

SYLLABUS – Fall 2013

CHEM 356, Physical Chemistry Laboratory

Course Objectives: The objective is to give engineering students a foundation in experimental methods used by chemists to characterize the properties and reactions of chemical substances. An organic chemistry module has been included as part of the curriculum.

Specific Objectives for Physical Chemistry Laboratory

- Develop laboratory skills for measuring physico-chemical properties such as density, viscosity, equilibrium constants and rates of chemical reactions.
- Develop a basic understanding of the principles underlying the determination of physico-chemical properties.
- Develop skills for scientific report writing including the ability to a) clearly and concisely describe the conceptual background for an experiment, b) describe the procedures used in the laboratory, c) meaningfully report results including graphs and error analysis, d) discuss scientific significance, and e) succinctly summarize.
- Develop skills and a basic understanding of the principles underlying synthetic organic chemistry and the separation of chemicals from mixtures.

Instructors:

Lecture: Dr. Daniel Kleier

Office: Stratton 414

Email: dak48@drexel.edu

Office hours: Thursday 10:00 AM – 12:00 noon

Tel: (215) 895-1861

Lab : Leah Pandiscia

Section 061 on Tuesday at 12:00 PM

Office: Disque 605

Email: Leah.pandiscia@drexel.edu

Office hours: Tuesday 11:00 AM – 12:00 noon

Tel: 215-895-2654

Lab : Lindsey Klinge

Section 062 on Thursday at 12:00 PM

Office: Main Bldg., AL 274 (CAE Grad Office)

Email: lindsey.klinge@drexel.edu

Office hours: Monday 1:00 – 3:00 PM

Tel: (215) 895-???

Lab : Xiang Liu

Section 063 on Tuesday at 3:30 PM

Section 064 on Friday at 2:30 PM

Office: Disque 604

Email: xiang.liu@drexel.edu

Office hours: Monday 12:30 – 2:30 PM

Tel: (215) 895-6951

Textbook:

There is no textbook required. Copies of the lab procedures will be provided.

Prerequisites: CHEM 241 (Organic Chemistry) Minimum Grade: D (May be taken concurrently)

Website: The official course website will be located on BBLearn, accessible through your Drexel One account ("My Courses" link). Please check this site frequently as important information will be posted on a regular basis.

Lecture (Monday, 12:00-12:50, CAT 268): Each student will be expected to have read and prepared for the intended laboratory experiment prior to the lab lecture session scheduled at the beginning of each week. The lab lecture session will focus on the principles and theory involved in that week's scheduled experiment and will include minimal detailed instructions concerning the experiment itself.

Attendance: Students are expected to attend the lecture and lab each week. Attendance will be taken in the lecture class, and students will be responsible for any information presented during the lecture. Attendance will be included as part of the "Lab work/Attendance" grade (see below)

Students are responsible for making up any labs they miss, regardless of the reason for the absence. A valid reason for missing the scheduled lab will not excuse the student from performing the lab. If a student is aware of a conflict in advance, he/she should contact the professor and attempt to attend another section, if possible.

Experiments (held in Disque 404):

Week of Sept. 22 (1) Measurement of Liquid Density/Statistics and Data Treatment

Week of Sept 29 (2) Viscosity of Liquids: Low Viscosities

Week of Oct. 6 (3) Review of Viscosity lab report

Week of Oct. 13 (4) The Kinetics of a Homogeneous Reaction in Solution – Part I

Week of Oct. 20 (5) The Kinetics of a Homogeneous Reaction in Solution – Part II

Week of Oct. 27 (6) Solid-Liquid Equilibrium in a Binary System

Week of Nov. 3 (7) Diffusion Coefficients

Week of Nov.10 (8) Combinatorial Synthesis of a Series of Carboxylic Esters

Week of Nov. 18 (9) Separation of a Mixture and Purification of the Individual Components

Week of Nov. 22 Thanksgiving Week (No regularly scheduled lab)

Week of Dec. 1 (10) Continuation of previous experiment.

Final Examination During Finals Week

Safety:

Students are expected to practice proper and **SAFE** laboratory procedures. After reading the attached lab safety document, please sign a copy and submit it to your lab instructor. No food or drinks are allowed in the labs. Eye protection and lab coats must be worn at all times. No bare legs. Shorts are not permitted in the lab. No open toed shoes. Sandals are not permitted in the lab.

Grading:

Lab reports (70%). The student's grade is mostly based on the written reports. The lowest lab report grade will be dropped from the final average.

Lab work/attendance (10%). This will be comprised of the student's attendance and the instructor's assessment of the quality of the work done in the lab. In order to get full credit, each student must be on time, practice safe and neat laboratory procedures, and be prepared for the lab, i.e., have read and understood the procedure before coming to lab.

Final Exam (in Exam Week) (20%). This exam will be based on the theory including material presented in the pre-lab lectures and on the analyses associated with the lab reports.

Cheating or dishonesty (which includes plagiarizing) will not be tolerated. Cheating or dishonesty may result in a ZERO, failure of the course, or dismissal, as appropriate.

