

Chemistry 214-001, Quantitative Analysis Laboratory

Summer 2017 Syllabus

Chem 214-001, Quantitative Analysis Laboratory (1 credit hour), May 22nd through June 29th 2017

Meets on **Mondays***, **Tuesdays**, **Wednesdays**, & **Thursdays 8:30 am – 11:15 am** in Flanner Hall 313 (FH-313)

*we will meet on Friday, June 2, which is a University scheduled make-up day for Memorial Day, May 29, on which there is no class. **Attendance is expected every day, including the make-up day, June 2.**

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

Instructor: Dr. Katrina Binaku

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Office Hours: Mondays 11:30 am-12:30 pm,
Wednesdays 3-4 pm OR by a scheduled appointment.

Teaching Assistant (TA): Elizabeth Jamka

Office: Flanner Hall 407

Phone: (773) 508-3137

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Office Hours: Mondays 12-1 pm OR by a scheduled appointment.

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.

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 prepare, plan, and execute laboratory experiments
- 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

Policy for Staying in Lab Course If Dropping Lecture (212):

Students wanting to drop lecture after midterm may stay in the co-req lab only if midterm grade, posted in LOCUS, is a D or better. Students should continue to attend lecture until the week of the drop date to gain as much background knowledge as possible. Students with a midterm grade of F must drop the co-req lab along with the lecture. No exceptions.

Attendance Policy: 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. You, the student, are enrolled in Chem 214-001, which meets Monday, Tuesday, Wednesday, and Thursday. You must attend all days. Students must have required materials and be properly dressed to perform experiments in the lab. *Make-ups for the Exam are not given [if you have a conflict, you must take it early via an arrangement with the instructor in advance!]* If a student misses an online pre-lab quiz, make-ups are not given. 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/experiments. Either finish the experiment in the constricted amount of time due to *your* decision to be absent, or take a ZERO grade for the experiment's accuracy. Polyprotic Acid, Spectrophotometry (Iron), and Wt. % Tartrazine are partner labs; if you are absent for ANY day of these labs in effect you are abandoning your partner; you earn a ZERO for the lab accuracy for the partner lab missed and you cannot complete the experiment alone. **Experiments that are not finished on time according to the laboratory schedule: students earn a ZERO failing grade on that experiment.** Students are required to initial a sign-in sheet each day of lab, documenting their attendance. If you are present in lab but forget to sign-in, safety points are deducted, as accountability is important. The sign-in sheet serves as a formal record. If an absence occurs, it is the student's responsibility to contact the Instructor ASAP. **It is not my problem if you choose to take a vacation during summer school; your grade will be negatively affected and that is your choice. You, the student, are well aware of LOCUS times for this course well in advance and you committed to all of the times/dates when you registered to take the course.** All absences are treated equal.

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] must be worn at all times in the laboratory.
- A *long-sleeve lab coat* must be worn at all times in the laboratory; it must be buttoned. Any color is ok.
- 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. The Instructor will inform you. If deemed a distraction, Instructor or TA will request it be put away. *Cell phones are not a calculator substitute. Cell phones are NOT allowed for use during pre-lab quizzes, the Exam, nor during lab experiments. They are a safety hazard.*

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/skirts [unless floor length] are not allowed. Bare skin on lower extremities is a safety hazard: Be advised, concentrated acids/bases will be used in most of the lab experiments. *Lab coats & goggles must be worn at all times, even when cleaning glassware!* Lab coats must be fully buttoned to be an effective shield against chemicals. Students will be sent home if proper clothing/footwear is not worn, this counts as an absence. A safety lecture is given the 1st day; this lecture is required to perform lab experiments. Students will sign a lab safety sheet acknowledging their understanding and commitment to adhere to lab safety 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. Do understand safety rules help keep students safe in the laboratory. *Instructor has discretion to prohibit a student from doing lab work if clothing or footwear of a student exhibits a hazard to perform an experiment safely.*

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 acceptable excuses for lack of having a lab report. There are many on-campus options for printing items.

