Chemistry 214-001, Quantitative Analysis Laboratory

Summer 2016 Syllabus

Chem 214-001, Quantitative Analysis Laboratory (1 credit hour), May 23rd through June 30th, 2016
Meets on *Mondays*, Tuesdays, Wednesdays, & Thursdays 8:30 am – 11:15 am* in Flanner Hall 313 (FH-313)
*****we will meet on Friday, June 3rd, which is a University scheduled make-up day for Memorial Day, May 30th, on which there is no class. Attendance is expected every day, including the make-up day, June 3rd.

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

Instructor: Dr. Katrina Binaku
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Office Hours: Mondays 3:30-5pm, Thursdays 1-2pm and by a scheduled appointment.

Teaching Assistant (TA): Elizabeth Jamka
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Office Hours: Wednesdays 11:20am-12:20pm, and by a scheduled appointment.

Course Objectives:

1) To acquaint students with some of the classical and modern techniques in analytical chemistry
2) To teach wet chemical lab skills, efficiency and planning of experiments, and importance of accuracy and precision of laboratory work. Building confidence in an individual's laboratory skill
3) To become familiar with conventional data collection in commercial and academic laboratories
4) To teach critical evaluation and interpretation of experimental results

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 for lab experiments will not be provided to students who are absent from a lab session or who come late to lab. Students must have required materials and be properly dressed to perform experiments in the laboratory. Make-ups for Exam #1 and Exam #2 will not be given. If a student misses an in-class pre-lab quiz, it is at the discretion of the Instructor on whether to allow a make-up pre-lab quiz or not and there are stipulations about this on page 5 of the syllabus. Students are required to initial a sign-in sheet on each day of lab, documenting and verifying their attendance. This sheet serves as a formal record. If an absence does occur, it is the absent student's responsibility to contact the Instructor promptly.

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 are 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 in the laboratory when handling glassware and chemicals. This even includes cleaning glassware.* Lab coats must be fully buttoned to be an effective shield against chemicals. Students will be sent home if proper clothing/footwear are 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 for the 1st day of lab 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 lenses' material may react with chemicals/chemical vapors if an accident occurs and chemicals get into the eye. Do understand all of these safety measures are meant to keep students safe in the laboratory.

Blanket statement about "technical difficulties:" It is *strongly encouraged* that all required online 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, 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 do not count as reliable internet connection tools.

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 NOT allowed] must be worn at all times in the laboratory.
- A *Lab coat* must be worn at all times in the laboratory. It offers a layer of protection against hazards. Any color is ok, but it must be long sleeve & buttoned. Amazon or the Loyola bookstore sell them.
- Chem 214-001 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, submission of experimental results, etc.)

For certain lab experiments, it may be advantageous to bring a laptop. If deemed a distraction, Instructor or TA will request that said computer be put away. Cell phones are a distraction and should not be in use during any portion of the laboratory.

Cell phones are not a calculator substitute. Cell phones are NOT allowed for use during pre-lab quizzes, Exam #1 and Exam #2, and also are not allowed to be used as a calculator during lab experiments.

Laboratory Procedures:

Instructor and TA will explain the procedures and goals for each lab experiment/assignment prior to its execution. Students will be given handouts for each lab experiment/assignment beforehand. Students are expected to read the lab experiment procedures ahead of time in order to comprehend the work and complete it safely in the laboratory. Experiment handouts will also be available on Sakai as a PDF. 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 first day of class. The schedule will be posted in Sakai as well as in FH-313. It is also at the end of this syllabus. Students therefore have a complete picture of everything going on in the laboratory. Therefore, there are no excuses of 'not knowing' due dates or what lab experiments are being performed on a particular day.

Lab Experiment Unknown Samples (referred to as "Unknowns"):