Lab Reports:

All reports with the exception of the last report are due to your lab instructor by 5 PM **1 week** after the date of completion of the experiment. The last report will be due **1 day** after the date of completion of the experiment. Points will be deducted from late reports (**5 points per day**). No reports will be accepted after the Wednesday of finals week.

Students will be working in groups of two or three. *Each group is responsible to submit one report for each experiment.* Since all members of the group will receive the same grade for the lab, good communication among the members of a group is essential. Note that the final exam will assume that all students have been involved in every aspect of the lab report to the extent that they can answer questions based on the lab.

Reports should follow a standard format. Each report must include 10 sections:

1. The title of the experiment, your name, etc.**2. Abstract**

This is a short paragraph that gives a summary of the experiment, including the final results with uncertainties, if possible.

3. Introduction (or background)

This section (generally no more than one page) describes the theory and concepts involved. Include primary equations used in the calculations.

4. Procedure

This should be a brief and general description of the experimental procedure, avoiding detailed descriptions of the operation of any instrumentation.

5. Data

Here the measurements and the raw data are presented. Use tables prepared with a spreadsheet. In general no calculations should be associated with the data.

6. Results

This section presents the results obtained using the raw data from the previous section, including any plots or figures produced (when making plots, label the axes and display the proper units). Once this part of the report is completed, you should know if you were able to accomplish the "Objective" of the experiment. For example, if the objective of the experiment is to measure the viscosity of a liquid at five different temperatures, you should have a table in the RESULTS section with values for viscosity at those five temperatures. An example of each type of calculation should be included in this section.

7. Error analysis

This section shows the accuracy and precision of the experimental results. The accuracy is represented by the relative error, which is obtained using the "true value" of the parameter of interest. The "true value" (or best accepted value) can usually be found in reference sources, such as the CRC Handbook of Chemistry and Physics. When reference data are cited, be sure to properly identify the source or sources of such data in the acknowledgements section.

In cases where repeated measurements are performed, the precision can be determined by obtaining the standard deviation and/or standard error. (A full treatment of the "error analysis" will be presented in the lecture for the density experiment.) Sample calculations of any error analysis should be included in this section.

This section should also include a discussion of sources of error and/or uncertainty. You must be specific here. "Human error" is not an acceptable source of error.

8. Conclusions and Discussion

The experimental results are discussed in this section. The quality of the experiment is evaluated considering its success or failure. In case of failure, the student should attempt to identify the source of the problem. In general, the student(s) should discuss how the lab demonstrated the objectives of the lab, or how the data answered the questions posed at the start of the lab.

9. Acknowledgements

This section should include any reference materials used in the interpretation of data, the writing of the report, or the answering of questions. Persons contributing to this work also should be acknowledged in this section (e.g., other groups who provided data).

10. Questions.

At the end of each experiment, there are a few questions. Include the answers to the questions in your report.

There are sample reports available from previous terms. You may look at them to get an idea of what is expected.

Lab Safety and Housekeeping

Print your name: _____

Hazardous Substances

- When a procedure indicates that a hazardous substance must be used, special caution is required. Please pay close attention to instructions in order to avoid injury.
- Rubber gloves will generally be available in the lab for handling these materials, and some materials should be handled only in the hoods
- Material Safety Data sheets (MSDSs) on all substances used in physical chemistry are kept in Disque 404 if you wish to see them.

Acid (or Base) Spills

- Spills on your skin or clothing should be treated immediately with large amounts of water. Notify your lab instructor.
- There is a "water station" in the lab, which includes a deluge shower, a hose, and an eye-washing fountain
- *Important!* Do not try to save your clothing first! Do not run to the washroom: Use the shower!

Eyes

- Safety glasses or goggles *must* be worn at all times in the laboratory. These are available in the bookstore. Be sure to purchase them before you come to the first laboratory class.
- Contact lenses are *never* permitted in the laboratory (even with safety glasses or goggles) as they make your eyes more vulnerable to vapors .
- In case of an accident: Wash eyes thoroughly for several minutes with a gentle stream of water using the eyewash fountain or eyewash dispenser. If, contrary to policy, you happen to be wearing contact lenses of any type first wash, remove them, and continue to wash.

Clothing

- Lab coats must be worn at all times in the lab. Coats are available from the bookstore.-
- Bare legs, shorts and open shoes are prohibited.

Cuts/ Glass and Metal Disposal

- Do not force glass tubing or thermometers in a rubber or cork stopper.
- Broken or cracked glassware should be immediately discarded in the marked container. *Never* put disposable glass Pasteur pipettes in the waste paper containers. Do not put paper in the glass and metal containers.

Fires

- There is a fire extinguisher in every lab.

Housekeeping

- Students are expected to clean up their space after their experiment. Failure of students in this regard will be dealt with by lowering your grade score for the experiments. Repeated failure of students to clean up will have a substantial impact on your grade.

I have read, understood, and agree to abide by all the information above concerning safety and housekeeping in the laboratory:

Sign here: _____ *Date* _____