

Chemistry 214-001, Quantitative Analysis Laboratory

Fall 2019 Syllabus

**Chem 214-001, Quantitative Analysis Laboratory (1 credit hour), August 26th through December 2nd, 2019
Mondays 8:20am-12:20pm, Flanner Hall 313 (FH-313)**

Prerequisite: Chem 106/102 and 112, as well as active attendance or completion of lecture Chem 212.

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Office Hours:* Mondays 1 – 2pm OR by a
scheduled appointment.

***Office hour location is the STEM Resource Center in Bremner Lounge @Centennial Forum. Do not come to our offices.**

Check out the STEM Resource Center in the Centennial Forum <https://www.luc.edu/tutoring/stemcenter/>

Course Description:

This lab course emphasizes application of topics/theory covered in the lecture course (Chem 212). It introduces students to classical and modern methods of chemical analysis and teaches wet chemical laboratory techniques including quantifying analytes of interest via acid-base titration, EDTA complexometric titration, pH titration curves and corresponding derivative graphs, ion chromatography, refractometry, spectrophotometry, and ATR-IR. Use of buffers, indicators, a variety of laboratory equipment/glassware, basic statistics, etc. Chemical knowledge spanning from general chemistry to new topics in Chem 212 lecture is vital. This list is not exhaustive but mentions the highlights. This course has a strict attendance policy; make sure you are 100% committed.

Course Goals & Outcomes for Students:

- 1) Acquaint students with classical and modern techniques in analytical chemistry
- 2) Teach wet chemical lab skills, efficiency and planning of experiments, and importance of accuracy and precision of laboratory work. Build confidence in an individual's laboratory skill
- 3) Become familiar with conventional data collection in commercial and academic laboratories
- 4) Teach interpretation and critical evaluation of experimental results

By completing Chem 214 students will be able to:

- Apply knowledge to plan and execute laboratory experiments efficiently (finish labs on time)
- Demonstrate proficiency in usage of laboratory equipment (analytical balances, burets, glassware, instrumentation) exposed to in this course
- Evaluate accuracy, precision, and validity of experimental data
- Articulate experimental results in concise, written format via lab reports

Please read the entire syllabus to understand what is expected of you in Chem 214. Your enrollment in this course requires you to commit fully, attend all labs, read the syllabus & all course materials, complete all required work, adhere to due dates, and know all expectations.

Required Materials:

- One bound (NOT 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 are NOT allowed] like the ones used in Gen Chem/Orgo labs.
- A *long-sleeve lab coat*. Any color is ok. It must be buttoned always. Amazon, Loyola bookstore sell them.
- Chem 214 lab manual and handouts, all handed out on 1st day of lab [always available in Sakai].
- Non-erasable pen [scientists do not write in pencil or erasable ink]. White out is not allowed.
- Use of Sakai (frequent access, pre-lab quizzes, submission of experimental results, etc.)

For some experiments it may be advantageous to bring a laptop (note lab schedule). *Cell phones are not a calculator substitute. Cell phones are NOT allowed for use during labs. They are distracting and a safety hazard.*

Attendance Policy:

Participation is mandatory. It is expected students attend every scheduled laboratory [i.e. lab] session/class. It is also expected students are *on time*. Additional time will not be provided to students who are absent from a lab session or who come late to lab. If student comes in late to lab, and pre-lab lecture is still going on, the student is allowed to stay. If a student walks into lab so late, that pre-lab lecture is already over, the student cannot stay for lab since they have missed important information; this counts as an absence and zero is recorded for the lab. Students must have required materials and be properly dressed to perform experiments in the lab. If a student misses an online pre-lab quiz, make-ups are not given. Stipulations are listed later in this syllabus. If you know you will be absent for a day of lab, contact the Instructor, but realize no time extensions are given for absent students for any of the course materials or experiments. A few experiments are partner labs; if you are absent you effectively abandon your partner [and they are paired up with someone else] and you earn a zero (0) on the lab experiment and are not allowed to complete the lab individually or with another partner when you return to lab the next week. Students are required to initial a sign-in sheet on each day of lab, documenting/verifying their attendance. If you are present in lab but forget to sign-in, safety points are deducted, as accountability is important for safety. The sign-in sheet serves as a formal record. **If absent, it is a student's responsibility to contact the Instructor ASAP.**

Students must inform Instructor of all information regarding any University Sponsored event that conflicts with laboratory time within 10 days of the start of the semester. There is no make-up work. Students cannot make up lab experiments missed. Instructor reserves the right to contact the Athletics Department or other parties involved to confirm time conflicts and express concerns of absence. Students missing classes while representing Loyola University Chicago in an official capacity (e.g. intercollegiate athletics, debate team, model government organization) cannot make up Sakai work. Laboratory work cannot be made up either; you cannot attend another lab section. These types of absences are handled on a case-by-case basis and likely remedies include writing a research paper for each lab missed due to the University event.

Students missing a lab experiment due to observing religious holidays must alert the Instructor no later than 10 days after the start of the semester to request a special accommodation. This is handled on a case by case basis and likely remedies include writing a research paper for each lab missed due to the University event. Instructor reserves the right to contact Campus Ministry, which has information on a plethora of religions & holidays.

Students must discuss with faculty the potential consequences of missing laboratory. Students must provide the Instructor with proper documentation describing date and reason for the absence. The document must be signed by an appropriate Faculty/Staff member, and it must be provided within 10 days after the start of the semester. It is the responsibility of the student to proactively ask about what will be missed during an absence.

