Chemistry 413 - Syllabus Part 2
Physical Chemistry Laboratory

General Information

Instructor:	Dr. Kimberly Lawler-Sagarin
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Lab Text:	Selected Experiments in Physical Chemistry (Packet, Required) A standard laboratory notebook is also required Readings from the Chemistry 413 and 412 lecture texts will be helpful
Required Materials:	Laboratory Notebook, Scientific Calculator
Web Site:	http://www.elmhurst.edu/˜ ksagarin/pchem/ *Laboratory write-up information, hints, & lab report directions are here.*

Format of laboratory:

This year, the laboratory portion of physical chemistry is offered on Tuesday afternoons from 1 p.m. to 5 p.m. That time will be use for laboratory experiments, data writeup, quizzes and some pre-lab instruction. Tentative experiments and dates are listed below. Lab groups rotation schedule follow. Dates may vary depending on equipment and experimental concerns substitutions for different experiments may be made.

Experiment Schedule

Weeks 1-3 (Jan. 31 - Feb. 14): All Students
- Handout: Kinetics of Polymerization

Weeks 4-5 (Feb. 21 - Feb. 28): All Students
- Experiment 18: Monomer-Dimer Equilibrium
- Error Analysis and Monomer-Dimer Calculations on 2/28

Weeks 6-9 (Mar. 6 - Mar. 27): Lab Rotation I
- Experiment 2: Heat Capacity Ratios
- Experiment 6: Phase Diagrams (Full)
- Experiment 34: Particle in a Box and in a Ring
- *There will be no lab meeting March 20th (Spring Break)*

Week 10 (Apr. 3): Introduction to Rotation II, Lab Book Quiz, Attendance Required

Weeks 11-15 (Apr. 10 - May 8): Lab Rotation II
- Handout: Vibrational Spectroscopy (tentative)
- Experiment 15: Langmuir Adsorption/Surface Equilibrium (Full)
- Experiment 28: Kinetic Salt Effect (Full)

Rotation Groups and Experiment Schedule

	3/6	3/13	3/27
Michelle Katie	Heat Capacity	Particle in Box	Phase Diagrams
Kate-Leigh Amy	Phase Diagrams	Heat Capacity	Particle in Box
Toan Ashley	Particle in Box	Phase Diagrams	Heat Capacity

	4/10	4/17	4/24	5/1	5/8
Michelle Amy	Vibrational Spectroscopy	Kinetic Salt	Kinetic Salt (con't)	Langmuir Absorption	Langmuir (con't)
Katie Ashley	Kinetic Salt	Kinetic Salt (con't)	Langmuir Absorption	Langmuir (con't)	Vibrational Spectroscopy
Toan Kate-Leigh	Langmuir Absorption	Langmuir (con't)	Vibrational Spectroscopy	Kinetic Salt	Kinetic Salt

Class time: All students will be required to spend four hours per week on in-class laboratory activities. Lab time after completing experimental activities should be used for data workup and record keeping. Please bring necessary materials to the lab to facilitate working on calculations: lab book(s) with all relevant data, your calculator, a jump drive for transferring data, spreadsheet and document files and anything else you might need.

Grading and General Policies

This is an upper division laboratory with a specific emphasis on data collection, calculations and scientific report writing. Thus, the majority of your laboratory grade will come from the quality of your data and your lab reports and experimental work-ups.

Point Breakdown

Type of Assignment	Points Possible
Phase Diagrams & Formal Report	25
Langmuir Adsorption & Formal Report	25
Kinetic Salt Effect & Formal Report	25
Polymerization Kinetics, Data Analysis & Partial Report	20
Monomer-Dimer Equilibrium, Data Analysis & Partial Report	15
Particle in a Box & Data Analysis	15
Heat Capacity, Abstract & Data Analysis	10
Vibrational Spectroscopy & Data Analysis	10
In class 1/31, 2/28 and 4/3	15
Lab book reviews/quizzes 2/28, 4/3, 5/8	20
Total Possible	180 Points

Attendance and participation in the laboratory is required. An unexcused absence will be awarded when a student misses their assigned or arranged laboratory time, is excessively late, or leaves the laboratory early. One unexcused absence will not incur any penalty, however, **two unexcused absences will result in a 30 point penalty in the lab. Three or more unexcused absences will result in failing the laboratory and the course.**

Please follow all safety procedures in the laboratory. Failure to follow safety regulations may lower your overall course grade by as much as a full letter grade.

Lab reports and data analyses are required: Failure to complete a laboratory report or data analysis will result in a **one grade** penalty for the course grade for Chemistry 413 for each incidence.

All experiments will be done in pairs or small groups as assigned. Both members of the pair (or all members of the group) must contribute to solution preparation and data collection. Only with the permission of the instructor may exceptions be made. For lab reports, all students must do their own calculations, though students may and should compare their final numbers to catch mistakes prior to turning in the laboratory report. Failure to follow these rules will result in a 10 point penalty on the lab report or writeup.

Laboratory Notebooks

You are responsible for keeping a detailed and complete laboratory notebook of the work you do in lab. You are also responsible for bringing your laboratory notebook to each lab period. Several laboratory notebook quizzes and/or reviews will be given. Laboratory notebook quizzes will be open notebook (but not lab manual) and will ask questions that are easily answered with a complete notebook.

Your lab notebook should contain the following items:

- dates on every entry
- experimental procedures as you performed them
- all data collected in lab with units and uncertainties
- identity and sources of chemicals used
- all calculations that were done by hand (for example - the calculation of the molarity of a solution you made)
- copies of experimental data printed by computer fastened to dated notebook pages
- calculated concentrations of all solutions prepared
- ambient temperature and pressure when relevant
- specific equipment used (type, brand, model)
- references to handouts, sources of experimental values, etc.