Each student will be assigned an unknown sample whose composition is known to at least **FOUR** significant figures. **Each student quantifies a particular analyte of interest in their unknown sample and is graded on how accurately their experimental determinations reflect the unknown's true [theoretical] composition.** Write the unknown # in the lab notebook AND sign for it on formal sign-up sheets provided by the TA. For each experiment's unknown, students will report, VIA SAKAI, their values of each individual determination (trials), average concentration (or percent composition), standard deviation, and parts per thousand (ppt) associated with the overall determination. *Students are permitted to repeat each lab experiment only once (referred to as a 'redo')*, as time permits, in order to improve technique to potentially earn a better accuracy grade. However, in a 'redo' the student must essentially repeat the ENTIRE procedure AND analyze a new/different unknown sample and it must be undertaken in the period established on the laboratory schedule. S**tudents MUST report experimental results for their unknowns via SAKAI as soon as possible [no later than 12 hours after finishing an experiment]!** This course is ACCELERATED. If you finish an experiment on a Tuesday, you MUST know by Wednesday walking into lab whether you are 'redo-ing.' To know that, you MUST submit results in Sakai BEFORE walking into lab. Only after Sakai submission is an accuracy grade calculated by the Instructor. When the accuracy grade is reported to the student in Sakai, he/she must decide whether to 'redo' the lab experiment or not. *Students must submit their data in Sakai and receive an accuracy grade before a 'redo' can be attempted!* If the Instructor finds a calculation error in the student's Sakai submission, a **5 point deduction** is applied to the "fixed" [re-submitted work]. A student must submit revised work if Instructor finds a mistake in the calculations. It is not the Instructor's job to proofread calculations submitted in Sakai; ask Instructor or TA questions before submitting work in Sakai. Students must realize they *cannot* let themselves get behind if they choose to complete a redo. Final accuracy grades for an experimental unknown will be determined as the better of the two reported accuracy findings if a 'redo' is completed. Lab experiments must be completed sequentially as defined in the laboratory schedule. A student CANNOT move on to the next lab experiment until they have determined whether to complete a 'redo' of the previous experiment. No retro-activity of a 'redo' is allowed nor are 'redos' allowed after the 'redo' deadline defined in the laboratory schedule. Following the timeline of the laboratory schedule is required. Lab experiments are completed by students individually, emphasizing development of an individual's laboratory skills. For a few lab experiments (Iron, RI, Polyprotic Acid) there is an *option* to work with a partner. Graded accuracy of unknown results will determine 65.15 % of the course grade.

Laboratory Notebook:

One bound (NOT metal spiral) Composition style notebook is required. Notebooks must be completed in PEN. Detailed notebook requirements are on pages 11-12. Notebooks must be organized but not perfect. They can contain strikeouts. White-out is not allowed. Students must come to lab prepared to optimize lab efficiency.

At the start of every <u>NEW</u> lab experiment each student must have written in their notebook:

1) The date and title of the experiment <u>and</u> 2) An introductory paragraph summarizing the purpose of the experiment & overview that may include a very brief procedure synopsis.*

*Instructor or TA review and initial the notebook in class (during a pre-lab quiz). See lab schedule to know when you must have 1) & 2) completed. A student cannot start an experiment until the notebook has 1) & 2) completed and signed. Notebooks are checked at the start of each new lab experiment as well as during Exam #1 and Exam #2. The notebook grade determines 6.11 % of the overall course grade.

Laboratory Reports:
Lab reports must be computer generated and follow the format defined on page 9-10 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 and ALWAYS cite the course lab manual. All experimental data must be included. A lab report will always contain data from the first attempt and if applicable, a second attempt (redo) if an experiment is repeated. Graded lab reports determine 12.21 % of the overall course grade. An example citation (lab #1) for the Chem 214 lab manual is as follows:

Chem 214 Quantitative Analysis Laboratory Packet of Lab Experiment Procedures, Spring 2016.
Acid-Base Titrations: Determination of Potassium Hydrogen Phthalate; Binaku, K., Ed.; p 1-4.

Lab report due dates are located on the laboratory schedule. Lab reports **will not** be 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 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 the laboratory 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 report on the due date, it is considered late. One cannot show a TA/Instructor a report on a laptop; that does NOT count as turning in the 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 penalty. If said absent student forgets their lab report on the next lab period, then it is considered late. If a student turns in the incorrect lab report i.e. a lab report that is not one of the three listed below, no credit is given 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 10% penalty deduction each business day the report is late and result in a grade of zero 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) may be resubmitted (revised) after the first version has been graded to receive at most ½ the lost points back. Both the original graded version and revised version must be handed in. Discuss any questions/concerns about lab reports with the Instructor or TA before report due dates or ask grading questions after reports are evaluated. Over the course of the semester, 7 lab experiments will be completed. Each student is required to complete all 7 lab experiments and turn in experimental data to Sakai for each. Writing skills are important to explain results and other information in the "real world." The Instructor realizes completing lab reports is labor intensive. Therefore, students only write lab reports for three (3) of the seven (7) lab experiments in this course.

