

Quantitative Analysis Laboratory, CHEM 214 Fall 2013 Syllabus

Quantitative Analysis Laboratory (1 credit hour)

Prerequisite: Chem 106/102 and 112; Chem 222/224 and 226 as well as completion of lecture Chem 212

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Graduate Teaching Fellows:

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Objectives:

- 1) To acquaint students with some of the classical and modern techniques in analytical chemistry
- 2) To teach wet chemical lab skills, efficiency and planning of experiments
- 3) To teach critical evaluation of experimental results
- 4) To become familiar with conventional data collection in commercial and academic laboratories.

Attendance:

Students are expected to be in attendance for all labs. Additional time will not be provided to students who are absent from lab. Make-up exams and quizzes will not be given unless approved by the Teaching Fellow and/or Instructor.

Laboratory Procedures:

It is the responsibility of the student to print out all lab procedures and have them available for use during each lab. Procedures and relevant information can found on Sakai.

At the start of each lab period, students will take the pre-lab quiz (if scheduled). The procedures and goals for the day will be discussed, and students will be informed of any specific hazards, waste disposal procedures, and other safety and equipment related concerns. Students may also be given additional handouts that are pertinent to each lab assignment. Periodically during the lab session, the teaching fellow and instructor may help acquaint students with specific details and methodology to be utilized throughout the lab experiment in order to efficiently and accurately perform the experiment. **It is critical that students give their full attention to these recommendations!**

Pre-Lab Quizzes

It is essential that the student come to lab prepared, having studied the procedure prior to entering the lab and be cognizant of the purpose and procedures specific to that day's lab. **Before the start of each experiment a quiz will be given.** These pre-lab quizzes are given to assess the preparedness of the students prior to the start of each experiment. If it is believed that a student is not adequately prepared to undertake the lab, they will be removed from the lab for additional instruction.

Quizzes will be given during the first 15 minutes of lab. You MUST be punctual in getting to lab on time; there will be NO excuses! If you arrive late to lab, you will NOT be allowed extra time to complete the quiz.

Lab Quizzes will also be a part of the overall grade. Questions will generally come from the procedure or calculations related to the lab. In some instances, questions will be asked which do not come directly from the procedure but require reviewing supplemental materials posted on the website or presented during lab overviews.

Laboratory Experiments and Unknowns

In most cases, accuracy will be graded based up the student's ability to determine the concentration of assigned unknown sample whose composition is known to at least **FOUR** significant figures. The student will determine the concentration or percent composition of the unknown sample. Grades assigned for accuracy will reflect how accurate the student result is to the known composition of the unknown. It is absolutely necessary that the unknown identifier (usually a number) be recorded in the lab notebook, in addition to signing for it on the unknown list provided by the teaching fellow. Experimental results to be graded **MUST** be submitted via Sakai. It is strongly encouraged that submissions be done as soon after the completion of the lab as possible.

Any submission that does not have an unknown identifier listed or does not report the correct number of significant figures will be given automatic failing score for accuracy of that particular lab. Corrections of these submissions will not count against re-doing a lab.

If the student is not satisfied with the score given for accuracy, the lab experiment may be repeated only once in order to get a better grade. However, a **new unknown sample must be used**. It is strongly encouraged that the repeated lab be done as soon after the initial trial as possible and following consultation with the instructor and/or teaching fellow. Results must again be submitted on Sakai as soon after completion as possible. If a lab is repeated, the accuracy grade will be the better of the two results. Accuracy accounts for about 67% of the overall grade (see breakdown below).

Good precision (≤ 5 ppt) must be maintained throughout all steps within a lab. **Precision** will be a component of the **lab report** grade. For each lab, it is necessary to report the values of the individual determinations; the mean concentration (or percent composition); and the standard deviation associated with the overall determination.

Laboratory Notebooks

It is required that students have bound (not spiral) lab notebooks. At the start of each new experiment, students should come to lab having written an experiment title, brief introductory paragraph (including the purpose of the lab), and procedures for the experiment. Guidelines and a rubric for the lab notebook are found later in the syllabus.

During the lab, students should actively be taking notes on observations, recording masses and volumes of materials used and completing calculations in the lab notebook. A brief conclusion statement should be included when the lab is completed.

The lab notebook does not necessarily need to be perfectly organized and neat, but it must be legible. The lab notebook must be completed in pen. Any errors made should not be erased. Strikeouts should be made to indicate errors.

Lab notebooks will be collected periodically throughout the semester to be graded. These submissions will be unannounced. Thus it is very important that the student stay up to date in the writing of the lab notebook.