Footwear/Clothing:

Closed toe, closed heel shoes are required [no sandals, flip flops, slippers, Crocs, ballet flats, boat shoes, perforated shoes, etc.] No skin on legs, ankles, or feet can be exposed. Long pants recommended. Shorts and skirts [unless floor length] are not allowed. Bare skin on the lower extremities is a safety hazard: Be advised, concentrated acids/bases will be used in most of the lab experiments. *Lab coats & goggles are required and must be worn at all times. This even applies to cleaning glassware!* Lab coats must be fully buttoned to be an effective shield against chemicals. Students will be sent home if proper clothing or footwear is not worn, this counts as an absence. A safety lecture will be given the 1st day of class; this lecture is required to perform lab experiments. Students will sign a lab safety sheet acknowledging their understanding and commitment to adherence of lab safety rules/policies. If a student is absent the 1st day and misses the safety lecture, he/she is not allowed to perform wet chemistry until the safety lecture is completed & safety sheet is signed. It is advised students do not wear contact lenses in the laboratory, as contact lens material may react with chemicals/chemical vapors if they get into the eye. All rules are meant to keep students safe in the laboratory. *Instructor and TA have complete discretion to prohibit a student from completing lab work if the student has clothing/footwear exhibiting a potential safety hazard.*

Interaction with Teaching Assistant:

In order to increase the amount of individual assistance students receive in lab, a teaching assistant will participate in delivering this course. The TA will be present the entire time in lab to assist & help you with your questions. Instructor and TA are a team; if the TA cannot answer a question, the Instructor will and has the final authority in all matters regarding the lab. Instructor may step out of lab briefly to handle absences, other curriculum items, or to get supplies from the stockroom. If at any time during the semester, a student has *any* questions or concerns regarding the teaching assistant, please contact the Instructor.

Blanket statement about “technical difficulties:”

It is *strongly encouraged* that all required submissions to Sakai as well as writing & printing lab reports, opening course/data/experiment files, be completed on a reliable wired internet connection [not wireless], that of which the University itself provides in the Information Commons and various computer labs on the Lake Shore Campus. Under NO circumstances will excuses of “technical difficulties” be accepted as this syllabus is stating all students should use a wired internet University computer [not wireless internet] to submit work in Sakai, take pre-lab quizzes, write & print lab reports, open course/data/ experiment files. Emailing lab reports, Sakai results, or other is not allowed in place of the required means of turning in lab reports or required submission of items in Sakai. This list is not exhaustive and do note that any activities this course may require a computer or internet connection for should be completed using University computers with wired internet connection. Use of home internet [wired or wireless], University wireless, or public wireless is at your, the student’s, own risk. It is not prohibited but as the Instructor has stated in this syllabus, the Instructor is not responsible for ANY technical difficulties of non-University devices [cell phone, tablet, home/work/public wireless internet or computer]. Do not submit items in Sakai using a cell phone or a tablet device as these devices do not count as reliable internet connection tools [and the Sakai website display on these mobile devices isn’t reliable]. Printing issues on or off-campus are not accepted as excuses for lack of having a lab report. There are many on-campus options for printing items.

Laboratory Procedures:

Instructor and TA briefly explain the procedures and goals for each lab experiment prior to its execution. Students are given all handouts beforehand (also available in Sakai). Students are expected to read lab procedures *several times* before coming to lab, to comprehend and complete labs safely in the laboratory. Students are encouraged to look over the pre-lab lectures provided in Sakai, for further information. Online pre-

lab quizzes assist in reinforcing accountability of knowledge. A lab schedule, detailing projected start/end dates for each lab experiment, pre-lab quizzes, lab report due dates, and other information will be provided to students on the 1st day of class. This schedule is posted in FH-313, Sakai, and at the end of this syllabus. Therefore, there are no excuses to not knowing what is required of you, the student, each day of lab and outside of lab. Any aspect of the schedule is subject to change. If change occurs, students are notified to write it on their copy of the schedule as it is not reprinted [for sustainability]. Changes will be posted in Sakai if applicable.

Lab Experiment Unknown Samples (referred to as “Unknowns”):

Most of the lab experiments are completed *individually*, emphasizing development of an individual’s laboratory skills. Each student will choose an unknown sample whose composition is known (to us) to at least **FOUR** significant figures. **Each student quantifies an analyte of interest in their unknown and is graded on how accurately the student’s experimental determinations reflect the unknown’s true [theoretical] composition.** Write down the unknown # in a lab notebook AND sign for it on formal sign-up sheets provided by the TA. Each lab experiment is completed once and in the order shown in the laboratory schedule. Essentially, a new experiment is completed start to finish each week of class. Come to lab prepared; nothing can be done if a student doesn’t finish the experiment [a grade of 50% is earned as the student doesn’t have all required data]. If a student is absent for an experiment, a zero (0) is earned as the student was not present to do work. **There are NO make-up labs.** If a student misses one of the ‘two-day’ labs (#3, #4) or the swap labs (#6-8), you cannot make them up on the other assigned day [absence means you forfeit any chance to complete the experiment you were assigned that day]. Note: the lowest accuracy grade (only one) earned out of the eight experiments will be dropped. If an absence occurs, it is the lowest accuracy grade [a zero] that will be dropped. Only ONE accuracy grade is dropped so if you are both absent AND also earn a low accuracy grade on another experiment, only the absence accuracy grade is dropped. Attendance is taken seriously; you pay tuition to attend each week. A second absence in the course warrants a zero (0) for the experiment too; you will have to earn enough points to pass the course with that zero included in the grade. If more than 2 experiment absences occur, you cannot pass the course. For each lab experiment’s unknown, students report VIA SAKAI, their data of each individual determination (trials), mean/average concentration (or percent composition), standard deviation, and parts per thousand (ppt) associated with the overall determination. *Students are NOT permitted to repeat/redo a lab experiment* so take care to use proper lab technique and ask Instructor/TA questions during lab & office hours, etc. to comprehend the tasks at hand. Accuracy grades for all experiment are directly related to lab technique.