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

1) Lab 1: Determination of % Potassium Hydrogen Phthalate (KHP) in an Unknown
2) Lab 3: Assay of SO_3 by Gravimetric Determination of Sulfate (Gravimetric Analysis)
3) Lab 5: Polyprotic Acids (Titration of a Polyprotic Acid with a Strong Base Using a pH Meter)

Laboratory Exams:
Two in-class written exams will cover concepts pertaining to the laboratory experiments. Exam #1 will include **Experiments 1-3** and Exam #2 will include **Experiments 4-7**. Exams cover theory, lab technique, significant figures, dimensional analysis, calculations, and error analysis. One or both of the exams may have a social justice question(s) pertaining to science. Neither exam is curved. Each exam is taken once, there is no 'redo'. Grades of exams are final unless the Instructor made a grading error [which must be brought to the Instructor's attention *the day* a graded exam is returned to the student]. See lab schedule for exam dates. Make-up exams are not given under any circumstances, so be present. Exams determine 10.18 % of the overall course grade.

Laboratory Quizzes (Pre-lab Quizzes):
Before the start of each new lab experiment a written, 15 minute pre-lab quiz will be given regarding background, procedure, and calculations to determine student preparedness for the lab experiment. **Quizzes will be given during the first 15 minutes of lab. Thus, be punctual and always get to lab on time! If one arrives late to lab, no extra time will be given to complete the pre-lab quiz.** Quiz answers must be written in pen to receive credit. If absent on the day of a pre-lab quiz, it is the student's responsibility to schedule an appointment with the Instructor to make up the quiz BEFORE the next lab period; otherwise, the student receives a zero (0) on the missed pre-lab quiz. Pre-lab quizzes account for 3.42 % 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. Do 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. Accommodations are not retro-active and begin only once documentation is 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 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 it is determined that lab reports, data, 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 policy/guidelines. Review Loyola University Chicago's guidelines on Academic Integrity: http://www.luc.edu/academics/catalog/undergrad/reg_academicintegrity.shtml

Safety Points:
Unsafe actions in the laboratory will NOT be tolerated. Each day of lab is allotted ~1 safety point. Students either earn the point, or do not. All or nothing. A student will be told when a safety infraction has been witnessed by TA or Instructor and that a safety point was deducted. This tally will be documented on the daily sign-in sheet. Safety points count towards 0.90 % of the overall course grade.

Safety point deductions will occur if Instructor or TA witness unsafe behavior such as:* Coming late to lab, not wearing a lab coat buttoned, 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 or 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 chemical spills on bench top/analytical balance/fume hood, standing/kneeling on chairs, improper disposal of chemicals, etc. *This list is not exhaustive; if it is determined an action is unsafe, but not listed, student will lose a safety point. IF LABORATORY BENCHES, ANALYTICAL BALANCES, OR OTHER EQUIPMENT IN FH-313 IS LEFT DIRTY, THE ENTIRE CLASS [all students] LOSES THE DAY'S SAFETY POINT.

Lab Clean-up: Each lab period is scheduled from 8:30 am – 11:15 am, Monday through Thursday. Students must leave the laboratory at 11:15 am. Students are REQUIRED to begin cleaning up their lab bench, equipment, and chemicals, no later than 11:05 am every day of the schedule laboratory course. 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 allow students to enter FH-313 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."

Grading Category	Pts	Percent
Analytical Findings (Accuracy)**	**1600**	65.15
Laboratory Report (100pts/each)	**300**	12.21
Pre-Lab Quizzes (12pts/each)	**84**	3.42
Lab Notebook	**150**	6.11
Safety Points	**22**	0.90
Social Justice Sakai Forum Posts	**30**	1.22
Social Justice Worksheet	**20**	0.81
Exam #1 (125), Exam #2 (125)	**250**	10.18
Total	**2456**	100.00

Grade Assignment:

Points Range	Letter Grade
2211 - 2456	**A- to A**
1965 - 2210	**B-, B, or B+**
1719 - 1964	**C-, C, or C+**
1474 - 1718	**D-, D, or D+**
≤ 1473	**F**

**6 labs @ 200 points each; 1 lab @ 400 points (EDTA Lab: 200 points titration & 200 points IC)

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 ≤ 59

*subject to change at the discretion of the Instructor.

Lab Report and Notebook Grading Rubrics:
The following is a guide of lab report/lab notebook grading. Point redistribution at the discretion of the Instructor and TA is possible if deemed necessary.