Laboratory Reports

The purpose of the report is to familiarize students with aspects of technical writing in the context of critically analyzing what was done in lab. The laboratory report should present what was done, results, a thorough analysis of the results, and conclusions in a logical and cohesive manner allowing anyone the ability to pick up the lab report, understand what was done, and replicate the experiment. The student is expected to identify at least three (3) possible sources of error from the experiment and fully analyze how the stated error impacts each specific step of the lab as well as the final result.

Written laboratory reports will be required for the following labs:

- 1) Acid-Base Titration: Determination of Potassium Hydrogen Phthalate and Unknown Sodium Carbonate
- 2) Spectrophotometric Determination of Iron
- 3) Assay of SO_3 by Gravimetric Analysis of Sulfate
- 4) EDTA Determination of Total Hardness and Determination of Individual Calcium and Magnesium

* The required lab reports may be changed at any time over the course of the term at the discretion of the instructor and/or teaching fellow.

The first written lab report may be corrected and resubmitted **only once** to earn back **up to half** of the points lost in the first writing. The corrected lab report must be handed in, accompanied with the original graded lab report and grade sheet, by the due date established on the class schedule. The remaining three lab reports **CANNOT** be corrected to earn back points.

Laboratory reports are to be computer generated and should follow the format defined later in the syllabus or a similar format. Reports must contain all data sets, including that from a redo if performed. Graded lab reports will determine about 17 % of the overall grade (see breakdown below). Hard copies of the lab reports are to be turned in by the end of lab on the respective due date. Electronic submission of lab reports will **NOT** be permitted. **Lab reports turned in late will receive a penalty of 10% each lab period the report is late and result in a grade of 0 if not received within two weeks of the established due date.**

Laboratory Exams

Two exams will be given over the course of the term. These exams will cover material from each of the immediately preceding experiments. The midterm exam will include **Experiments 1-4** and the Final Exam will include **Experiments 5-9**. The questions will cover theory and concepts related to each lab experiment as well as related calculations.

Other Materials:

Access to an inexpensive calculator having logarithmic, exponential, and trig functions is also suggested. Lab goggles are **required** to be worn in the lab at all times. All items must be brought to every lab session. In some instances it may be advantageous to have a laptop computer or tablet available in lab for immediate data entry, analysis and calculations. If it is deemed to be a distraction or hazard, the TA or Lab Instructor may request that

it be put away. Please note that cell phones are not a substitute for a calculator and will NOT be allowed for use during quizzes, the midterm, or final exam.

Academic Honesty

While it is encouraged that students work together, cheating will not be tolerated. Please review Loyola University Chicago policy on Academic Integrity through the following web address:

http://www.luc.edu/academics/catalog/undergrad/reg_academicintegrity.shtml. Suspected cases of cheating will be handled according to Loyola University policies.

Grading Policy

The grading policy established here is subject to change, including, but not limited to, the assignment of plus and minus grades, at the discretion of the Instructor and/or the Teaching Fellow.

Grading Category	Points	Percent
Analytical Findings (Accuracy) 2 @ 100 pts and 7 @ 200 pts	1600	66.67 %
4 Detailed Laboratory Reports	400	16.67 %
9 Lab Quizzes	90	3.75 %
Midterm exam	100	4.17 %
Final exam	100	4.17 %
Lab Notebook	110	4.58 %
Total	2400	100 %

Grade Assignment	
Points	
2160 – 2400	A
1920 – 2160	B
1680 – 1920	C
1440 – 1680	D
Below 1440	F

Lab Report and Notebook Grading Rubrics

The following is a rough guideline of how points will be assigned on your lab reports and the lab notebook. Redistribution of points from the outline below may occur from lab to lab at the discretion of the Teaching Fellow.

Lab Report Categories	Points
Title and Introduction	14
Materials and Methods	20
Calculations, Results and Discussion	46
Conclusions	10
Report Quality (Grammar, spelling, punctuation, organization, etc.)	10
TOTAL	100

Lab Notebook Categories	Points
Table of Contents	3
Title, Date, and Introduction (1 pt./exp.)	9
Procedures (2 pts./exp.)	18
Data, Results, Calculations (5 pts/exp.)	45
Conclusions (3 pts./exp.)	27
Organization and format (Labeled sections, legible handwriting, etc.)	8
TOTAL	110

General Guidelines for Laboratory Reports

Lab reports for Quantitative Analysis should be more complete, accurate, and detailed than reports done in the past for General Chemistry or Organic Chemistry. This is an upper division level science class, and more thoroughness is expected of the student. Lab reports should be written in a stand-alone format, such that, anyone after reading it, would clearly understand what was done and be able to reproduce it.

