

PHYSICAL CHEMISTRY II LAB
Chemistry 310A
Spring 2006

Instructor: Dr. Mark D. Ellison
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Office hours: Mon. 10–11 am, Tues. 2:30–4 pm, Weds. 10–11:30 am,
Thurs. 2:30–4 pm, Fri. 10–11 am

Lab: W 1:30–4:30 PM
Pfahler 208 (Pre-lab)
Pfahler 302 (Lab)

Course Materials:

Textbooks: *Physical Chemistry Lab Manual*
Scientific Calculator
Laptop
Safety Goggles

Course Objectives: This course has several goals. First, it will help you gain familiarity with experiments that demonstrate principles of physical chemistry. You will be surprised to find out that “all that math” actually is useful in understanding the behavior of chemical systems. Second, it will make you think about experimental design and technique. As you enter your junior or senior year, expectations are changing. A few years ago, you followed the instructions to the best of your ability and crossed your fingers and hoped you got the desired results. Now, you still follow instructions, but you need to think carefully about each step. In the unlikely event that you don’t get the desired result, you will be asked to explain (not guess!) why. In the more likely event that you get close to but not exactly the “right” result, you will be asked to explain why. Was it the limitations of the apparatus, the techniques, or the design of the experiment? That is, even if you performed each step perfectly, you might expect to be, at best, within 10% of the accepted result. Or, was it that the experiment, as designed, should be capable of giving very close to the accepted answer, but one error or an accumulation of errors led to the result being “off”? Finally, even a nearly perfect result should be explained. Sometimes scientists get lucky and errors cancel each other. More often, scientists practice careful, precise technique and that leads to good results.

1. Labs. The primary focus of laboratory exercises is safety. Do not wear shorts or loose clothing. You must **always** wear safety goggles while in lab. Lab will be carried out individually or in pairs. It is your responsibility to find someone that you can work with, unless circumstances require my intervention. You are expected to have read the manual and be familiar with the procedures **before** coming into the laboratory.

The labs will often involve spectroscopy, which is the study of the interaction of light with matter. Chapters 12 and 13 in the Chem 310 text will be covered during pre-lab sessions, and the material contained in them will be tested on the final exam. Additionally, I will probably assign problems from these chapters.

2. Notebook. A bound laboratory notebook provides a place for the recording of events while performing the experiments. If the pages are not numbered, number the entire notebook yourself. It should contain a brief purpose statement for the experiment, pertinent equations and literature values needed, experimental modifications and observations, organized data tables for recording experimental results, and complete calculations showing reported results, including any needed error analysis. You are by now well-acquainted with the protocols of keeping a good laboratory notebook. You will use a bound notebook for this lab course. The notebook is to be a complete record of what you have done in lab, so keep it neat and well organized. Ideally, you should be able to find this notebook in ten years and easily repeat all the experiments! Some information should be entered into the notebook before you come into lab, while the rest is recorded while you are in the laboratory. The notebook should include:
 - Table of Contents: Include the title of experiment, dates experiment performed, and pages on which experiment is recorded.

- In the body of the notebook, begin a new experiment on a new page and write the title of the experiment and the date at the top of the page. If for some reason, there are empty pages between experiments, draw a line through the entire page or write “This page intentionally left blank.”
- Objective or Purpose: Write a sentence or two about what you plan to do and how you will accomplish it.
e.g. I will measure the heat of combustion of naphthalene using bomb calorimetry.
- Procedure and MSDS Info:
 - Before you come to lab, you will fill the safety and procedure sheet and submit it; after you receive it graded, paste it in your notebook. Additionally, reference in your notebook the pages in the manual where you found the procedure, so you can find it later. If there have been any changes to the procedure, note them.
e.g. The procedure was that on page 165-168 of Shoemaker, Garland, and Nibler. A pressure sensor was used instead of the mercury manometer.
 - While you are in the lab, you should record what you do.
e.g. Weighed the tablets using the Mettler analytical balance.
- Data: Record all the data neatly. When appropriate, create tables and graphs. Write down the parts of even the simplest calculations. If you make a mistake, you will still be able to correct it later.
- Observations: This section should include a description of everything that happens, no matter how inconsequential or ordinary it might seem. This may help elucidate the cause of outlying data.
- Calculations and Results: (only in the case of oral reports) For written reports, your calculation and results will go in the report, but for oral reports, these calculations should go in your notebook.
- Graphs: Any graphs you create from data should be taped neatly into your notebook.

