Chemistry 214-002, Quantitative Analysis Laboratory

Spring 2016 Syllabus

Chem 214-002, Quantitative Analysis Laboratory (1 credit hour)
Tuesdays AND Thursdays 2:30 – 5:15 pm, Flanner Hall 313 (FH-313)
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: Tuesdays 11:30 am-12:30 pm, Wednesdays 12-1 pm, OR by scheduled appointment.

Teaching Assistant (TA): Kathryn Renyer
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Office Hours: Wednesdays 10-11 am, 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. Build confidence in an individual's laboratory skill
3) To become familiar with conventional data collection in commercial and academic laboratories
4) To teach interpretation and critical evaluation 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 will not be provided to students who are absent from a lab session or who come late to lab. Students are allowed to attend only the section in which they are enrolled. Students must have required materials and be properly dressed to perform experiments in the lab. 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. 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 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.* Lab coats must be buttoned. Students will be sent home if proper clothing/footwear is not worn, this counts as an absence. A safety lecture will be given the 1st day of class; this lecture is required to perform lab experiments. Students will sign a lab safety sheet acknowledging their understanding and commitment to adherence of lab safety rules/policies. If a student is absent for the 1st day safety lecture, he/she is not allowed to perform wet chemistry until the safety lecture is completed & safety sheet is signed.

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, 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.

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 *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 214-002 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, exams #1 and #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. 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 FH-313. It is also at the end of this syllabus. Any aspect is subject to change.

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 will quantify an analyte of interest in the unknown and be graded on how accurately the student's experimental determinations reflect the unknown's true composition.** Write down the unknown # in the lab notebook AND sign for it on formal sign-up sheets provided by the TA.

For each lab experiment's unknown, students will report VIA SAKAI, their data of each individual determination (trials), mean concentration (or percent composition), standard deviation, and ppt associated with the overall determination. *Students will be permitted to repeat each lab experiment only once (referred to as a 'redo')*, as

time permits, to improve technique and potentially earn a better accuracy grade. In a 'redo' the student must analyze a new/different unknown sample and it must be undertaken in the period established on the laboratory schedule. In order to accomplish this, **students MUST report experimental results for their unknowns via SAKAI as soon as possible [no later than 72 hours post finishing the experiment]!** Only after Sakai submission will an accuracy grade be calculated by the Instructor. The accuracy grade evaluates a student's experimental results in comparison to the known value. When the accuracy grade is reported to the student, he/she then may decide to repeat the lab experiment or not. *Students must submit their data in Sakai and receive an accuracy grade before a 'redo' can be attempted!* A final accuracy grade is 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 deciding whether to complete a 'redo' of the previous experiment. No retro-activity of a 'redo' is allowed. The time line of the laboratory schedule must be followed. Lab experiments are completed by students individually, which emphasizes the development of an individual's set of laboratory skills. For a couple of lab experiments (Iron and Polyprotic Acid) there is an *option* to work with one lab partner. Graded accuracy will determine 65.15% of the course grade.

Laboratory Notebook:

One bound Composition style notebook is required. Metal spiral notebooks are not allowed. Notebooks must be completed in PEN. Detailed notebook requirements are listed on pages 10-11 of this syllabus. Notebooks must be organized but not necessarily perfect and thus can contain strikeouts. White-out is not allowed.

Students must come to lab prepared in order to optimize lab efficiency. **At the start of <u>every NEW experiment</u> 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 an experiment & overview that may include a very brief procedure synopsis.*

*Use the lab schedule as a guide for knowing when to complete this. Instructor and TA review and initial all lab notebooks in class (while a pre-lab quiz is taken). A student will not be allowed to start an experiment until the notebook has these requirements completed. Notebooks are checked at the start of each new lab experiment as well as during Exam #1 and Exam #2. The notebook grade determines 4.07% of the overall course grade.

Laboratory Reports:

Lab reports must be computer generated and follow the format defined on page 8-9 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. Cite outside sources when applicable; cite the 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.