Students MUST report experimental results for their unknowns via SAKAI as soon as possible [no later than a week after the experiment is completed]! For example, Lab #2 is completed on Monday, September 16th by 12:20pm, so students must submit their experiment results in Sakai no later than 8:20am on the following Monday. LATE submissions are NOT accepted [in a rare case that I alter this rule, a 15-point late deduction is applied to the accuracy grade] or you earn a zero (0) for the lab experiment if results are not submitted on time. NO EXCEPTIONS. I encourage students to see me during office hours or by an appointment, to answer any questions that are not resolved during lab time. I am here to help but you must ask for assistance! Only after Sakai submission of results will an accuracy grade be calculated by the Instructor. If the Instructor finds a calculation error [or has to ask a student to double check their work due to invalid results] in the student’s Sakai submission a **15-point deduction** is applied to the “fixed” [re-submitted work]. A student must submit revised work if Instructor finds a mistake/errors in the calculations/results. Therefore, try to ask Instructor and TA questions before submitting results in Sakai. We are very friendly and helpful, but we must know you need the

help in order to assist you. **Unknown numbers/info must be a part of the results submission** or accuracy will not be graded [all Sakai results submissions have directions to tell you exactly what to submit]. A **15-point deduction** is applied to accuracy grades if: 1) unknown # isn't in the Sakai results submission, 2) student emails Instructor/TA or verbally asks (via office hours or other) what their unknown number is. A **20-point deduction** is applied if students do not sign-up for their unknown on the unknown sign-up sheet for an experiment (located in the lab). Lab experiments must be completed sequentially as defined in the laboratory schedule. For Polyprotic Acid, Iron, ATR-IR, and % Tartrazine there is a chance to work with one lab partner. Teamwork in science is very common. Both students are expected to put in equal effort in completing the wet chemistry and data analysis. Both students are required to submit lab data for an accuracy grade. Graded accuracy of laboratory work will determine 57.66 % of the course grade.

Laboratory Notebook:

One bound Composition style notebook is required. Metal spiral notebooks or notebooks with 'tear-able' pages are not allowed. Complete notebooks in PEN. Detailed notebook requirements are listed on pages 13-14 of this syllabus. Notebooks must be organized but not necessarily perfect. They can contain strikeouts. Do not rip pages out of the notebook or points will be deducted in the notebook grade. White-out is not allowed.

Students must come to lab prepared in order to optimize lab efficiency. **At the start of every NEW experiment (which is virtually every week)* each student must have written in their notebook:**

- 1) The date and title of the experiment*
- 2) An introductory paragraph summarizing experiment purpose & overview. This need not be more than one full notebook page. Minimum length is $\frac{1}{2}$ a notebook page; maximum length is 1.5 notebook pages*
- 3) A procedure outlining steps of the experiment. This can be denoted as points or paragraph form & may take several notebook pages to complete, depending on the experiment.*

*Look at the lab schedule. A student will receive a zero (0) for this portion if the information is not completed before a student walks into the lab for that particular experiment/day OR if it doesn't meet the minimum guidelines required. Notebooks are checked/signed by Instructor or TA at the start of each new lab experiment and when the notebook is turned in. The notebook grade determines 7.96 % of the overall course grade.

Laboratory Reports:

Lab reports must be computer generated and follow the format defined on page 10-12 of this syllabus. They are to be completed individually. Plagiarizing other students' reports (current or former), book or internet sources, or lab procedures will not be tolerated. You CANNOT copy the Chem 214 lab manual text word for word; that is plagiarizing. Cite outside sources when applicable; **ALWAYS cite the Chem 214 lab manual.** All experimental data and calculations must be included in the lab report. Graded lab reports are 21.97 % of the overall course grade.

An example citation (based on lab #2 KHP) for the Chem 214 lab manual is as follows:

Chem 214 Quantitative Analysis Laboratory Packet of Lab Experiment Procedures, Fall 2019.
Acid-Base Titrations: Determination of Potassium Hydrogen Phthalate; Binaku, K., Ed.; p 1-4.

Lab report due dates are located in the laboratory schedule. Lab reports **are not** accepted via email. Reports must be printed and handed to the TA in lab, on the due date, within the first 15 minutes of the official lab start

time (8:20am). After 8:35am, a lab report is considered a day late if it is not in the possession of the TA. If a student is not present at the beginning of class on the date a lab report is due, but comes into FH-313 at any point *after* the first 15 minutes of the official lab start time, their lab report is *still* considered late when turned in and there are no exceptions to this statement. Printing issues, etc. are not an excuse, see 'blanket statement about technical difficulties.' If a student is present on time in lab and forgets to turn in the lab report on the due date [or claims it would not print, or asks to leave the lab to print it], it is considered a day late. One cannot show TA or Instructor a lab report on a laptop or other device; that does NOT count as turning in a lab report on time as it is not printed as required. If a student is absent on the day a lab report is due, said student must turn in the lab report at the beginning of the next lab period and will not receive a late penalty. If said absent student forgets their lab report on next lab period, it is considered late. If a student turns in the incorrect lab report i.e. a lab report that is not the required report(s) listed no credit is given so a zero (0) is recorded and the student is offered an opportunity to turn in the correct report, but it is considered late based on the late lab report policy. **Late lab reports will receive a 20% penalty deduction each business day the report is late and result in a grade of zero (0) if not received within one week of the due date.** Business day is defined as Monday through Friday.

To assist students in improving writing skills and address any deficiencies, the first lab report (only) Lab #2 KHP may be resubmitted (revised) after the first version has been graded to receive at most $\frac{1}{2}$ the lost points back. Both the original graded version and revised version must be handed in or no credit is given to the revised report. Do discuss any questions/concerns about lab reports and revisions with the Instructor or TA.