Laboratory Procedures:

Instructor and TA explain the procedures and goals for each lab experiment prior to its execution. Students are given a lab manual the 1st day of lab. Handouts will also be available in Sakai as a PDF. **Students are expected to read procedures before lab** to comprehend and complete them safely in the laboratory. Not reading lab procedures ahead of time is a safety hazard. Students should also look over pre-lab lectures provided in Sakai, for further experiment information. Online pre-lab quizzes assist in reinforcing the notion of accountability. A laboratory 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, in Sakai, and at the end of this syllabus. *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 [not reprinted for sustainability].

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

Most of the lab experiments are completed *individually*, which emphasizes 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. Because of the nature of summer lab times, experiments are completed over a series of days. However, there are deadlines and expectations. Come to lab prepared; nothing can be done if a student doesn’t finish the entire experiment [a grade of zero (0), student doesn’t have data] in the allotted time according to the lab schedule. If a student is absent for an experiment, the only options are to finish the lab in the remaining (constricted) amount of time due to *your* decision to be absent, or take a ZERO grade for the experiment’s accuracy and not do the lab at all.

Absent students get no extensions; nothing can be done if absent students don't finish an experiment other than the student earns a ZERO for lab accuracy on that experiment. **There are NO make-up labs.** However, the lowest accuracy grade (only one) earned out of the eight experiments will be dropped. If an absence occurs that results in a ZERO lab accuracy grade, this is the lowest grade to be dropped. Only ONE accuracy grade is dropped so if you are both absent AND also earn another low accuracy grade on another experiment, only ONE low accuracy grade is dropped. **Attendance is taken seriously; your registration for a class is a committal agreement on your part to attend ALL days/times listed in LOCUS for the course.**

If more than 2 lab experiment absences occur, you automatically do not pass the course. For each lab experiment's unknown, students report VIA SAKAI, 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 a lab experiment* so take care to use proper lab technique and ask Instructor and TA questions during experimentation (and during office hours, etc.) to clearly comprehend the tasks at hand. The accuracy grade for experiments is directly related to student's lab technique.

Students MUST report experimental results for their unknowns via SAKAI in "Assignments" as soon as possible [no later than ~48 HOURS after an experiment has been completed]! For example, Lab #1 is completed on Thursday, May 25th which means students must submit their results to Sakai no later than 11:59 pm on Saturday, May 27th. LATE submissions ARE NOT ACCEPTED. Due dates for data are all in Sakai in the Assignments tab. I encourage students to see me [OR TA] outside of lab whether it is during office hours or via appointment, to answer questions not resolved during lab time. I am here to help but you have to ask!

Only after Sakai submission of results will accuracy grades be calculated by the Instructor. If the Instructor finds a calculation error, has to ask a student to double check their work due to invalid results, OR has to ask that a student re-upload a required data file in the student's Sakai submission a **15-point deduction** is applied to the "fixed" re-submitted work/data for the lab accuracy grade. A student must submit revised data if Instructor finds a mistake or other errors in the Sakai submission. Therefore, ask the Instructor and TA questions before submitting results in Sakai. We are very friendly and helpful, but we must know you need help in order to assist. **Unknown numbers 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 **30-point deduction** is applied if students do not sign-up for their unknown on the unknown sign-up sheet for each experiment (located in the lab). Lab experiments must be completed sequentially as defined in the laboratory schedule. For Polyprotic Acid, Iron, and Weight Percent Tartrazine labs there may be a chance to work with one lab partner. Teamwork and collaboration in science is very common. Graded accuracy of laboratory work will determine 56.15 % 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 12-14 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 (note the lab schedule for this information) 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 ½ a page; maximum length is 1.5 pages.*
- 3) A procedure outlining steps of the experiment. This can be as points or paragraph form; it may take several notebook pages to complete, depending on the experiment.*

*Use the lab schedule to know when to complete this. See notebook requirements on pages 12-14 for details. A student will receive a zero (0) for this portion if information is not completed before a student walks into the lab for that particular experiment/day. Students who do not have it done will have to complete it in lab before starting wet chemistry [no points earned on this because was is late/not done on time]. Notebooks are checked/signed by Instructor or TA at the start of each new lab experiment as well as during the exam. The notebook grade determines 7.75 % of the overall course grade.