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

Notebook (Pts breakdown based on 7 experiments)	**Points**
Table of Contents	7
Title & Date of experiment (3pts/experiment)	21
Introduction (must be signed, 4pts/experiment)	28
Results/Raw Data and Calculations (8pts/experiment)	56
Conclusion (4pts/experiment)	28
Organization (sections labeled, writing legible)	10
Total	**150**

Social Justice in the Sciences:
One of the emphases of the Jesuit community is social justice. How can social justice be integrated in the field of science? We will ponder this question in-class AND in *Forums* in Sakai, with some prompts for content. An initial inquiry will be had on the first day of class. Three (3) forum posts total in Sakai relating to the topic(s) will be required for each student. The Forum opens on Monday, May 23rd at 11:15 am and remains open 24/7 until 11:55 pm on the last day of class, June 30, 2016. Each student's post is worth 10 points, 30 points total for the Sakai Forum. At the end of the semester [see laboratory schedule] an in-class presentation by the Instructor, followed by an in-class worksheet (20 points) students complete, will be accomplished. This work counts towards 2.04 % of the overall course grade. Here are a couple of resources to engage thinking; use this information to brainstorm potential injustices pertaining to the sciences. Additional information will be in the Sakai Forum. The activity is meant to be an enlightening, interactive experience full of open conversation on the topic. Do speak your mind when posting but do not be disrespectful to classmates if you disagree with opinions.

http://blogs.luc.edu/socialjustice/social-outreach-resources/
http://jesuits.org/whatwedo?PAGE=DTN-20130520124035

If a student does not complete *three* required social justice postings by 11:55 pm on June 30, 2016 a zero is recorded in the gradebook. NO EXCEPTIONS. You had [will have] 6 weeks to complete these postings and there is no excuse not to get them completed with this generous amount of time.

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 and development to be achieved during and as a result of completing the Chem 214 laboratory course. Towards the end of the semester, an email is sent by an IDEA administrator requesting completion of the IDEA course/instructor rating for Chem 214–001. The *essential* and *important* objectives will be 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. Learning appropriate methods for collecting, analyzing, and interpreting numerical information.

See the following pages for Lab Report and Notebook Requirements!

ALL portions of the Chem 214 [Chem 214-001] 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 [Chem 214-001] 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.

Lab Report Format and Guidelines: Chem 214-001

Lab reports for Quantitative Analysis are more detailed than those in General or Organic Chemistry labs. A lab report is a **VERY IMPORTANT** part of a laboratory course, at the undergraduate and graduate level.

Basic formatting: 12pt Times New Roman font, normal 1" margins, double-spaced, and out of the spirit of sustainability do try to print lab reports double-sided. Reports must be stapled! Define each section of a lab report in **bold (Introduction, etc.)** with respective element names described below.

Lab reports must consist of the following elements:

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

Introduction– 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 procedure so do NOT simply summarize the procedure [you will not receive credit for that]. Introduce principles, techniques i.e. what is being learned and accomplished as a result of completing the lab experiment. MINIMUM length is 1 page, double-spaced. Maximum is 2 pages double-spaced.

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

- This must be summarized from the lab manual in complete sentence form. It must be written in one's own words! ***Do not plagiarize.*** The lab manual must be cited at the end of this section!
- CANNOT use bullet points. NARRATIVE form is required.
- 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 preparation instructions for solutions. You will dissolve/dilute chemicals in a volume smaller than what the final volume will be and then dilute to the final volume mark. *For example*: Dissolve approximately 12 grams of potassium hydroxide (KOH) in 300 mL H_2O, 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, <u>in a table format</u>

- Be mindful of SIGNIFICANT FIGURES of glassware!
- 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 describing the contents within.

- 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 # 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.: $\mathbf{M_1V_1=M_2V_2}$ 12.0 M x (v_1)=0.100 M x (1000.00 mL) v_1=8.33 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 standardized molarity work AND the unknown analysis.

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 analyte, standard deviation, and ppt of the work. This part can be similar to the Results paragraph but NOT just a copy. Discuss precision (ppt); discuss accuracy based on Sakai accuracy grade. State confidence level in the experimental work completed.
- 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 mistake didn't occur, etc.)?
- MINIMUM length of the conclusion section is 1 page; there is no maximum limit.

Additional Considerations

- The lab report components must follow the order as listed.
- Page numbers required in the bottom center of each page. Staple lab reports.
- All parts of the lab report must be typed (example calculations are an exception).
- Keep entire tables on a single page. If you must split a table, include column/row headings again on the next page.
- Lab reports must have good spelling, sentence structure, etc. Do not use run-on sentences, fragments, or personal pronouns (I, we, me, etc.). PROOFREAD!
- Use of SUBSCRIPTS and SUPERSCRIPTS is required.