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 (2:30 pm). After 2:45 pm, a lab report is considered a day late if it is not in the possession of the TA. If a student is not present at the beginning of class on the date a lab report is due, but comes into FH-313 at any point after the first 15 minutes of the official lab start time, their lab report is *still* considered late when turned

in and there are no exceptions to this statement. 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. 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 this next lab period, then it is considered late.

Late lab reports will receive a 10% penalty deduction each day the report is late and result in a grade of zero if not received within one week of the due date.

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. Do discuss any questions/concerns about lab reports 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 three (3) of the eight (8) lab experiments in this course.

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

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

1) **Lab Experiment #1: Determination of % KHP in an Unknown (Acid-Base Titration)**
2) **Lab Experiment #3: Determination of Vitamin C in an Unknown (Redox Titration)**
3) **Lab Experiment #4: Determination of % SO3 in an Unknown (Gravimetric Analysis)**

Laboratory Exams:

Two in-class written exams will cover concepts pertaining to the laboratory experiments. Exam #1 will include **Experiments 1-4** and Exam #2 will include **Experiments 5-8**. Exams cover theory, lab technique, calculations, and error analysis. Both exams may also have a social justice question(s) pertaining to science. Neither exam is curved. Each exam is taken once, there is no 'redo'. Exam grades are final unless Instructor made a grading error [which must be brought to the Instructor's attention *the day* the graded exam is returned to the student]. See lab schedule for exam dates. Make-up exams are not given under any circumstances. Exams determine 8.14% of the overall course grade.

Laboratory Quizzes (Pre-lab Quizzes):

Before the start of each <u>new</u> 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 is 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 <u>with the Instructor</u> to make up the pre-lab quiz BEFORE the next lab period; otherwise, the student receives a zero (0) on the missed pre-lab quiz. Pre-lab quizzes account for 3.91% 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. 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/

Journal Article Assignment:
Referencing scientific journal articles is an important aspect of research. Each student is required to select, read, and write a report on a journal article published in *Analytical Chemistry* [ACS journal] OR the *Journal of Analytical Chemistry*. The assignment aids in students recognizing principles of analytical chemistry in the "real world." Detailed information will be handed out and posted in Sakai. The final report, typed in MS Word, and a PDF of the journal article both must be submitted in Sakai under *Assignments*. Printed copies OR emails of a completed report & journal article are not accepted and would result in a zero (0) on the assignment if presented. The due date is in the lab schedule. This assignment determines 4.07% of the course grade.

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 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

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/Instructor and that a safety point was deducted. This will be documented on the daily sign-in sheet. Safety points count towards 1.02% of the overall course grade.

Safety point deductions occur if Instructor/TA witness unsafe behavior such as:* Coming late to lab, not wearing or 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 it is determined an [unlisted] action is unsafe, a 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 2:30 pm – 5:15 pm, on Tuesdays AND Thursdays. Students must leave the laboratory at 5:15 pm. Students are REQUIRED to begin cleaning their lab bench, equipment, and chemicals, no later than 5:05 pm every day of the schedule laboratory course. Students are not allowed to stay past 5:15 pm to do wet chemistry under any circumstances [unless in an extremely rare case Instructor deems this necessary and allows entire class to do so] 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 2:15 pm on Tuesdays AND Thursdays to sign-in and prepare for the tasks for that day.

Grading Policy:

The established grading policy is subject to change at Instructor discretion. Please note the University uses the +/- grading scale system and it will be implemented in this course. Grades are not rounded.