Laboratory Reports:

Lab reports must be computer generated and follow the format defined on page 10-11 of this syllabus. They are to be completed individually. Plagiarizing other students' reports (current/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 and ALWAYS cite the Chem 214 lab manual. All experimental data and calculations must be included in the report. Graded lab reports determine 10.70 % of the course grade.

An example citation (lab #1 KHP) for the Chem 214 lab manual is as follows:

Chem 214 Quantitative Analysis Laboratory Packet of Lab Experiment Procedures, Spring 2017.

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 (8:30 am). After 8:45 am, a lab report is considered a day late if it is not in the possession of the TA or Instructor. If a student is not present at the beginning of lab 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. 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 not on the required reports list no credit is given, so a zero (0) is recorded. 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 #1 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 #1: Determination of % KHP in an Unknown (Acid-Base Titration)**
- 2) Lab Experiment #4: Total Hardness (EDTA Titration and Ion Chromatography)**

If a student is absent for one of these lab experiments listed above, the student will be given an alternative assignment to the lab report [since he/she has no experiment data] called the Journal Article Assignment worth 100 points. That will offset the zero (0) out of 100 on the lab report the student earned. This alternative assignment however does not offset the zero (0) out of 150 for the accuracy grade for the missed lab work.

Laboratory Exam:

One in-class written exam will cover concepts pertaining to the laboratory experiments. The cumulative Exam will include **Experiments 1-8**. You will be allowed an ‘equation sheet’ [a 3” x 5” notecard] which we will discuss when the exam is closer in time. The exam covers theory, lab technique, significant figures, dimensional analysis, calculations, and error analysis. The exam is not curved. Exam grade is final unless Instructor made a grading error [which must be brought to the Instructor’s attention *the same day* the graded exam is returned to the student]. Be advised students graded exams are scanned as PDFs. See lab schedule for exam date. Make-up exams are not given under any circumstances, so be present otherwise you earn a zero (0) on the exam. Exam determines 13.37 % of the course grade. Viewing the graded exam the last day of class and checking out of the lab locker is worth 10 points, or 0.53 % of the course grade. The graded exam cannot be viewed on any other day than the last lab day.

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 eight pre-lab quizzes to take this semester. Each pre-lab quiz (except lab #1) is open for 4 days preceding the date of the lab experiment [hence the name pre-lab quiz, it is done BEFORE coming to do the experiment that day]. *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, 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 lab procedure for a particular experiment a couple of times before taking the pre-lab quiz. The pre-lab quiz can 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.** If you complete it early, that is awesome but you won't see your grade/feedback until your classmates complete the work. Absent or ill students do not get extensions on pre-lab quiz deadlines; four days of time is more than sufficient to access Sakai and complete the 30-minute quizzes. Due dates are posted in Sakai and the laboratory schedule. Pre-lab quizzes account for 10.27 % of the overall course grade.

Services for Students with Disabilities (SSWD) Policy:

Necessary accommodations will be made for students with disabilities who procure a SSWD letter. However, extra time in lab to complete experiments is not an option. Discuss your academic needs with the Instructor as soon as possible! However, to receive any accommodations self-disclosure, proper documentation, and registration with the SSWD office at Loyola University Chicago is required. Accommodations cannot be made until the Instructor receives proper documentation. Furthermore, accommodations are not retro-active and begin only once appropriate documentation has been received by the Instructor in a timely manner. Recognize the time the course is scheduled in LOCUS is fixed. No extra time on wet chemistry is given to a student with an SSWD letter; it is simply not possible. Only those accommodations that are specifically listed in the formal SSWD letter will be provided. SSWD Policies and procedures can be found here: <http://www.luc.edu/sswd/>

Academic Honesty:

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 (except first and last day) is worth 1 safety point. Students either earn the point 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 1.23 % of the overall course grade.