Over the course of the semester, 8 lab experiments will be completed. Each student is required to complete all 8 lab experiments and turn in experimental data for each lab experiment. Writing skills are important to explain results and other important information in the "real world," but the Instructor realizes completing lab reports is labor intensive. Students will only write lab reports for two (2) of the eight (8) lab experiments in this course.

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

- 1) Lab Experiment #2: Determination of % KHP in an Unknown (Acid-Base Titration)
- 2) Lab Experiment #6: Refractive Index Quantification of % H₂O in an Unknown

If a student is absent for a lab experiment listed above, one is given an alternative graded report [since one has no experiment data] called the Journal Article Assignment worth 100 points. This can offset the zero (0) out of 100 on the lab report. The alternative report does not offset the zero (0) accuracy grade for missed lab work.

Laboratory Quizzes (Pre-lab Quizzes):

Before the start of each new experiment a timed [30-minute] pre-lab quiz must be taken in Sakai. There are 8 pre-lab quizzes. Each pre-lab quiz is open for one week preceding the date of the lab experiment [hence the name pre-lab quiz, it is done BEFORE coming to do the experiment]. *Each pre-lab quiz can only be taken once. No late submissions are allowed* [i.e. if you forget to take a pre-lab quiz it is a zero (0)]. Don't open the pre-lab quiz until you are ready to take it. **Take it as an individual (no help from others as that is cheating). You ARE allowed to use the Chem 214 lab manual, PowerPoints, lecture book, calculator, etc.** When 30 minutes are up the pre-lab quiz is auto-submitted and graded. If you don't finish, it is graded as is. Read the experiment procedure a couple of times before taking the pre-lab quiz. Pre-lab quizzes have questions on background information, procedure/equipment, and calculations to determine student preparedness for the lab experiment. **Grades for each of the pre-lab quizzes are released when all students complete it each week.** If you complete

it early, you won't see a grade/feedback until all of your classmates complete it. Absent/ill students do not get extensions on pre-lab quiz deadlines; one week of time is more than sufficient to complete the 30-minute quiz. Due dates are posted in Sakai and the lab schedule. Pre-lab quizzes account for 10.54 % of the course grade.

Accommodations via Student Accessibility Center (SAC) Policy:

If you have a documented disability and wish to discuss academic accommodations, contact the Instructor within the first two weeks of the semester. The Coordinator of the Student Accessibility Center (SAC), formerly referred to as SSWD, is located in the Sullivan Center and must be contacted independently by you.

Necessary accommodations will be made for students with disabilities who procure a SAC letter. However, to receive any accommodations self-disclosure, proper documentation, and registration with the SAC office at Loyola University Chicago is required. Accommodations cannot be made until the Instructor receives proper SAC documentation. Furthermore, accommodations are not retro-active and begin only once appropriate SAC documentation has been received by the Instructor in a timely manner. Recognize that the course day/time in LOCUS is fixed. No extra time on wet chemistry is given to a student with a SAC letter; it is not possible and the SAC office has been made aware of this. Only those accommodations that are specifically listed in the formal SAC letter will be provided. If an accommodation letter suggests the Testing Center be utilized, it does not apply for this course as there are no exams in this course. SAC Policies and Procedures can be found here:

<https://www.luc.edu/sac/>

Academic Integrity:

Both the Instructor and TA encourage students to consult one another in class during lab experiments and outside of class. Students can converse, brainstorm, and work through questions together but copying other students' (current or previously in Chem 214) work and presenting it as one's own is unacceptable. There is a difference between sharing knowledge and cheating. If lab reports, data, pre-lab quizzes, or other materials in this course are plagiarized or have been shared between students (current or past), no credit will be given for the work in question. Cases of suspect academic dishonesty will be handled according to University guidelines. Review LUC Policy: http://www.luc.edu/academics/catalog/undergrad/reg_academicintegrity.shtml

Laboratory Safety Points:

Unsafe actions in the lab are NOT tolerated. Each lab day (11, as Fall/Thanksgiving Break, and first/last day are not counted) is worth 2 safety points. Students either earn the points, or do not. It is all or nothing. A student is told when a safety infraction is witnessed by TA/Instructor and that safety points were deducted. This is documented on the sign-in sheet. Safety points count towards 1.21 % of the overall course grade.

Potential safety point deductions:* Coming late to lab, not signing the sign-in sheet when present, not wearing or needing to borrow borrowing lab goggles or a lab coat, eating/ drinking in lab, chewing gum, taking goggles off in FH-313 when chemicals/glassware are still on any of the 3 lab benches (even if not your chemicals/lab bench), not wearing goggles when using/cleaning glassware, chemicals, or equipment, touching face/cell phone/personal belongings with gloves on, leaving lab with gloves on, not cleaning up spills on bench top/balances/fume hood, standing/kneeling on chairs, improper chemical disposal, not starting clean-up on time, etc. *The list is not exhaustive; if an [unlisted] action is unsafe, a student will lose a safety point. IF LAB BENCHES, BALANCES, SINKS, OTHER EQUIPMENT IN FH-313 IS LEFT DIRTY, ENTIRE CLASS LOSES SAFETY POINTS.

Lab Clean-up:

Each lab period is 8:20am-12:20pm. Students must leave the laboratory at 12:20pm. Students are REQUIRED to begin cleaning no later than 12:10pm each lab period. Students are not allowed to stay past 12:20pm to do wet chemistry under any circumstances NOR can a student gain access to the laboratory room, FH-313, outside of the LOCUS scheduled class day & time. An exception is when TA/Instructor allows students to enter FH-313 early to sign-in and prepare for the day.

