralized, which will impact the cooling costs of the plant.

Your team must study the heat changes associated with a variety of neutralization reactions, and each of you will prepare a full report for the plant manager. The report should compare the heat changes associated with reactions between acids and bases when the following variables are changed:

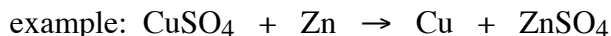
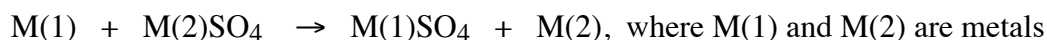
- a) the “strengths” of the acids and bases; that is, strong vs. weak electrolytes (see Tropp 147-149)
- b) the concentrations of the solutions used in the reactions
- c) the amounts of the solutions used in the reactions (the “scale” of the reaction)

If there is time, you may also study:

- d) the design of the calorimeter
Aspects of the calorimeter design that can be varied include the material from which it is constructed, whether the cover is on or off, etc.

Project 2: Heat Changes Associated with Recovering Elemental Metals from Metal Salts

A jewelry manufacturing company has come across a source of low cost metal salts and would like to recover the elemental form of the metals from these salts. They have hired your consulting firm to advise them as to the best course of action. Your firm recommends that they react each of the metal salts with a reactive metal via a redox reaction, as shown:



There are heat changes associated with these types of redox reactions. The jewelry manufacturer wonders if the energy produced from any of the reactions is significant enough to use in powering some of their machinery.

Your firm has been asked to do a full study of the heat changes associated with the redox reactions. Each of you will prepare a report that should compare the heat changes when the following variables are changed:

- a) the physical form of the metal (foil, wire, powder, etc.)
- b) the identities of the metals involved
- c) the concentration of the metal salt solution used in the reaction
- d) the amounts of the metal and the salt solution used in the reactions (the “scale” of the reaction)

If there is time, you may also study:

- e) the design of the calorimeter
Aspects of the calorimeter design that can be varied include the material from which it is constructed, whether the cover is on or off, etc.

Which metal would be the most versatile choice for the purposes of the jewelry manufacturer?

Project 3: Heat Changes Associated with the Preparation of Electrolyte Solutions

You work for a company that manufactures batteries, and you have been given an assignment by the Senior Scientist that involves the preparation of electrolyte solutions of varying conductivities. You have noticed that as you dissolve the salts in water, sometimes the container begins to feel warm to the touch, while in other cases the container becomes noticeably colder. You realize that when large batches of these solutions are prepared, changes in the temperature could affect the instrumentation used to measure the properties of the solutions.

You decide to enlist the help of two or three other technicians to do a full study of the heat changes associated with dissolving a variety of salts in water. Each of you will present a full report of the findings to the Senior Scientist. The report should compare the heat changes associated with dissolving solid salt compounds in water when the following variables are changed:

- a) the identity of the cation in the salt
- b) the identity of the anion in the salt
- c) the amounts of the salt and water used in the dissolution
- d) the design of the calorimeter
Aspects of the calorimeter design that can be varied include the material from which it is constructed, whether the cover is on or off, etc.

Hints and other important information for Projects 1, 2 and 3

Do **not** place a temperature probe in an acidic or basic solution that has a concentration greater than 2 M or the probe will corrode.

You must determine the heat capacity of any calorimeter(s) that you use. You can use the reaction and technique from Experiment 9 to do this determination.

Assume that the density and specific heat of any aqueous solution is the same as that of water. (density = 1.00 g/mL; specific heat = 4.18 J/g°C) **Note:** this assumption is *not* reasonable if the solutions are too concentrated (6 M or greater).

It is advisable to perform duplicate runs of all temperature change determinations.

The pertinent equations are:

(heat change in a reaction or process) = (heat change of total volume of solution) +
(heat change of the calorimeter)

$$-\Delta H = (m_{\text{solution}} \times (\text{sp ht})_{\text{solution}} \times \Delta T) + (C_{p,\text{cal}} \times \Delta T)$$

$$-\Delta H^\circ = \frac{-\Delta H}{\text{number of moles of limiting reagent}}$$

where: $-\Delta H$ = heat change
 $-\Delta H^\circ$ = molar heat change
 m_{solution} = mass of the *solution*
 $(\text{sp ht})_{\text{solution}}$ = specific heat of the *solution*
 $\Delta T = T_f - T_i$ (change in temperature; may be either a positive or a negative value depending on the reaction or process)
 $C_{p,\text{cal}}$ = heat capacity of the calorimeter

Equipment and chemicals which are available that might be of use include:

Styrofoam, cardboard and plastic cups
 plastic caps
 aluminum foil
 temperature probes and/or thermometers
 0.5 M acetic acid, standardized
 NaCl, KCl, NH₄Cl, Na(CH₃COO⁻), K(CH₃COO⁻), NH₄(CH₃COO⁻), NaNO₃,
 KNO₃, NH₄NO₃ (solids)
 magnesium, copper, iron and zinc metals
 FeSO₄•7H₂O, ZnSO₄•7H₂O, CuSO₄•5H₂O, MgSO₄•7H₂O (solids)
 Note that these are *hydrates* (see Tro, p. 92). You must take this into account
 when calculating molar mass. **Make 0.1 – 0.5 M solutions.**
 dried potassium acid phthalate
 dried sodium carbonate
 phenolphthalein
 methyl red

Projects 4 and 5: Gases

Project 4. The Influence of Varying Atmospheric Conditions on Gases

The “Top of the World” company, which manufactures hot air balloons, has decided to expand their business by selling balloons for scientific investigations. Scientific payloads containing sensitive instrumentation can be carried up to the stratosphere by helium filled balloons where measurements are obtained regarding atmospheric conditions or astronomical observations. It is important that the company has a thorough understanding of how the balloons will respond to changing atmospheric conditions as the balloon rises. Environmental factors such as pressure and temperature will change drastically as the altitude increases, causing the balloon to either expand or contract. In addition, the porous material used to make the balloon allows diffusion of gas, thus the number of moles of gas molecules that are contained within the balloon will change over time.

The company has assigned your team to study the following relationships as they apply to gases:

- Pressure and Volume
- Volume and Temperature
- Pressure and Temperature
- Volume and number of moles of gas molecules

Your team is expected to design experiments that graphically illustrate each of these relationships. The company executives know that under moderate conditions, all gases behave similarly with respect to temperature, pressure, volume and molar amount; therefore, they will not need to provide you with helium gas to study these relationships. Each of you will provide a full report of your findings to the company managers.

Project 5. The Effect of Temperature on the Water Solubility of Carbon Dioxide, a "Greenhouse" Gas

The Environmental Protection Agency is concerned that the buildup of carbon dioxide gas in the atmosphere is contributing to the “Greenhouse Effect”, which could result in a gradual warming of the earth. They have funded several studies which are aimed at producing models that will predict when and where the warming will occur and by how much the temperatures will increase. All sources of carbon dioxide, from the burning of fossil fuels to mammalian respiration, must be taken into account to accurately model environmental conditions. One source of carbon dioxide to be considered is found in the bodies of water on the earth. Carbonate salts, such as calcium carbonate, are present in rocks that line lakes and ponds. These salts dissolve into the lakes and ponds and dissociate to form carbon dioxide. Some of the carbon dioxide remains in the water due to its solubility properties, while some of it will escape into the atmosphere. The EPA has provided funds to your team to conduct a study of the solubility of carbon dioxide in water. Because different bodies of water are at different temperatures depending on their geography and the time of year, they need to know the relationship between the solubility of carbon dioxide and the temperature.

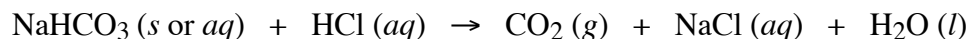
Your team needs to design an experiment that will determine the solubility of carbon dioxide gas in water at a variety of temperatures. The apparatus set-up that was used in Experiment 8 can be utilized here, however, some modification will be required.

In addition, water which comes from the faucet has been exposed to the atmosphere and therefore already has a significant amount of carbon dioxide in it. Carbon dioxide free water must be generated for this experiment. The EPA expects a full report of the study from each of you that includes a graphical representation of the relationship between temperature and the solubility of carbon dioxide in water.

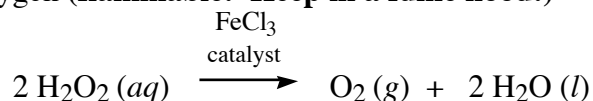
Hints and other important information for Projects 4 and 5

The following gases can be generated by the chemical reactions indicated:

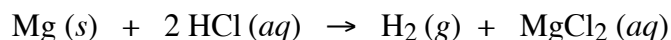
carbon dioxide



oxygen (**flammable! Keep in a fume hood!**)



hydrogen (**flammable! Keep in a fume hood!**)



Note: if you choose to collect a gas over water, be aware that carbon dioxide is water soluble.