Safety point deductions occur if Instructor/TA witness unsafe behavior such as: * Coming late to lab, not signing the sign-in sheet when present in the lab, not wearing or needing to borrow borrowing lab goggles or a lab coat, eating/drinking in the 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 laboratory with gloves on, not cleaning up spills on bench top/analytical balance/fume hood, standing/kneeling on chairs, improper chemical disposal, etc. *The list is not exhaustive; if Instructor/TA determine a student's [unlisted] action is unsafe, a student will lose safety points. IF LABORATORY BENCHES, ANALYTICAL BALANCES, OR OTHER EQUIPMENT IN FH-313 ARE LEFT DIRTY, THE ENTIRE CLASS [all students] LOSES THE DAY'S SAFETY POINTS.

Lab Clean-up:

Each lab period is 8:30 am – 11:15 am on Mondays, Tuesday, Wednesdays, Thursdays. There is one exception where we meet on a Friday (June 2nd) as the Memorial Day make-up day the University provides. Students must leave the laboratory at 11:15 am. Students are REQUIRED to begin cleaning no later than 11:05 am each day of the scheduled lab. Students are not allowed to stay past 11:15 am to do wet chemistry under any circumstances NOR can a student gain access to the laboratory room, FH-313, outside of the scheduled class day/time in LOCUS. An exception is when TA or Instructor allows students to enter FH-313 early at 8:15 am to sign-in and prepare for the tasks for that day.

Grading Policy:

The established grading policy is subject to change at Instructor discretion. The University uses the +/- grading scale system and it is implemented in this course. 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. That is too much content to miss! Make sure you can make a full commitment to lab.

| Grading Category | Pts | Percent |
|----------------------------------|------|---------|
| Analytical Findings (Accuracy)** | 1050 | 56.15% |
| Lab Reports (100pts/each) | 200 | 10.70 |
| Pre-lab Quizzes (24pts/each) | 192 | 10.27 |
| Lab Notebook | 145 | 7.75 |
| Safety Points | 23 | 1.23 |
| Exam | 250 | 13.37 |
| Exam review / locker check-out | 10 | 0.53 |
| Total | 1870 | 100.00% |

** 7 lab experiments @ 150 points accuracy for each; the lowest accuracy grade out of the 8 labs is dropped.

Typical 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 the discretion of Instructor.

Lab Report and Notebook Grading Rubrics:

The following is a guide of lab report/lab notebook grading.

| Lab Report | Points |
|-----------------------------|------------|
| Title Page | 5 |
| Introduction/Purpose | 15 |
| Procedure | 15 |
| Results | 35 |
| Conclusion | 20 |
| Grammar/Formatting/Spelling | 10 |
| TOTAL | 100 |

| Notebook (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 |

IDEA (Individual Development and Educational Assessment):

IDEA is a course/instructor evaluation system. *Essential* and *Important* objectives have been selected by the Instructor which represent the goals/development to be achieved during and because of completing Chem 214. Near the end of the semester, an email is sent by IDEA administrators requesting completion of the IDEA course/instructor rating for Chem 214-001. *Essential* and *important* objectives are discussed with students the first day of lab.

Essential objectives:

3. Learning to apply course material (improve thinking, problem solving, and making decisions)
4. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course

Important objectives:

1. Gaining a basic understanding of the subject (e.g. factual knowledge, methods, principles, generalizations, trends)
13. Learn appropriate methods for collecting, analyzing, and interpreting numerical info.

See the next several pages for lab report and lab notebook guidelines!

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.

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 simply summarize the procedure [will not 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.