The following has been said:
"A student could do mediocre laboratory work and write up an excellent lab report, and the work will be thought of as wonderful. A student could do wonderful laboratory work and write it up poorly, and the work will be thought of as mediocre."

Lab Notebook Guidelines and Grading Rubric

The notebook MUST be bound (spiral notebooks are not accepted). NOTEBOOK MUST BE COMPLETED 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 simply write the name of each experiment on a separate line. Next to the experiment name, write the page # that the experiment starts on. The table of contents does not need to be more detailed than that.

On every day of lab work, the date should be written in the notebook at the beginning of class. This will allow a student to keep track of what was completed on a particular date, including solutions prepared, experimental work and calculations.

Each of the sections of the notebook should be labeled as such using roman numerals and the section headings as displayed below.

At the start of each new experiment the following is required 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. From this short paragraph, someone reading the 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. This paragraph can be roughly ½ a page but no more than 1 page long.

Note: The instructor or TA will initial above sections. It is the student's responsibility to get their notebook signed as required initials will count towards notebook point value. If this section is not initialed, 1pt deduction per missing signature, per experiment.

III. Procedure (optional)
It is helpful for a student to write out the entire experiment's procedure in their own words in detail, and they can do so in their notebook. It is not a requirement though, as students have the printed experimental procedure to reference while completing each experiment.

IV. Results

First, the unknown number should be clearly written at the beginning of this section. This section, as described earlier in the syllabus, should contain only 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, etc. Values written down should have units and chemical identity accompanying them i.e. 15.05mL of NaOH. All data should be written in pen. Strikeouts are acceptable as no notebook is perfect. If alterations or changes in an experimental procedure occur, this is the section to include that information as well. If experiments required generating graphs in Microsoft Excel (or other program), print out the graphs and tape/staple them in the laboratory notebook.

V. Conclusion

Brief. Restate the purpose of the experiment and what was accomplished (one or two sentences, which must state the unknown # and what was quantified in the unknown). If any major errors occurred in the experiment i.e. student accidently disposed of a sample, lost product, etc state that here as well.

Example: The purpose of this experiment was to quantify the percent sodium carbonate in an unknown sample. In unknown #12, it was determined that the solid unknown sample contained an average of 39.57 % sodium carbonate (Na_2CO_3). Standard deviation was 0.1256 and parts per thousand was 3.17, indicating great precision of lab work. To the experimenter's knowledge no major errors occurred during the completion of the experiment. In terms of accuracy, reported to me in Sakai via the instructor, the experimental value of 39.57 % sodium carbonate versus the theoretical composition of unknown #12 earned me 187.5 out of 200 points, a 93.8 % accuracy grade. This indicated a high degree of accuracy of the experimental work.

*Format Check: Students may request a format check after lab experiment #1 from the TA/Instructor.

Chem 214-001 Quantitative Analysis Lab Schedule* (Summer 2016)