It is encouraged that the student looks to the current scientific literature to develop strategies on how to structure the lab report. While the main content areas that must be included are calculations and analysis of experimental error, it is important to structure your lab report into a stand-alone overview of your work. The following elements will aid in structuring a comprehensive lab report. Inclusion of these elements will be considered when grading laboratory reports.

Lab reports should generally consist of the following elements:

1. Title
2. Abstract (not required for this lab)
3. Introduction
4. Materials and Methods
5. Calculations and Results
6. Discussion
7. Conclusions
8. References (include as necessary)

The entirety of the lab report should be written using the student's own words. While it may seem easier to copy certain portions from handouts, such as the methods, this is **plagiarism** and is not acceptable for academic writing, and it is certainly not acceptable for the scientific literature.

When writing the laboratory report it is important to be very clear and concise in your writing. Details do matter and the slightest change in wording may distort the original intent of what was written. It is also important to properly label all tables and figures with descriptive captions as well as making sure the appropriate units are included where necessary. It is suggested that 1 inch margins be used with 1.5 lines spacing for paragraphs. Individual tables and figures should not be split onto separate pages. Laboratory reports should have good spelling, grammar, sentence structure, etc. Use of personal pronouns (I, we, me, etc.) is strongly discouraged. Finally, take the time to check over your work and re-read your report to make sure that what you wrote is clear and makes sense. If necessary have a friend edit your report as well.

The lab report write-up is a **VERY IMPORTANT** part of any laboratory-based work, especially at the junior/senior undergraduate level and, of course, for graduate and even professional level work. It has been said that a student may do mediocre work and write up an excellent lab report, and the work will be thought of as wonderful. However, a student may do wonderful work and write it up poorly, and the work will be thought of as mediocre.

General Guidelines for Lab Notebooks

First and foremost, lab notebooks MUST be completed in pen.

It is strongly encouraged that the first two pages be left blank for the table of contents and labeled as such. Number all pages with the appropriate page number. Then, over the course of the lab, fill in appropriate experiment titles and respective page numbers in the Table of Contents.

The sections of each experiment entry should be appropriately labeled (Introduction, Procedure, Results, Conclusions, etc.).

At the start of each experiment write the title of the experiment and the date. This should be completed prior to coming to lab as well as writing a brief introduction to the lab. The introduction should provide a synopsis of what the point of the experiment is and methods (titration, precipitation, etc.) or instrumentation used in the experiment. Procedures should also be written out prior to coming to lab.

Data, results, and conclusions should clearly include your unknown identifier and all necessary data (tables, graphs, etc.). Calculations for anything prepared in lab should appear in this section as should all masses and volumes used to either make solutions or to complete the experiment. It is also strongly encouraged that any and all observations be recorded. This includes, but is not limited to, color changes (initial solution color and endpoint color in a titration for example), final and initial burette readings for all experimental trials, sample masses, instrument settings, etc. Values that are written down should have units and chemical identity accompanying them (i.e. 15.05 mL of 0.1 M NaOH). Again, everything should be written in pen. Strikeouts are acceptable as no notebook is perfect. Any changes to the procedure should be noted here as well, including the reasons for the change. If data is rejected, reasons MUST be recorded for the rejection of the data. Any procedural errors should also be recorded (such as lost samples, contamination, etc.).

Conclusions should be brief. You can simply restate the purpose of the experiment and what was accomplished. Other suggestions, hints, etc. discovered along the way can be included as well. A conclusion statement may be as simple as "The purpose of this experiment was to determine the percent sodium carbonate in an unknown sample. In unknown #12, it was determined that the unknown sample contained 39.57% sodium carbonate."

Every notebook entry MUST include a date. This will allow you to better keep track of what was completed and when it was completed. It is not necessary to have an introduction, purpose, and procedure for each day following the start of an experiment that continues over multiple days. If you feel writing out a procedure for everyday is helpful, then please do so. What is outlined above it meant to give you some general idea of what to include in a lab notebook. Feel free to set-up your lab notebook as best fits your needs. However, please keep the grading rubric in mind when setting up your lab notebook.

Finally, lab notebooks may be collected randomly throughout the term. Intermediate grades may be assigned based on what is completed to date, but the grade will only be based on what is possible at that time. For example, if the notebooks are collected after the completion of the first lab for grading, the total number of points will only be out of 11 points. Points for the table of contents and organization and format will only be assigned after the last collection of the notebooks.