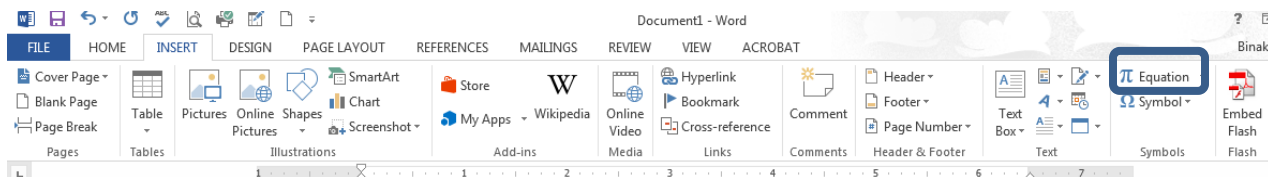
- This must be summarized from the lab manual. Do NOT copy the lab manual word for word. Write procedure in own words! **Do not plagiarize.** Cite lab manual at the end of this section!
- CANNOT use bullet points. NARRATIVE form is required. Use complete sentences.
- ALWAYS note starting & ending color 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

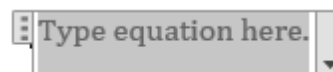
- Be mindful of SIGNIFICANT FIGURES of glassware and in all DATA/calculations reported!
- Define chemical formulas, abbreviations before use: sodium hydroxide (NaOH), milliliters (mL)
- Multiple trials are necessary to verify data has good precision. All data must be shown, including repeat 'redo' lab experiment data if applicable.
- 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 this 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 # for the calculation being completed
- 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 M HCl x (v₁)=0.100 M HCl x (1000.00 mL) v₁=8.33 mL HCl
 - 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.
- **Using 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!

Directions:

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 the 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 are using for the lab report (Times New Roman). That is OK; equation editor likes to use Cambria Math. If font is 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 experiment. Then, state the unknown #, % composition, molarity, etc. of the unknown analyte, standard deviation, and ppt. This part can be similar to the Results paragraph but NOT just a copy.
- Discuss precision (ppt). Discuss accuracy (grade). State confidence level in lab work and WHY.
- Briefly discuss how to improve the experiment if you were to complete it again.
- Include a **detailed** analysis of error (3 separate errors) in paragraph form based on student's own data/results. 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 & blaming instrumentation or raw chemicals for example, is NOT a valid error.
 - How does the error affect subsequent steps in the lab experiment? How does it change the calculated value of an analyte (concentration higher/lower than it would be if the mistake didn't occur, etc.)?
- MINIMUM length of the conclusion section is 1 page double-spaced; there is no maximum limit.

The following has been said:

“A student could do mediocre work and write up an excellent lab report, and the work will be thought of as wonderful. A student could do wonderful work and write it up poorly, and the work will be thought of as mediocre.”

Continue reading syllabus for information on the lab notebook requirements!

Lab Notebook Guidelines

The notebook MUST be bound (spiral notebooks are not accepted). NOTEBOOK MUST BE COMPLETED IN PEN. Leave the first two 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 experiment 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 page numbers and section headings displayed below.

At the start of each new lab experiment the following is required to be in the notebook at the beginning of lab (i.e. completed before coming to lab):

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 and chemical reactions if applicable so someone reading your notebook will have a basic idea of what the experiment entails. The FIRST SENTENCE of the introduction should state the purpose/what will be discovered in the particular experiment. Introduction should be roughly ½ 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. But, you must write out exactly what to do for each experiment BEFORE coming to class to complete it.

Note: Instructor/TA initial all above sections at the START of each new experiment. It is the student's responsibility to get their notebook signed. If sections are not initialed, point deductions are applied. Falsifying initials will result in a zero (0) out of 145 points for the notebook score!

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 of data 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 (yours or those provided to you), 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 %). **YOU MUST REFLECT ON ANY 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 for the experimental work. DISCUSS AT LEAST TWO AREAS where you potentially performed ERRORS 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. In terms of accuracy, 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 accuracy 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 experiment, I was inconsistent in the light-pink endpoint color [lighter versus darker pinks] meaning 1) I didn't follow Instructor or TA's 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 my laziness to correct the problem would ultimately affect my grade. I will be much more mindful in the laboratory, careful in my laboratory technique, and make sure to follow directions in the lab manual and the advice of instructor and TA. Reflecting now on my lab technique, I know I did not read the buret carefully enough. I was not completely at eye-level with the buret; I did not think it mattered too much that due to my height I was reading at a slight angle below when reading the endpoint volume of NaOH. This likely contributed to my accuracy score as well as 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 as well as ALL course materials (paper or electronic) are NOT allowed for distribution elsewhere outside of class nor allowed for distribution outside of the University. Uploading, posting, copying, or sharing any electronic or non-electronic course materials pertaining to Chem 214 outside of class [i.e. uploading to share sites] is NOT allowed. If it is discovered a student completes such action, the University will be notified immediately. It is a serious offense.