Assignment Dates	Week #	Class #	Date	Lab Experiments	Proposed Tasks**
First Day. Check-in, etc.	1	1	Monday, May 23, 2016	Syllabus, Safety, SF/Equipment Check-in, S.J. **Lab 1)**	*Syllabus. Safety. Sig figs. Equipment check-in. Social Justice. Prep lab #1 solns.*
Lab 1 Prelab Quiz		2	Tuesday, May 24, 2016	**Lab 1) Determination of % KHP in an Unknown**	*Standardize NaOH solution w/KHP; titrate unknowns.*
		3	Wednesday, May 25, 2016		*Titrate unknowns, complete calculations, submit to Sakai. Begin REDOS.*
		4	Thursday, May 26, 2016		*FINISH unknown titrations, Cont. Lab #1 REDOS; Prep glassware for Lab #2.*
No Class	2	5	Monday, May 30, 2016	***Memorial Day; NO CLASSES***	***No Class***
Lab #1 (KHP) Lab Report Due; Lab 2 Prelab Quiz		6	Tuesday, May 31, 2016	**Lab 2) Vitamin C Redox Titration** & *Last day for Lab #1 REDOS*	*Complete lab #2 in one session; Prep & standardize iodine, analyze unknown. MUST submit results in Sakai before Wednesday. Last day for Lab #1 REDOS.*
		7	Wednesday, June 01, 2016		*Lab #2 REDOS OR Prepare empty crucibles for Lab #3.*
Lab 3 Prelab Quiz		8	Thursday, June 02, 2016	**Lab 3) Gravimetric Analysis, Assay %SO3 via BaSO4** & *Last day for Lab #2 REDOS*	*Prep Lab #3 unknowns (digest?). Empty crucible wts. Last day for Lab #2 REDOS.*
ATTENDANCE REQUIRED; Make-up day for Memorial Day		9	Friday, June 03, 2016	*You are REQUIRED TO BE PRESENT on this make-up day*	*Digest samples 1.5 hrs. If tiime, begin to filter digested samples via crucibles. Put crucibles in oven w/product and leave to dry until next lab session.*
	3	10	Monday, June 06, 2016		*Heat/weigh crucibles with product. CLEAN crucibles; Start Lab #3 REDOS.*
		11	Tuesday, June 07, 2016		*CLEAN crucibles if not done already. Cont lab #3 REDOS.*
EXAM #1		12	Wednesday, June 08, 2016	**Exam #1 / Notebook Check #1 / Cont. lab work**	*In-class EXAM #1; Bring Calculator AND Notebook;* ***Assays for Labs 1-3 must be in Sakai by MIDNIGHT TONIGHT!*** *Cont. Lab #3 REDOS; Possible Lab #4 prep.*
Lab 4 Prelab Quiz		13	Thursday, June 09, 2016	**Lab 4) Determination of Total Hardness (Ca & Mg) via EDTA Titration and Ion Chromatography** & *Last day for Lab #3 REDOS*	*Prep EDTA & CaCO3 solutions. Prepare unknown dilution & give to TA or Instructor. Standardize EDTA solution. Last day for Lab #3 REDOS.*
Lab #3 (Sulfate) Lab Report Due	4	14	Monday, June 13, 2016		*FINISH EDTA standardization; Titrate unknown solution.*
		15	Tuesday, June 14, 2016		*Titrate unknown solution; Complete titration calculations; Analyze IC results.*
		16	Wednesday, June 15, 2016		*FINISH unknown titrations/calculations; IC calculations; Start Lab #4 REDOS.*
Lab 5 Prelab Quiz		17	Thursday, June 16, 2016	**Lab 5) Polyprotic Acids: pH Titration Curve**	*Partner Lab. Re-standardize NaOH from Lab #1OR Continue Lab #4 REDOS.*
	5	18	Monday, June 20, 2016	*Last day for Lab #4 REDOS*	*pH titration of unknown acid; graph data during lab. Last day for Lab #4 REDOS.*
		19	Tuesday, June 21, 2016		*Graph Derivatives; Review data analysis; submit results in Sakai. Start Lab #5 REDOS.*
Lab #5 (Polyprotic) Lab Report Due		20	Wednesday, June 22, 2016	**Lab 6) Spectrophotometric Iron Determination; Lab 7) Refractive Index Quantification of % H2O** & *Last day for Lab #5 REDOS*	*Concurrent Experiments! Partners assigned Lab #6 or Lab #7; Complete assigned lab in one lab session. Last day for Lab #5 REDOS.*
Lab 6 Prelab Quiz ALL Students		21	Thursday, June 23, 2016	*Last day for Lab #6 or #7 respective REDOS*	*Concurrent experiments Lab #6 and Lab #7; FINISH respective REDOS.*
Lab 7 Prelab Quiz ALL Students	6	22	Monday, June 27, 2016		*Swap lab experiments; Complete swapped experiment in one lab session.*
		23	Tuesday, June 28, 2016	*Last day for Lab #6 or #7 respective REDOS*	*Concurrent experiments Lab #6 and Lab #7: FINISH respective REDOS.*
		24	Wednesday, June 29, 2016	**Lab 8) Social Justice Discussion & Worksheet**	***Wet chemistry finished by today's end!*** *Glassware/Equipment Checkout.*
EXAM #2 ; Last Day of Lab		25	Thursday, June 30, 2016	**Exam #2 / Notebook Check #2 / Last Day of Lab**	*Bring Calculator and Notebook!* ***Assays for Labs 4-7 must be in Sakai by 11:15AM TODAY! Sakai social justice postings finished by 11:55PM TONIGHT!***

*** 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 11:00am.

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 are rarely concurrent on a day-to-day basis, due to the extra detail in which lecture requires to satisfactorily cover said topics. With that being said, some material will be covered & discussed lab before lecture. Students will be prepared appropriately for the required tasks. After all, lab and lecture are two *different* courses; they are treated as such and students must realize that.