Grading Category	Pts	Percent
Analytical Findings (Accuracy)**	1600	65.15%
Lab Reports (100pts/each)	300	12.21%
Pre-lab Quizzes (12pts/each)	96	3.91%
Lab Notebook	100	4.07%
Journal Article Assignment	100	4.07%
Safety Points	25	1.02%
Social Justice Activity (Sakai, wksheet)	35	1.43%
Exams (#1 & #2, 100pts/each)	200	8.14%
Total	2456	100.00%

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+**
Below 1473	**F**

**8 lab experiments @ 200 points accuracy for each

Typical Grading Scale* (%): A 100-94.0, A- 93.9-90.0, B+ 89.9-87.0, B 86.9-83.0, B- 82.9-80.0, C+ 79.9-77.0, C 76.9-73.0, C- 72.9-70.0, D+ 69.9-68.0, D 67.9-63.0, D- 62.9-60.0, F $\leq$ 59.9

*subject to change at the discretion of Instructor. There is no curve & final grades are not rounded.

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 is possible if deemed necessary.

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**
Table of Contents	8
Title & Date of Experiment (1pt/experiment)	8
Introduction (must be signed, 2pts/experiment)	16
Results/Raw Data and Calculations (5pts/experiment)	40
Conclusion (3pts/experiment)	24
Organization (sections labeled, writing legible)	4
Total	**100**

Social Justice in the Sciences:

One of the emphases of the Jesuit community is social justice. How can social justice be integrated or thought about in terms of the field of science? We will ponder this question in-class during a discussion 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 will be open all semester and close at 2:30 pm on the last day of class, Thursday, April 28, 2016. Each student's post is worth 5 points; 15 points total for the required three (3) posts in Sakai Forums. Towards 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 as 1.43% of the overall course grade. Here are a couple of resources to engage your thinking; use them to brainstorm potential injustices pertaining to the sciences. Additional information will be in the Sakai Forum. This activity is meant to be an enlightening, interactive experience full of open conversation on the topic. Do speak your mind in these posts but do not be disrespectful to your classmates if you disagree with them.

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

IDEA (Individual Development and Educational Assessment):

IDEA is a course/instructor rating system. *Essential* and *Important* objectives have been selected by the Instructor which represent the goals to be achieved during and because of completing the course. Towards the end of the semester, an email will be sent by an IDEA administrator requesting completion of the IDEA course/instructor rating for Chem 214–001. We will discuss objectives the first day of lab.

Essential objectives:

3. Learning to apply course material (improve thinking, problem solving, 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 factual knowledge (terminology, classifications, methods, trends)
11. Learning to *analyze* and *critically evaluate* ideas, arguments, and points of view

See the following pages for Lab Report and Notebook Requirements!

Lab Report Format and General Guidelines: Chem 214-002

Lab reports for Quantitative Analysis are more detailed than those in General or Organic Chemistry labs. This is an upper division lab course, and more thoroughness is expected. The lab report is a **VERY IMPORTANT** part of a laboratory based course, both at the undergraduate and graduate levels. There are example lab reports (not perfect 100%) provided in Sakai.

Basic formatting: 12pt Times New Roman font, 1 inch margins double-spaced, and out of the spirit of sustainability do try to print the lab reports double-sided. Lab reports must be stapled! Define each section of a lab report in **bold (Introduction, etc.)** with the 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 partners name (for partner labs only), unknown #, and date the report is due should be in the lower right corner of the page

Introduction/Purpose – brief statement of the reason for performing the experiment and the goal of the work. Then, expand on the chemistry principles (theory). Introduce what is being learned and what will be accomplished as a result of completing the lab experiment. Should be no more than 2 pages long.

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 can be summarized from the lab procedure but must be rewritten in one's own words***! Do not plagiarize.*** The lab manual must be cited (use ACS format).
- 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 g 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!
- Multiple trials are necessary to verify data as having 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 <u>brief</u> titles describing the contents within.
- Statistical analysis (average, standard deviation, Grubb's Test, ppt, etc.) of your data should also be included in this section whenever these statistics are applicable.

