Expectations/Rules/Format for CHEM 4900

Expectations

- Hours: Students are expected to put in a minimum of 3 hours per week per credit. Hours should be during normal business hours or times when a chemistry department member (Preferable David Brownholland) is available for emergency situations.
- Independence: Student is responsible for planning, organizing and documenting research project. Student is expected to read material necessary to understand project. Student is expected to be creative in finding new experiments to try. The responsibility of the advisor is to answer questions and to go over plan with student making suggestions, etc.
- Communication: Students are expected to meet, as prescribed by the primary investigator (PI), with the research group, present their data, and discuss future directions. Students also need to write a full lab report on their semester's progress and be fully responsive and communicative with the entire group.

Rules

1. Students cannot work in lab alone. If no chemistry professor is present in the building, student should plan to do reading, data analysis, writing, etc.
2. Students MUST wear appropriate eye protection at ALL times when doing lab work. Students should also wear gloves and a lab coat when necessary. Students MUST be aware of safety routine in case of an accident.
3. Students MUST know how to properly use a fire extinguisher, safety shower, eye washer, etc.
4. Students MUST read SDS sheets for chemicals in use.
5. Students are responsible for labeling any waste and/or dealing with disposal.
6. Students are responsible for keeping balances and lab area clean. *The best chemists are clean chemists!!*
7. Students MUST keep notebook in lab at all times and the notebook must remain in the lab.

Grading

- Final Report
  - Draft of Introduction on 3-9-20 5%
  - Draft due on 4-17-20 5%
  - Day after Finals 20%
- Weekly Reports at Group Meeting 10%
- Lab Notebook 15%
- Proper labeling of spectra and samples 5%
- Overall Effort 20%
- Professionalism including: 20%
  - Safety
  - Cleanliness
  - Responsiveness

Notebooks

A laboratory notebook is a living document. It is the **complete** record of your time in the lab. Expect to make and fix mistakes in your laboratory notebook. Three times during the semester, your notebook will be evaluated. The first time will not be for a grade. These checks will be done, during lab period, randomly and without notice. Not all student notebooks will be evaluated on the same day.

1. Number **EVERY** page sequentially, upper outside corner.
2. Reserve the first five pages for a **Table of Contents** and **Notes and Abbreviations**. These will be updated as experiments are performed.
3. Record entries in notebook with permanent **black** ink.
4. Each new experiment should be started on a fresh page, with the starting date on the top right corner.
5. Write out the reaction scheme on the top of the page.
6. Include a table of properties below the reaction scheme. This should include all chemicals and relevant physical properties and amounts used.
7. Use only the right-hand side of the notebook, reserve the left-hand side for notes including all pertinent calculations (clearly labeled).
8. When you begin the experiment, write **Experimental Procedure**, and add the date to the top of the page. In the Experimental Procedure, describe what you performed, immediately as possible, in the past tense verb form, using third person and passive tense. Include names of apparatus, techniques, observations and data. This involves direct entries in notebook, **never** on other pieces of paper, etc., for later transcription into the notebook.
9. If student is doing the experiment for the first time, a **VERY** detailed procedure is necessary giving colors, equipment used, observation and every step of the method. The next time, student may refer to the previous experiment and record only new amounts, observations, changes, etc.
10. Include a literature reference if the experiment is be taken from one.
11. The information recorded should be in sufficient detail that you and other students who have passed organic laboratory could reproduce or improve your work from only your notebook and without the lab manual or handout. An incorrect entry, no matter how small or large, should be **marked through only once**, with correction entered as close as possible or directed to specific other pages.
12. All TLC data should be drawn in the notebook, including R_f values, identity of spot (if known), solvent conditions, and how the spots were visualized.
13. You may skip pages to allow space to finish an experiment if you wish. If you run out of space, indicate that your experiment is continued on a later page by writing "**continued on page y"** at the bottom the page. On page y, note that this page is continued "**from page x**."
14. After completing each page, add your initials to the bottom external corner of the page.
15. Entries for the **Conclusions** may be entered in the lab or later, again dated and initialed by you. In the Conclusions, there should be a discussion of the observations and data with respect to the Objectives. Include any relevant suggestions about the outcomes and how your work could have been improved.
16. Spectra should be recorded in a 3-ring binder and labeled as described below.
17. You are expected to have notebook entries checked by another student or Dr. B. to ensure that they understand your entry.
18. You are expected to periodically check you notebook with Dr. B. (for full time research, weekly).

REMEMBER: Another student MUST be able to repeat the experiment done based ONLY on a former student's notebook!!!