A pressure sensor is available that can be plugged into the computer interface and used with the Logger Pro software. This pressure sensor can be attached to either an Erlenmeyer flask via a rubber stopper or to a syringe (see [Figure page, Projects 4&5](#)). When the system is sealed off from the atmosphere, it will measure the pressure exerted by the gases contained in the flask or the syringe.

There are several ways to collect and contain gases in the laboratory. These include, but are not limited to:

- The set-up used in Experiment 8, Determining the Mass Percent Composition of an Aqueous Hydrogen Peroxide Solution. See figures in the module.
- A Ziploc bag can be used to contain gases. A solid chemical can be placed in the bag and a liquid chemical can be added to it via a plastic pipet (see [Figure page, Projects 4&5](#)). Place the solid and the pipet which contains the liquid into the bag. Smooth out the bag so it contains a minimum amount of air (do not press on the pipet!) and carefully seal it. Hold the bag as shown in the figure and slowly squeeze the pipet bulb so that the liquid falls onto the solid. If the bag is properly sealed, the gas generated will remain trapped in the bag.
- Balloons can be used to contain gases.
- A syringe with a tight seal on the end can be used to contain gases. The volume of gas in the syringe is easily measured using the scale.

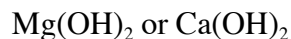
Equipment and chemicals which are available that might be of use include:

- thermometers and/or temperature probes
- pressure sensor and plastic tubing with connectors
- rubber stoppers of various sizes, with zero, one or two holes
- large Styrofoam buckets
- 25 mL burets
- Ziploc bags
- syringes of various sizes
- stopcocks with connector
- 3% H_2O_2 solution
- magnesium ribbon or powder
- FeCl_3 (solid)
- dried potassium acid phthalate
- dried sodium carbonate
- phenolphthalein
- methyl red

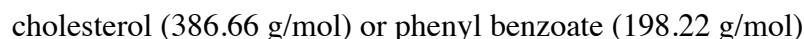
Projects 6 and 7. Unknown Mixtures

Project 6. Identification and Separation of a Base and an Organic Substance

A chemical manufacturing company which produces a variety of specialty chemicals has come across an old waste jar with an illegible label during a lab clean-up. In order to properly dispose of the material, the company needs to identify the components and determine the percent composition, by weight, of the mixture in the jar. They know that the waste contains two different chemical compounds that are both **solids** at room temperature. One of the components is one of the following inorganic bases:



while the other is one of the following organic substances:

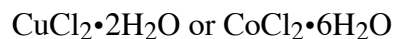


Your group has been assigned to separate, identify and weigh the two components. In addition, your group must use **one other method** to determine the mass percent of one of the components in the mixture in order to check the results. You must each prepare a full report of the analysis for the company.

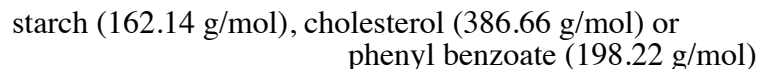
For this project, a standardized 0.5 M HCl solution will be provided for you, if requested.

Project 7. Identification and Separation of a Metal Chloride and an Organic Substance

A chemical manufacturing company which produces a variety of specialty chemicals has come across an old waste jar with an illegible label during a lab clean-up. In order to properly dispose of the material, the company needs to identify the components and determine the percent composition, by weight, of the mixture in the jar. They know that the waste contains two different chemical compounds that are both **solids** at room temperature. One of the components is one of the following metal chloride salts:

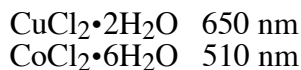


Note that these are *hydrates* (see Tro p. 92). You must take this into account when calculating molar mass. The other component is one of the following organic substances:



Your group has been assigned to separate, identify and weigh the two components. In addition, your group must use **one other method** to determine the mass percent of one of the components in the mixture in order to check the results. You must each prepare a full report of the analysis for the company.

The following wavelengths are appropriate for a spectrophotometric determination:



When using a spectrophotometer, it is best to prepare dilute solutions such that the absorbance measured is less than 1.000.

Hints and other important information for Projects 6 and 7

Pieces of equipment and chemicals which are available that might be of use include:

"standards" (starch, cholesterol, phenyl benzoate, $\text{Mg}(\text{OH})_2$, $\text{Ca}(\text{OH})_2$,
 $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$, $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$)

25 mL burets

5 mL, 10 mL and 25 mL pipets

50 mL, 100 mL and 250 mL volumetric flasks

organic solvents: acetone, ethanol, hexane (these solvents, especially hexane, are
flammable!)

phenolphthalein

methyl red

dried potassium acid phthalate

dried sodium carbonate