On the following page is the entire semester laboratory schedule!

Chem 214-001 Quantitative Analysis Lab Schedule* (Summer 2017)

| Assignment Dates | Week # | Class # | Date | Lab Experiments | Proposed Tasks** |
|--|--------|---------|--------------------------|--|--|
| First Day. Check-in, etc. | 1 | 1 | Monday, May 22, 2017 | Syllabus, Safety, SF/Check-in, Review glassware/equip | <i>Syllabus. Safety. Sig figs. Equipment check-in. Review of Glassware, etc.</i> |
| Lab 1 Pre-Lab Quiz Due in Sakai by 8:30am | | 2 | Tuesday, May 23, 2017 | Lab 1) Determination of % KHP in an Unknown (Individual Lab) | <i>Standardize NaOH solution w/KHP; titrate unknowns if time.</i> |
| | | 3 | Wednesday, May 24, 2017 | | <i>Titrate unknowns, complete calculations in LAB, submit to Sakai.</i> |
| | | 4 | Thursday, May 25, 2017 | | <i>FINISH Lab #1 by today's end. Complete calculations in lab. Submit to Sakai.</i> |
| No Class; Memorial Day | 2 | 5 | Monday, May 29, 2017 | Memorial Day; NO CLASSES | No Class |
| Lab 2 Pre-Lab Quiz Due in Sakai by 8:30am | | 6 | Tuesday, May 30, 2017 | Lab 2) Stats and the Use the Excel (Individual Lab) | Bring a laptop or rent one from the IC. Familiarity with some common statistics used in lab; use Excel for basic statistics, graphing, formulas, linear regression, etc. |
| Lab #1 (KHP) Lab Report Due @ 8:30 am IN LAB; Lab 3 Pre-Lab Quiz Due in Sakai by 8:30am | | 7 | Wednesday, May 31, 2017 | Lab 3) Polyprotic Acids: pH Titration Curve (Partner Lab) | Partner Lab. Bring laptop. Re-standardize NaOH from Lab #1 if applicable. Set-up rough titration and complete it. Analyze data to determine how to improve lab technique for Thursday's work. |
| | | 8 | Thursday, June 01, 2017 | | <i>FINISH Lab #3. pH titration of unknown acid; graph data during lab. Complete calculations in lab. Submit to Sakai.</i> |
| Make-up day for Memorial Day | | 9 | Friday, June 02, 2017 | TBA | Labs 1-3 data must be in Sakai by 11:15AM today! Do this in lab if it's not done already |
| Lab 4 Pre-Lab Quiz Due in Sakai by 8:30am | 3 | 10 | Monday, June 05, 2017 | Lab 4) Determination of Total Hardness (Ca & Mg) via EDTA Titration and Ion Chromatography (Individual Lab) | <i>Prep EDTA & CaCO₃ solutions. Prepare unknown dilution for IC analysis & give to TA or Instructor. Standardize EDTA solution. Analyze unknown via IC</i> |
| | | 11 | Tuesday, June 06, 2017 | | <i>FINISH EDTA standardization; Titrate unknown solution. Analyze unknown via IC</i> |
| | | 12 | Wednesday, June 07, 2017 | | <i>Titrate unknown solution; Complete titration calculations; Analyze unknown via IC</i> |
| Lab #1 (KHP) Lab Report REVISIONS Due 8:30am IN LAB | | 13 | Thursday, June 08, 2017 | | <i>FINISH Lab #4 all titrations, all calculations; IC analysis. Submit to Sakai.</i> |
| Complete the prelab quiz based on your assigned lab | 4 | 14 | Monday, June 12, 2017 | 5) Spectrophotometric Determination of Fe in Unknown (Partner Lab) OR 6) Refractive Index Quantification of %H₂O in Unknown (Individual Lab) | <i>Concurrent Experiments! Bring a laptop. Partners assigned Lab #5; Lab #6 is individual, not partner. Complete assigned experiment.</i> |
| Lab #4 (EDTA) Lab Report Due @ 8:30 am IN LAB | | 15 | Tuesday, June 13, 2017 | | <i>FINISH same lab experiment by today's end if not finished yesterday! Laptop. Calculations and data analysis in lab. Submit to Sakai.</i> |