3. Lab Reports. Fully written reports are required for some of the laboratory experiments. Those reports will follow the format of the Journal of Physical Chemistry; therefore, you should consult that journal to determine the exact nature of the report. The report must be double-spaced, typed, and page-numbered, the figures should be computer-generated using a graphing software package, and the references must conform to the ACS format. Laboratory reports are to be submitted to me for peer review one week after the date that the laboratory is performed. The draft report will be reviewed by a student classmate and returned with comments. The final, revised report will then be due one week after the draft is returned to you. These procedures mimic the practices used in the sciences for publishing one’s work in refereed journals and allow ample time for you to produce a professional report. Late reports will be subject to a 5% per day deduction. Again, a report is considered late if submitted after 5:00 PM on the due date. As in the lecture policies, no lab reports will be accepted after 10:00 AM on the first day of finals week.

A list of the labs that will be performed and the type of lab report required for each lab is listed below. For worksheet type reports, worksheets will be available on Blackboard. A general guideline for formal lab reports will also be available on Blackboard.

4. Due Dates. The Safety and Procedure sheets are due by 5 pm the day before you perform the lab (Tuesday). Lab reports, worksheet or formal, are due by 5 pm one week after the lab is performed. The exception is for labs performed the week before spring break. Those lab reports are due the Wednesday following spring break.
5. Honesty and Ethics. Science depends upon the honesty of its researchers. Scientists work under an honor system that requires them to report the results of their experiments in a truthful manner and credit the source of original ideas and information. I expect you to follow the same honor system. Assignments should reference all sources of information (books, articles, people, etc.) that contribute to its completion. Also, falsifying data is not acceptable. You must honestly report the results of your experiment. Part of the learning process is explaining why an expected result was not obtained.

Lab	Report Type	Points
Temperature of the Universe	Worksheet	25
The Photoelectric Effect	Worksheet	25
Seeing Electrons in Atoms	Formal Report	25
Particle in a Box: Cyanine Dyes	Worksheet	25
Particle in a Box: Quantum Dots	Worksheet	25
Symmetry and Physical Chemistry	Worksheet	25
Infrared Spectroscopy of HCl and DCl	Formal Report	25 + 25
Infrared Spectroscopy of SO ₂	Formal Report	25 + 25
Infrared Spectroscopy of C ₂ H ₂	Worksheet	25
Electronic Spectroscopy of I ₂	Group Project	50
Fluorescence of Chlorophyll	Worksheet	50
TOTAL		375

6. Grading. I do not grade on a curve for this course. Points will be distributed as follows:

Graded Item	Points Each	Total Points
Pre-lab	5	50
Labs	See above	375
Peer Review	25	75
Final	100	100
TOTAL		600

Your final course grade will be based on the percent of the total points that you earn:

A+ 97.0 – 100%	A 93.0 – 97.0%	A- 90.0 – 93.0%
B+ 87.0 – 90.0%	B 83.0 – 87.0%	B- 80.0 – 83.0%
C+ 77.0 – 80.0%	C 73.0 – 77.0%	C- 60.0 – 63.0%
D+ 67.0 – 70.0%	D 63.0 – 67.0%	D- 60.0 – 63.0%
F below 60.0%		

Week, Date	Experiments/Topic	Notes
WK1, 1/17	What is the temperature of the universe?	Bring laptops!
WK2, 1/24	G1 Seeing Electrons in Atoms G2 The Photoelectric Effect G3 Particle in a Box: Cyanine Dyes G4 Particle in a Box: Quantum Dots	Groups will be assigned in Week 1
WK3, 1/31	G1 Particle in a Box: Quantum Dots G2 Seeing Electrons in Atoms G3 The Photoelectric Effect G4 Particle in a Box: Cyanine Dyes	
WK4, 2/7	G1 Particle in a Box: Cyanine Dyes G2 Particle in a Box: Quantum Dots G3 Seeing Electrons in Atoms G4 The Photoelectric Effect	
WK5, 2/14	G1 The Photoelectric Effect G2 Particle in a Box: Cyanine Dyes G3 Particle in a Box: Quantum Dots G4 Seeing Electrons in Atoms	Happy Valentines Day!
WK6, 2/21	Symmetry and Physical Chemistry	Bring molecular models!
WK7, 2/28	Symmetry and Physical Chemistry	Bring molecular models!
WK8, 3/7	Infrared Spectroscopy of HCl	
WK9, 3/14	SPRING BREAK, NO LAB	☺☺
WK10, 3/21	Infrared Spectroscopy of SO ₂	
WK11, 3/28	Infrared Spectroscopy of C ₂ H ₂	
WK12, 4/4	Electronic Spectroscopy of I ₂	
WK13, 4/11	Fluorescence of Chlorophyll	Bring laptops!
WK14, 4/18	No lab—COSA	
WK15, 4/25	Fluorescence of Chlorophyll	Bring laptops!
WK15, 4/30 (Monday)	Finish up labs from WK14 Clean up	
Final Exam	5/10 9 am – 12 pm, Pfahler 112/302	☹☹☹
Notebooks Due by Friday, April 27 at 4:30 p.m. Pick up graded notebooks from the secretary.		