Grading Policy:

The established grading policy is displayed below. The University uses the +/- grading scale system and it is implemented in this course. Grades are not weighted; points earned divided by total points is the calculated grade. Grade rounding only applies to the final course grade percentage. Sakai reports course grades to TWO digits past the decimal (XX.XX%); this percentage is rounded to the closest integer. For example, an 89.50% or 89.90% (B+) rounds up to a 90% (A-), BUT an 89.30% or 89.45% (B+) round to the integer 89% (B+), as it is the closest integer. There are no extra credit assignments in Chem 214 because, frankly, there is nothing of the sort in the "real world." If you miss more than 2 lab experiments, you will not pass the course [and I will report to the Dean's Office, the Wellness Center, and your academic advisor. That is too much content to miss out on. Enroll for a section of lab and fully commit to it for the entire semester.

Grading Category	Points	Percent
Analytical Findings (Accuracy)**	1050	57.66%
Lab Reports (200pts/each)	400	21.97%
Pre-Lab Quizzes (24pts/each)	192	10.54%
Lab Notebook	145	7.96%
Safety Points	22	1.21%
Checkout last day & notebook view	12	0.66%
Total	1821	100.00%

Grading Scale* (%): A 100-94, A- 93-90, B+ 89-87, B 86-83, B- 82-80, C+ 79-77, C 76-73, C- 72-70, D+ 69-67, D 66-63, D- 62-60, F \leq 59 *subject to change at Instructor discretion.

Course Repeat Rule:

Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: <http://www.luc.edu/chemistry/forms/> and obtain a signature from the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

Lab Report and Notebook Grading Guide/Rubrics:

Lab Report Rubric	Points
Title Page	20
Introduction/Purpose	35
Procedure	30
Results	50
Conclusion	40
Grammar/Formatting/Spelling	25
TOTAL	200

Notebook Rubric (Pts breakdown based on 8 experiments)	Points
Name and section # on front of notebook cover (not on the inside of cover)	4
Table of Contents (2pts/experiment title & page numbers listed)	16
Title & Date of Experiment (1pt/experiment, each signed by TA/Instrctr)	8
Introduction (2pts/experiment, half a page minimum each, signed by TA/Instrctr)	16
Procedure (3pts/experiment, as points or paragraph form, signed by TA/Instrctr)	24
Results/Raw Data and Calculations (4pts/experiment + 1pt/experiment for unknown # listed explicitly in this section & box drawn around it to clearly see it)	40
Conclusion (4pts/experiment)	32
Organization (sections labeled, writing legible, page numbers)	5
Total	145

Digital Media Lab (Equipment Loan):

Students who do not have a laptop can borrow one from the University via the Digital Media Lab in the Information Commons. Students are responsible for equipment checkout, return, and keeping it safe. Instructor does not guarantee nor is responsible for the equipment. Obtain more information here: <http://www.luc.edu/digitalmedia/equipmentloan/>

Smart Evals:

Feedback on the course is important so that an Instructor can gain insight into how to improve the course, the teaching style, and so the department can learn how best to shape the curriculum for future semesters. Towards the end of the semester, students will receive an email from the Office of Institutional Effectiveness with a reminder to provide feedback on the Chem 111 course the student is enrolled in. This office will send you constant reminders during the open period of feedback until the evaluation has been completed.

The evaluation is completely anonymous. When the results are released, no one will be able to tell which student provided the individual feedback. The feedback is not released until after the semester is over, therefore any feedback given will not impact student grades.

Lab Report Format and General Guidelines: Chem 214

Lab reports for Quantitative Analysis are more detailed than those in General or Organic Chemistry labs. The lab report is an **IMPORTANT** part of a laboratory course. It allows one to articulate the experimental work in report form and reflect on the data.

Basic formatting:

- Size 12, Times New Roman font, 1-inch margins, double-spaced.
- Page numbers are required: bottom center of each page. Print reports double-sided if possible.
- Define each lab report section in **bold (Introduction, etc.)** with respective element names.
- Use of SUBSCRIPTS and SUPERSSCRIPTS is required.
- Lab reports must have good spelling, sentence structure, etc. Do not use run-on sentences, fragments, or personal pronouns (I, we, me, etc.). PROOFREAD!
- All parts of report must be typed (example/skeletal equations and calculations in the Results Section are an exception).
- Keep entire tables on a single page. If you split a table, include column/row headings again.
- Print report double-sided! Ask us if you do not know how to do this. Save paper!!

Lab reports must consist of the following elements:

Title page – lab experiment title and number centered on the page; your name, lab partners name (for partner labs only), course section #, TA's name, unknown #, and date the report is due should all be in the lower right corner of the page

Introduction/Purpose – begin with a statement of the reason for completing the experiment and the goal of the work. Then, expand on the chemistry principles. Any relevant CHEMISTRY i.e. chemical reactions must be in the introduction! This is NOT a rehash of the lab procedure so do NOT just summarize the procedure [no receive credit for that]. Introduce principles, techniques i.e. what is being learned and accomplished because of completing the lab experiment. MINIMUM length is 1 page, double-spaced. Maximum is 3 pages double-spaced.

Procedure – a *narrative* of all the steps necessary to perform the experiment, including any changes that may have been made to the original printed procedure.