| ALL/BOTH Lab 5 AND Lab 6 Pre-Lab Quizzes Due in Sakai by 8:30am | | 16 | Wednesday, June 14, 2017 | SWAP experiments 5) OR 6) depending on lab assigned | <i>Swap lab experiments; Now Lab #6 individuals partner up for Lab #5. Lab #5 partners split up to complete Lab #6 alone. Laptop. Complete assigned experiment.</i> |
| | | 17 | Thursday, June 15, 2017 | | <i>FINISH same lab experiment by today's end if not finished yesterday! Laptop. Calculations and data analysis in lab. Submit to Sakai.</i> |
| Complete the prelab quiz based on your assigned lab | 5 | 18 | Monday, June 19, 2017 | 7) ATR-IR (Individual Lab) OR 8) Determination of %wt. Dye in Marshmallow Candy (Partner Lab) | <i>Concurrent Experiments! Bring a laptop. Lab #7 is individual; Partners assigned Lab #8 is same partner from Lab #5; Complete assigned experiment.</i> |
| | | 19 | Tuesday, June 20, 2017 | | <i>Continue to work on experiment assigned. Ideally finish data collection today. Laptop. Work on calculations and data. Submit to Sakai.</i> |
| ALL/BOTH Lab 7 AND Lab 8 Pre-Lab Quizzes Due in Sakai by 8:30am | | 20 | Wednesday, June 21, 2017 | SWAP experiments 7) OR 8) depending on lab assigned | <i>Finish any remaining calculation/data analysis in the FIRST half of lab. Laptop. Submit to Sakai. THEN SWAP lab experiments and begin working on other lab.</i> |
| | | 21 | Thursday, June 22, 2017 | SWAP today if didn't on Wednesday | <i>Continue to work on experiment assigned. Ideally finish data collection today.</i> |
| | 6 | 22 | Monday, June 26, 2017 | | <i>Continue to work on experiment assigned. Finish data collection today AND work on calculations and data. Laptop. Submit to Sakai.</i> |
| | | 23 | Tuesday, June 27, 2017 | <i>Study period for exam if all wet chem is done by today</i> | Wet chemistry finished by today's end! Make sure ALL lab data is in Sakai!!! |
| | | 24 | Wednesday, June 28, 2017 | Exam / Notebook Check | <i>Bring calculator and notebook! 2 hour written exam. No more wet chemistry.</i> |
| Last Day of Lab | | 25 | Thursday, June 29, 2017 | Last Day of Lab | <i>Locker check, see graded Exam. Labs 4-8 assays must be in Sakai by 11:15AM!</i> |

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

Lab is scheduled from 8:30am to 11:15am, MTWTh. Every day attendance is expected. NO extra time will be given [cannot stay past 11:15am] nor extra days. Clean-up begins at 11:05am.

ALL LAB REPORTS ARE TO BE PRINTED OUT AND HANDED IN AT THE BEGINNING OF LAB ON THE DUE DATE ABOVE [within the first 15 minutes after official lab start time] ON THE DUE DATE and are late if not printed.

Emailed lab reports will NOT be accepted under any circumstances!

** Please be advised that the 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.

This laboratory course is designed to emphasize many important principles/concepts from the lecture course *but* the topics in lecture & lab rarely are concurrent on a day to day basis, due to the extra detail lectures requires to satisfactorily cover topics. Some material may be covered/discussed in lab before lecture. Students will be prepared appropriately for the tasks at hand. After all, lab and lecture are two *different* courses.