

Chemistry 214, Quantitative Analysis Laboratory

Spring 2015 Syllabus

Chem 214-002, Quantitative Analysis Laboratory (1 credit hour), Mondays/Wednesdays 2:45-5:30 pm, FH-313

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

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Course 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 Policy

It is a *requirement* for students be present for every scheduled lab session. Additional time will not be provided to students who are absent from lab. Students are allowed to attend only the section in which they are enrolled due to university policy. Students must have required materials and be properly dressed to perform experiments in the laboratory. Make-up exams and quizzes will not be given unless approved by the Instructor.

Footwear/Clothing

Proper clothing and footwear for working in a lab is expected to be worn at all time for each lab. If you are not appropriately clothed (i.e. long pants, lab coat and safety goggles, closed toed shoes, etc.) you will be expected to return to your residence to obtain the appropriate clothing before beginning the day's activities. No extra time will be given to complete the assignment. A safety lecture is given the 1st day of class; attendance is required in order to perform lab experiments. Students must sign a safety sheet acknowledging understanding, commitment to follow policies.

Required Materials:

- One bound (NO SPIRAL) *laboratory notebook* such as a national-brand Composition book.
- An inexpensive *calculator* having logarithm (base 10 and e), exponential, and trig functions.
- A pair of *lab goggles* [safety glasses NOT allowed] which must be worn at all times in the laboratory.
- *Lab coat*. Offers a layer of protection against hazards. It must be worn at all times during lab experiments. Must be long sleeve. Can be found on Amazon or at the bookstore.
- Laboratory procedures and handouts (posted in Sakai)
- Non-erasable pen

Bring all materials to every lab session. For some experiments, it may be advantageous to bring a laptop computer for data entry, analysis, and calculations. If it is deemed to be a distraction/hazard, TA or Instructor may request that it be put away.

Note: Cell phones are NOT allowed for use during quizzes, the midterm, or final exam and strongly discouraged during lab. If necessary, please take calls in outside hallway after informing the instructor and/or the TA that you will be stepping out.

Laboratory Procedures

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 pertinent to that day's 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. 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. Thus, one MUST be punctual in getting to lab on time! If one arrives late to lab, no extra time will be given to complete the quiz.** Quiz answers must be written in pen or credit will not be given.

Questions will generally be generated from the procedure or calculations necessary to complete the lab. In some instances, questions may be asked which do not come directly from the procedure but will come from required supplemental materials posted on Sakai or presented during lab overviews. The quizzes will be part of the overall grade for the course.

Lab Experiment Unknowns

For every lab, students will be assigned a standard 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 students' results are in comparison to the known unknown composition. It is **ABSOLUTELY** necessary that the unknown identifier (usually a letter and number combination) be recorded in the student's lab notebook as well as be signed for on the unknown list posted by the TA. The experimental results for each lab must be submitted via Sakai. **NO** e-mail submissions nor paper submissions will be accepted. **It is imperative that students turn their results in Sakai in a timely and efficient manner. Labs will only be OPEN for submission of results for a few weeks past initiation of experiment, so it is students' responsibility to submit in data a timely manner.** Accuracy is the main component of the overall grade.

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.

For each experiment's unknown assignment, students will report the values of your individual unknown determinations, the mean concentration (or percent composition) and the standard deviation associated with the overall determination and the parts per thousand precision (ppt). Students will be permitted to repeat each lab only once as time permits in order to earn a better accuracy grade. However, they will need to analyze a **new unknown sample** and it must be undertaken in the period established on the laboratory schedule. If a lab is repeated, the accuracy grade will be the better of the two results.

Laboratory Notebook

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. Lab notebook does not need to be perfectly organized and neat, but it must be legible. Do not erase any errors that are made, but place a single bold line through the error, or strike-out the error. **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.

Lab report due dates are located on the semester schedule Lab 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 at the beginning 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 day the report is late and result in a grade of 0 if not received within 5 days of the due date.**

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.

The following list* includes the experiments for which a completed lab report is required:

- 1) Acid-Base Titration: Determination of % Carbonate in Unknown (Lab 2)
- 2) Spectrophotometric Determination of Iron (Lab 3)
- 3) Assay of SO₃ by Gravimetric Analysis of Sulfate (Lab 4)
- 4) EDTA Determination of Ca and Mg via Titration and Ion Chromatography (Lab 7)

*At the discretion of the Instructor or TA, this list can be modified at any time over the course of the semester.

Laboratory Exams

Two written exams will be given which cover concepts pertaining to all of the laboratory experiments. The Midterm exam will include **Experiments 1-4** and the Final exam will include **Experiments 5-8**. Exams will cover the theory as well as related calculations.

Academic Honesty

Instructor and TA encourage students to consult one another during lab experiments and outside of class. Students can converse, brainstorm, and work through questions together but copying other students' work and presenting it as one's own is unacceptable. There is a difference between sharing knowledge and cheating. If it is determined that lab reports or other materials in this course are plagiarized or have been shared between students (current or past), no credit will be given for the assignment. Cases of suspect academic dishonesty will be handled according to University policy and guidelines. Please review Loyola University Chicago's policy on Academic Integrity via this link: http://www.luc.edu/academics/catalog/undergrad/reg_academicintegrity.shtml

Grading Policy

The established grading policy is subject to change at Instructor and/or TA discretion. Please note the University uses a +/- grading scale system and it will be implemented in this course.

Grading Category	Pts	Percent
Analytical Findings (Accuracy)*	1600	66.78%
Detailed Laboratory Reports	400	16.69%
Lab Quizzes	96	4.01%
Lab Notebook	100	4.17%
Midterm exam	100	4.17%
Final exam	100	4.17%
Total	2396	100.0%

Points Range	Letter Grade
2156 - 2396	A- to A
1916 - 2155	B-, B, or B+
1677 - 1915	C-, C, or C+
1438 - 1676	D-, D, or D+
Below 1438	F

Grade Assignment:

*8 labs @ 200pts/each

Grading Scale (%): A 100-94.0, A- 93.9-90.0, B+ 89.9-86.9, B 86.8-83.0, B- 82.9-79.9, C+ 79.8-77.0, C 76.9-72.9, C- 72.8-70.0, D+ 69.9-67.9, D 67.8-63.0, D- 62.9-60.0, F ≤ 59.9

Lab Report and Notebook Grading Rubrics

The following is a generous guide provided by the Instructor with a rough estimate of systematic grading of lab reports and notebooks based on the completion of 8 labs. Points can be redistributed at the discretion of the Instructor and TA.

Lab Report	Points
Title and Introduction	10
Materials and Procedure	20
Calculations, Results, and Discussion	50
Conclusion	10
Report Quality (Grammar, spelling, punctuation, organization, etc.)	10
TOTAL	100

Table of Contents	5
Title, Date, and Introduction (1 pt./exp.)	8
Procedures (2 pts./exp.)	16
Data, Results, Calculations (5 pts/exp.)	40
Conclusions (3 pts./exp.)	24
Organization and format (Labeled sections, legible handwriting, etc.)	7
TOTAL	100

Lab Notebook Categories	Points
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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. Points for the table of contents and organization and format will only be assigned after the last collection of the notebooks.