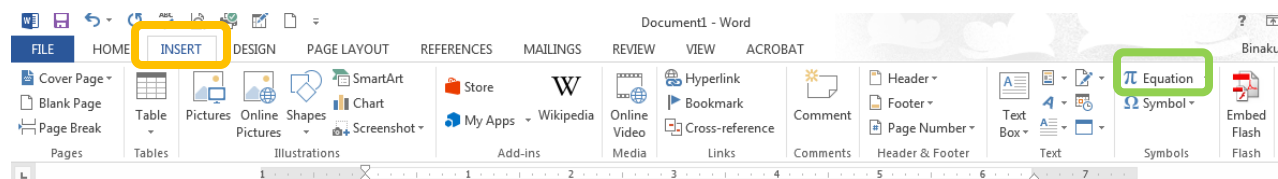
- This must be summarized from the lab manual. Do NOT copy the lab manual word for word. Write procedure in own words! **Do not plagiarize.** Cite lab manual at the end of this section!
- CANNOT use bullet points. NARRATIVE form is required. Use complete sentences.
- ALWAYS note starting & ending color of a reaction mixture (i.e. indicator use for example)
- It must be so clear that anyone not familiar with the lab would know exactly what to do.
- It should not contain the actual masses, volumes, etc. used by the student.
- Be careful writing preparatory instructions for solutions. *For example:* Dissolve approximately 12 grams of potassium hydroxide (KOH) in 300 mL H₂O, dilute to 500.00 mL mark in a volumetric flask, parafilm, and invert to mix.
- It should NOT be in 1st or 2nd person (no "I", "you", "we", "he" or "she")

Results – list data obtained, such as volumes measured, weights, temperatures, in a table format

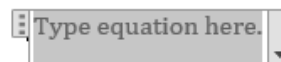
- Be mindful of SIGNIFICANT FIGURES of glassware and in all DATA/calculations reported!
- Define chemical formulas, abbreviations before use: sodium hydroxide (NaOH), milliliters (mL)
- Multiple trials are necessary to verify data has good precision. All data must be shown.
- Data must be represented in table format with appropriate column and row headings and include individually determined trials' values, averages (concentrations, percent, unknowns, etc.), standard deviation, ppt and other. When applicable include units in column headings i.e. "NaOH volume (mL)" or "mL of NaOH." Tables must be labeled with appropriate brief titles.
- Statistical analysis (average, standard deviation, Grubb's Test, parts per thousand, etc.) of data should also be included in the results section whenever these statistics are applicable.
- ALWAYS note starting & ending color of a reaction mixture (i.e. indicator use for example)
- If applicable, include graphs/figures. All must be labeled with a title, proper x and y axes labels (including units). Graphs should be constructed in Excel or a similar program.
- If graphs/figures are included (spectra, chromatograms, or calibration curves) they must be properly labeled i.e. Figure 1, and brief description directly below it.
- Include calculations labeled appropriately with units, chemical identity. Properly identify what is being calculated and the trial # the calculation is being completed for.
- Include general (also known as skeletal) equations corresponding to each calculation i.e. general equation for **dilutions** (see example), average, standard deviation, ppt, to name a few.
Example calculation for volume of HCl for 0.100 M HCl. The calculations may be written in pen neatly so they can be read and understood.
 - Show an outline of equation being used and at least one example with your values
 - ex.: $M_1V_1=M_2V_2$ $12.0\text{ M} \times (v_1)=0.100\text{ M} \times (1000.00\text{ mL})$ $v_1=8.33\text{ mL}$
 - Please utilize leading zeros before the decimal point (0.1 mL and NOT .1 mL).
- **A required paragraph explaining the results must also be present** to show the student interpreted the experimental results/data shown in tables, figures, and/or graphs. Results include any preparation & standardization work AND the unknown analysis.
- **Use Equation Editor in Microsoft Word** - This equation editor is SO helpful to create equations for your lab report. Unless hand-writing all equations, the equation editor is required in reports! Points will be deducted for typed equations that were not created through an equation editor.

Directions for Equation Editor in Microsoft Word:

1. Click 'INSERT' tab.
2. Look for the "Equation" icon.



3. Click the "Equation" icon. You will see a box appear in your document:



4. There are ALL SORTS of options now, from fractions to exponents, parentheses, etc. Use the tools you need to create the proper equations for a lab report.

Example Equation: standard deviation (sd) =
$$\sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Notes to consider: The font (and sometimes size) of the equation may be different than the font you use for the lab report (Times New Roman). That is OK; equation editor likes to use Cambria Math. If font of equation looks too small, increase the size of the equation text.

Conclusion – a restatement of results, and what the results reveal

- The first sentence should state the purpose of the lab experiment. Then, state the unknown #, % composition/molarity of the unknown analyte, standard deviation, and parts per thousand (ppt) of the work. This part can be similar to a synopsis Results paragraph but NOT just a copy.
- Discuss precision (ppt). Also discuss accuracy based on your accuracy grade. State confidence level in the experimental work completed and WHY that confidence level or lack thereof. Confidence level can be numeric [i.e. I am about 90% confident] or qualitative [i.e. I am very confident or I have an above average confidence in my lab work...].
- Include a **detailed** analysis of errors (total of 3 separate errors) in paragraph form based on student's own data/results. LABEL errors in paragraph (i.e. A possible error #1 is.....). **There is an illustrated example of an error analysis in Sakai Resources.**

Analysis of error may be on theoretical errors too, even though a student may not have actually made the error(s). Errors must be TECHNIQUE dependent. An example is improper buret reading and how it affects all measurements and calculations. Dirty glassware, timing issues, or blaming instrumentation or raw chemicals, for example, are NOT valid errors.

Approach an error analysis:

1. Identify the error and where it happens in the lab experiment
 2. What calculation does that error affect?
 3. How does the error affect subsequent steps/calculations in the lab experiment? How does it change the calculated value of an analyte (concentration higher/lower than it would be if mistake didn't occur, etc.)?
- MINIMUM length of the conclusion section is 1 page double-spaced; there is no maximum limit.

DO NOT TRY TO 'COPY' AND PASTE ANY EQUATIONS (CHEMICAL OR MATHEMATICAL) FROM MY ONLINE DOCUMENTS OR OTHERS. THAT IS A FORM OF PLAGIARISM. YOU MUST DO ALL OF YOUR OWN ORIGINAL WORK.