Data and Sample Recording

1. All spectra, graphs, etc. MUST be labeled to correspond to the page number (example: DBH-1-56; 1 = notebook 1; 56 = page number).
2. Spectra, graphs, etc. MUST be kept in an organized 3-ring binder. Each spectra should receive a number (examples, DBH-7), which is referred to in the appropriate lab page.
3. The theoretical yield should be calculated at the end of the experiment and this value written by the reaction scheme in the top right corner of the first page of the experiment.
4. Samples to be stored need to be stored in a scintillation vial with a piece of paper taped to the vial indicated the sample number (your initials-book number-page number), the date, and the amount added. You should talk to me about what products we need to keep samples of. In general, we need 50 mg of a good sample for any *new* product or any key step in our synthesis.
5. For any new compound or key step in our synthesis, we typically need good quality proton and carbon NMR, IR, MP (if a solid), and potentially combustion analysis or high resolution mass spectroscopy.

Writing a Formal laboratory Report

Title Page

The title page should consist of the following:

- A descriptive title of the report
- Your name
- The department and institution (Department of Chemistry, Carthage College)
- Date of report of submission (when you turned in the report)

Introduction

The purpose of the introduction is to very briefly explain about the experiments you conducted and to convince the reader of its significance. The most common method of writing the introduction is to begin with the description of the significance of the work and eventually lead into the specific experiment. In other words, the general practice is gradually move from the general to the specific. What to include (or not include) in this section:

a. Tell the reader why this is important/significant
b. Briefly address the problem you are trying to solve
c. Include reaction scheme (no mechanism)
d. Briefly summarize what you are going to attempt
e. Include *no results* in this section
f. Do not say things such as "the purpose of this lab," etc.

Also, properly reference any information obtained elsewhere, even if written in your own words. Do not use quotations to quote another reference, do use your own words.

Results and Discussion

The biggest distinction between the format you have used in the past and what I expect is that the results and discussion are combined into one section. This section will include three major sections:

- A brief discussion of what was done; For example, you can mention that you treated salicylic acid with methanol and acid to generate the methyl ester. You do not need to talk about experimental details of this reaction, only that is was performed. You could also mention that you recrystallized caffeine in water, but again, do not go into the details of exactly how you recrsystallized.

- Your observations and results; this is the appropriate place to mention yield of reaction and purification. This is also the appropriate place for spectral charts, reporting melting point, tables of gas chromatography results, etc.
- Interpretation of the results; this is your opportunity to put your results in context. What does it mean that your melting point was 5 degrees lower than the literature value? What does you gas chromatograph indicate about your purification?

The following should also be discussed in the Results/Discussion section:

- How you would improve the experiment. Avoid arguments such as "be more careful" or "reduce human error" or "get better equipment." Tell the reader how, if you were to do the same experiment again, with the same equipment, what you might do differently to improve the results.
- Provide significant mechanisms

Conclusion

Briefly summarize the significance, what was done, major results, and interpretation. By major results, this includes data such as yield and evidence of purity (or lack thereof).

Experimental

You need to write sufficient detail so that a trained chemist could repeat your experiment. Include, specifically, what was done, what was observed, how much was recovered (if a reaction), and % yield. You do not need to include description here that is obvious to a chemist. For example, you can just say the reaction was stirred for 30 minutes. You do not have to say it was stirred on a hot plate with a magnetic stirrer. This section needs to be written in indicative mood.

Other Notes

- Double-space (or 1.5 spaced)
- All figures should be described in written form. Figures should be included in-text and labeled (**Figure 1**, **Figure 2**, etc.) and referred to in the text.
- The report is written similar to the suggested style for publication in chemistry journals (such as the *Journal of Organic Chemistry*).
- Avoid first person (I, my, me, etc.) and use past tense in the results and experimental sections.
- Compounds can be numbered if a structure is included. This permits later reference to the compound by the assigned number. The first numbered structure should be given a bold **1**, and so forth.
- Experimental should include enough detail for an experienced chemist to repeat your work. This section also includes observations and data. Some or all of the data may be repeated in the Results and Discussion section, perhaps in a revised format such as a table, etc.
- Information about the instrumentation and techniques used may be relevant if precision and accuracy are a concern.
- Often the quality and source of starting materials are relevant.
- On occasion (and required for this assignment), actual copies of spectra (for IR, NMR) and chromatogram (for GC) can be included as Appendices but would not replace the data given in the experimental.
- Include a space between any numbers and their unit.
- You need to use appropriate use of subscripts and superscripts (it is CH_4 not CH4)
- Tables and Figures should not be split over 2 pages