Lab Tasks

This term many courses will be using the center lab. Lab tasks will be assigned each week in an attempt to help keep the lab in order. Small numbers of points will be awarded or subtracted periodically at the instructor's discretion.

Deadlines

Lab Reports are due Tuesdays at the beginning of lab. The following are the current due dates.

- Kinetics/Polymerization: T, Feb. 20th
- Monomer-Dimer: T, Mar. 6th
- Report/Writeup #3: T, March 13th
- Report/Writeup #4: T, March 27th
- Report/Writeup #5: T, April 10th
- Report/Writeup #6: T, April 24th
- Report/Writeup #7: T, May 8th
- Report/Writeup #8: T, May 15th

Excused Late Labs: You will receive two flexible late certificates for lab assignments. Each will allow you to turn in a lab report or write-up two weekdays late. For example, the assignment will be due on Th for T due dates with one certificate, the use of two certificates will result in a M due date. These certificates are to be used for minor emergencies, such as when you get sick, your car breaks down, your computer crashes, or you have too much to do. Exceptions will be made for serious illness, hospitalization or other catastrophic emergencies with documentation.

Unexcused Late Labs: I will deduct 20% of the total possible for late labs unaccompanied by a late certificate if they are turned in by noon on Thursday. Labs up to one week late unaccompanied by a late certificate will receive a 30% deduction. After this, labs will receive a 50% deduction.

Full Lab Reports and Write-ups

We will be performing 8 experiments over the course of the semester. Three of these experiments will be written up as full laboratory reports - standard formal laboratory reports. The remaining experiments will be written up in a shorter form. Specific requirements for these will be provided on the course website. Report types are indicated on the experimental schedule.

Format for Full Laboratory Reports

Regular formal laboratory reports will be graded out of 25 points.

Abstract (score 3): Writing abstracts is an important skill for several reasons. A person may first skim the abstract of a paper to decide whether or not to read the paper in more detail. Many secondary sources (*Chemical Abstracts*, for example) publish the abstracts of primary sources only. Additionally, electronic searching tools (becoming more and more important) often allow a user to search a database for document keywords or to search abstracts directly. Even in the case of the document keyword searches, it is important to write a good abstract, as keywords are often chosen by the search service, not the author. We will discuss the characteristics of a good abstract in class. (Exceptional/very good=3; good/fair=2; poor=1.)

Introduction (score of 4): This section should put the experiment in perspective for the reader. If you look through the literature, you will see that what authors choose to put in this section varies. Some of this is due to differing journal expectations or the conventions of particular fields of chemistry, some is due to good/bad judgment on the part of the authors. For the types of experiments we will be doing, a good introduction will include a summarization of the theoretical background and a statement about what

you are doing and why. In order to be considered "exceptional", an introduction must go above and beyond what is in common laboratory texts. (Exceptional = 4; good = 3; adequate= 2; Poor = 1; Missing=0)

Experimental (score of 2): This section should contain the experimental details of *YOUR* work in simple prose form (not as a list). This should not be a simple restatement of the published procedure. Rather, it should be written entirely from your laboratory notebook. Equipment should be specified with brand and model number. Correct chemical names should be used along with the source of the reagent. Another person with your background should be able to repeat your experiment based on your experimental section. A sketch of the apparatus may be appropriate. Procedures taken from published sources should be referenced. Raw data may be included here (calibration, synthetic yields, etc.) if appropriate. (Very good = 2; Fair/minor problems = 1; Poor/missing/major problems=0)

Results (score of 8): Your results should be organized into tables where appropriate and **have proper units and uncertainties.** However, this section should not be just a collection of tables. You must provide guidance for the reader, referring to tables or graphs when appropriate. Data and results should also be presented graphically if this enhances clarity. You will be graded on the quality of your data (3 pts) and the correctness and completeness of your computations (5 pts). (Calculations: Exceptional/complete & correct = 5; Very good/complete w/ only minor problems = 4; Fair/missing minor elements or too many minor problems = 3; Poor or missing major elements = 2 ; Missing=0. Data: Very good/complete w/ only minor problems = 3; Fair/missing minor elements or too many minor problems = 2; Poor or missing major elements = 1 ; Missing=0.)

Discussion and Conclusion (score of 6): This is where you will evaluate your results and discuss what they mean physically. Compare them to literature values, if appropriate. Compare and contrast methods used, if appropriate. Answer the questions asked in the results and calculation section of the lab textbook or handout. This section must be complete in order to be considered very good or exceptional. Your grade in this section will suffer if your "Results" section is incomplete, since the two are related. The report should end with a restatement of your primary conclusions. (Exceptional/Very good; Good=4 Adequate=3; Poor = 1-2; Missing=0)

Citations (score of 2): You will find it helpful to go to the literature or textbooks to find information for the introduction and discussion sections. Make sure you reference any external materials you use - including the laboratory directions and your textbook. Specific citations should be made within the text, collecting the references as endnotes at the end of the laboratory report. Use American Chemical Society (ACS) format for all citations. (Good/thorough=2; Fair/minor problems=1; Missing/unacceptable=0)

Spelling, Grammar, Organization (possible -2 deduction): Too many distracting spelling and/or grammar mistakes will result in a deduction. Very poor organization will also result in a deduction. Please spell check your document and read it over for clarity. Reports which are considered unacceptable will be returned for rewriting. (Major problems = -2; Minor problems = -1; Acceptable = 0)

Nothing in life is certain except death, taxes and the second law of thermodynamics. – Seth Lloyd

Physical Chemistry is the study of theories in chemistry. Chemistry is the study of matter and all its aspects. Since all science involves matter, and anything interesting in science involves theory, a physical chemist can study anything interesting in science. – Unknown