Lab Notebook Guidelines and Grading Rubric

The notebook MUST be bound (spiral notebooks are not accepted). NOTEBOOK MUST BE DONE IN PEN. Leave the first 2 pages of the notebook blank. At the top of these two pages, write TABLE OF CONTENTS. Over the course of the lab, # the pages in the notebook. In the table of contents, write the name of each experiment on a separate line. Next to the experiment name, write the page #s that the experimental work is on. The table of contents does not need to be more detailed than that.

Every day of lab work, the date should be written in the notebook at the beginning of class. This allows a student to keep track of what was completed on a particular date. **Each notebook section must be labeled with roman numerals and section headings displayed below.** On the start day of each new experiment I., II., III are required in the notebook at the beginning of lab (i.e. completed before coming):

I. Title of experiment, date

II. Introduction

A paragraph synopsis/overview of what the point of the experiment is, methods (titration, precipitation, etc.) or instrumentation (if applicable) utilized in the experiment. Include some theory. From this someone reading your notebook will have a basic idea of the details. The FIRST SENTENCE of the introduction must state the purpose/what will be discovered in the experiment. The Introduction can be roughly $\frac{1}{2}$ a page but no more than 1.5 pages long.

III. Procedure

Students find it helpful to write out the lab experiment's procedure in their own words, SO it is a REQUIREMENT to do so in the notebook. Students will have the printed experimental procedure to reference while completing each experiment. You must write out exactly what you are doing in this section of the notebook for each experiment BEFORE coming to lab.

Note: Instructor/TA initial all above sections at the START of lab each week when a NEW experiment is started. It is the student's responsibility to get notebook signed. If sections are not initialed, point deductions are applied according to the rubric. Falsifying initials will result in a zero (0) out of 145 pts.

IV. Results

This section should contain calculations for solutions physically prepared in class and all observations/pertinent data generated during the experiment. This includes but is not limited to color changes (initial solution color and endpoint color in a titration for example), initial/final buret readings for all experimental trials, balance weights for solid samples, balance #, instrument settings, stock solution concentrations, etc. All values should have units and chemical identity accompanying them i.e. 15.05 mL of NaOH. All data should be written in pen. Sometimes drawing a data table in a notebook is helpful to organize data. Strikeouts are acceptable as no notebook is perfect. If alterations in an experimental procedure occur, note it in this section. *The unknown number should be clearly visible in this section when beginning to record data for the unknown!* **If experiments require generating graphs in Microsoft Excel (or other program), print out the graphs & tape/staple them in notebook. If an instrument generates data, a graph, calibration curve graphs, you are also required to include that in your notebook!**

V. Conclusion

Restate the purpose of the experiment, what was accomplished (state unknown #, analyte quantified in the unknown, and accuracy grade %). **Reflect briefly on POTENTIAL errors that occurred in the experiment i.e. student accidentally disposed of a sample, lost product, lack of care in quantitative transfer, mis-reading buret, etc. state that here too.** Reflect on your accuracy grade and discuss where you believe you made mistakes that contributed to the grade. Discuss TWO areas where you potentially erred in the experiment AND how you would improve your technique.

Example: The purpose of this experiment was to quantify the percent sodium carbonate in an unknown sample. It was determined unknown #A-12 contained an average of 39.57 % Na_2CO_3 . Standard deviation was 0.1256 and ppt was 3.17, indicating great precision of lab work. The experimental value of 39.57 % Na_2CO_3 versus the theoretical composition of unknown #12 earned me 187.5 out of 200 points, a 93.8 % accuracy grade. The grade indicated a high degree of accuracy of the lab technique/experimental work. I am confident in my laboratory skills but areas of improvement for myself include endpoint color, buret reading, and following directions. In standardization of the NaOH, I was inconsistent in the light-pink endpoint color [lighter versus darker pinks] meaning 1) I didn't follow Instructor advice nor the lab manual directions and 2) I knew I made the mistake but didn't fix it. This contributed to the inconsistency in NaOH molarity, which directly affected % KHP calculation for the unknown. Little did I know that not correcting the problem ultimately affect my grade. I will be more mindful in the lab, careful in my lab technique, and follow directions in the lab manual & the advice of instructor and TA. Reflecting now on technique, I know I did not read the buret carefully. I was not completely at eye-level; I did not think it mattered that due to my height I was reading at a slight angle below when reading the endpoint volume of NaOH. This mistake contributed to my accuracy score too if the buret reading was not accurate; this inaccurate value was used in the calculation of the NaOH molarity and in the % KHP calculation. If experimental data is not collected in a careful manner, with proficient laboratory technique, the calculations are meaningless. In the real world, care must be taken as analytical results directly affect the outcome of a product, for example.

*Format Check (optional): Request from Instructor or TA after completing lab experiment #1.

ALL portions of the Chem 214 syllabus, course materials (paper/electronic) are NOT allowed for distribution outside of class nor outside of the University. Uploading, posting, copying, or sharing electronic/non-electronic Chem 214 materials outside of class [i.e. share sites] is NOT allowed. If it is discovered a student completes such action, the University will be notified immediately.

Chem 214-001 Quantitative Analysis Lab Schedule* (Fall 2019, MONDAYS 8:20AM-12:20PM)

Assignment Dates	Week #	Date	Lab Experiment	Proposed Tasks**
First Day. Check-in, solution prep, etc.	1	Monday, August 26, 2019	Syllabus, Safety, Equipment/calculation review, locker check-in, solution prep	<i>Syllabus. Safety. Sig fig/Equip review. Check-in locker. Prep NaOH for Lab #2.</i>
LABOR DAY, NO CLASSES	2	Monday, September 2, 2019	Labor Day; NO CLASS TODAY	NO CLASS
Lab 1 Pre-Lab Quiz Due in Sakai by 8:20am	3	Monday, September 9, 2019	1) Stats and the Use the Excel. BRING A LAPTOP [zero on experiment if you don't bring it to lab]	Bring your own laptop or rent one via the IC equipment loan program. <i>Familiarity with common statistics used in lab; use Excel for stats, graphing, formulas, linear regression, etc. Submit results to Sakai by next lab period.</i>
Lab 2 Pre-Lab Quiz Due in Sakai by 8:20am	4	Monday, September 16, 2019	Lab 2) Determination of % KHP in an Unknown	<i>Standardize NaOH soln. Titrate unknowns. Complete all calculations in lab. Additional titrations if appl. Submit results to Sakai by next lab period.</i>
Lab 3 Pre-Lab Quiz Due in Sakai by 8:20am	5	Monday, September 23, 2019	3) Polyprotic Acid Titration: pH Titration Curve to Determine I.D. and Conc. of Unknown Acid (Partner Lab) BRING A LAPTOP	<i>Check NaOH molarity if appl, complete pH titration curve of unknown, then derivative curves, calculations, etc all in lab. Work efficiently w/partner; do not sit around! Finish all lab #3 wet chemistry today at minimum.</i>
Printed Lab #2 (KHP) Lab Report Due in class at 8:20am	6	Monday, September 30, 2019	FINISH LAB 3; Prep for Lab #4	<i>Finish derivative graphs and data analysis for Lab #3. Submit Lab #3 results to Sakai by next lab period. Prepare EDTA solution for Lab #4, etc.</i>
FALL BREAK, NO CLASSES	7	Monday, October 7, 2019	Fall Break; NO CLASS TODAY	NO CLASS
Lab 4 Pre-Lab Quiz Due in Sakai by 8:20am	8	Monday, October 14, 2019	4) Determination of Total Hardness (as Ca) of Unknown via EDTA Titration and Both Speciation (Ca & Mg) and Total Hardness (as Ca) by Ion Chromatography (IC)	<i>Prepare CaCO₃ soln. Standardize EDTA soln. Half of class prepare unknown dilution for IC & analyze during lab (can do some titrations while waiting). Other half of class complete unknown titrations first (no IC).</i>
	9	Monday, October 21, 2019	FINISH LAB 4	<i>Swap. Other half of class prepare unknown dilution for IC & analyze. Rest of class complete unknown titrations. All EDTA lab work must be finished by day's end. Submit Lab #4 results in Sakai by next lab period.</i>
	10	Monday, October 28, 2019	5) Spectrophotometric Determination of Fe in Unknown (Partner Lab) OR 6) Refractive Index Quantification of %H₂O in Unknown (Individual Lab) BRING LAPTOP	<i>Concurrent experiments! Partners assigned Lab #5. Individuals assigned Lab #6. Bring laptop. Must do wet chem start to finish on day assigned. Work on calcs. in lab, results, etc. Submit results to Sakai by next lab period.</i>
BOTH Lab 5 AND Lab 6 Pre-Lab Quizzes Due in Sakai by 8:20am	11	Monday, November 4, 2019	SWAP experiments 5) OR 6) depending on lab assigned	<i>Finish lab assigned today; data analysis or questions resolved DURING lab period. Submit results to Sakai by next lab period.</i>
BOTH Lab 7 AND Lab 8 Pre-Lab Quizzes Due in Sakai by 8:20am	12	Monday, November 11, 2019	7) FT-IR (Partner Lab) OR 8) Determination of %wt. Dye in Marshmallow Candy (Partner Lab) BRING LAPTOP	<i>Concurrent experiments! Partners assigned Lab #7 or Lab #8. Bring laptop. Complete the lab you/partner are assigned. Must be completed start to finish on day assigned. Work on calculations in lab, results, etc. Submit results to Sakai by next lab period.</i>
Printed Lab #6 (Refractive Index) Lab Report Due in class at 8:20am	13	Monday, November 18, 2019	SWAP experiments 7) OR 8) depending on lab assigned	<i>Swap experiments. Same rules apply as last week; complete lab start to finish. Work on calculations, etc. Submit results to Sakai by next lab period.</i>
	14	Monday, November 25, 2019	Finish up all calculations and notebook; NOTEBOOK IS DUE BEFORE LEAVING LABE or earn a zero (0)	<i>Finish any remaining data analysis or questions DURING lab period. Submit results to Sakai in class and TURN IN NOTEBOOK BEFORE LEAVING lab.</i>
Last Day. Check-out etc.	15	Monday, December 2, 2019	Last day / Points for checkout & view of graded notebooks / Misc. / Know lab course grade when done	<i>Clean up all chemicals & check-out of lab locker. Point value for completion of locker check-out today and view graded notebook (zero points if absent). Recap of experiments and applicability.</i>

* This schedule is subject to change at the discretion of the Instructor or TA at any point during the semester

Lab is scheduled once a week on Mondays from 8:20AM-12:20PM. Attendance is EXPECTED every lab period. No make-up day/time is offered. No extra time is allowed.

Lab clean-up begins at 12:10pm to ensure all students are out of the laboratory by the scheduled end time of 12:20PM.

** Please be advised that these proposed tasks should be used as a guide and are under no circumstances the only tasks that can be performed. This is the bare minimum.

*** This schedule is meant to be a guide, to clearly map out the vigor and expectations for this course. It is not all encompassing and students must be responsible enough to keep track/stay on task.

****If you do not finish the lab experiment in the allotted time, your grade suffers. You are graded on what you finished. Points are deducted based on what you didn't finish. Use time wisely & BE PREPARED.