- If applicable, include graphs in this section. Graphs 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, such as spectra or chromatograms, they should be accompanied with a proper label i.e. Figure 1, and brief description directly below it.
- Include calculations in this section labeled appropriately with units, chemical identity. Properly identify what is being calculated and the trial # the calculation is being completed for.
- Include general (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 a general equation being used and at least one example with your data
    - 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 HCl
    - Please utilize leading zeros before the decimal point (0.1 mL and not .1 mL).
- A short paragraph must also be present to show the student did interpret/summarize experimental results and all of the data shown in tables and graphs.

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

- If accuracy of your experimental work is known, comment on your closeness to the theoretical value of the unknown. Use standard deviation and ppt to assess your lab technique too.
- How can student technique be improved?
- Include a **detailed** analysis of error (3 different errors) in paragraph form based on the student's own data/results. An analysis of error can also be theoretical errors, even though the student may not have made said errors in the actual experiment.
    - How does the error affect the subsequent steps in the lab experiment? How does the error change the calculated value of the analyte (concentration higher/lower than it would be if mistake didn't occur, etc.)?

Additional Considerations

- Lab report components must follow the order listed.
- Lab reports must have page numbers in the bottom center of each page. Staple the lab report.
- All parts of a lab report must be typed (example calculations are an exception).
- Keep entire tables on a single page. If you must split up a table, remember to include column and row headings again on the next page where the table continues.
- Lab reports should have good spelling, sentence structure, etc. Do not use run-on sentences, fragments, or personal pronouns (I, we, me, etc.).
- Take the time to re-read a lab report. Make sure that what is written is clear and makes sense.

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."

Lab Notebook Guidelines and Grading Rubric

The notebook MUST be bound (NO plastic/metal spiral notebooks). COMPLETE NOTEBOOK 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 name, write the page # that the experiment starts on. The Table of Contents does not need to be more detailed than that.

On each 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, including solutions prepared, experimental work, and calculations.

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

At the start of each <u>new</u> 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. <u>Introduction</u>
A paragraph synopsis/overview of what the point of the experiment is, methods (titration, precipitation, etc.) or instrumentation (if applicable) utilized in the experiment. Include some theory. From this someone reading your notebook will have a basic idea of what the experiment entails. The FIRST SENTENCE of the introduction should state the purpose/what will be discovered in the particular experiment. The Introduction can be roughly ½ a page but no more than 1 page long.

Note: Instructor and TA initial above sections. It is the student's responsibility to get a notebook signed. If this section is not initialed, a 2-point deduction per missing signature, per experiment, is applied.

III. <u>Procedure (optional)</u>
If students find it helpful to write out the lab experiment's procedure in their own words, they may do so in the notebook. It is not a requirement as students will have the printed experimental procedure to reference while completing each experiment.

IV. <u>Results</u>
First, the unknown number should be clearly written at the beginning of this section. 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. **If experiments require generating graphs in Microsoft Excel (or other program), print out the graphs & tape/staple them in notebook.**

V. Conclusion

Brief. Restate the purpose of the experiment and what was accomplished (one or two sentences that state the unknown number 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 average unknown sample contained 39.57% sodium carbonate. Standard deviation (0.00451) and parts per thousand [ppt] calculations 5.02 suggestion good precision was achieved.

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

ALL portions of the Chem 214 [Chem 214-001, Chem 214-002] 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, or Chem 214-002 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.

Chem 214-002 Quantitative Analysis Schedule* (Spring 2016)

Assignment Dates	Week #	Class #	Date	Proposed Experiment	Proposed Tasks**
First Day. Check-in, etc.	1	1	Tuesday, January 19, 2016	Syllabus, Safety, SF/Equipment, J Article, S.J.	*Syllabus. Safety. Sig fig/Equip review. Check-in. Social Justice.*
Lab 1 Pre-Lab Quiz		2	Thursday, January 21, 2016	**1) Determination of % KHP in an Unknown**	*Prepare NaOH & HCl. Standardize NaOH solution*
	2	3	Tuesday, January 26, 2016		*Titrate unknowns, complete calculations, submit to Sakai*
		4	Thursday, January 28, 2016		*Titrate unknowns, complete calculations, submit to Sakai; lab #1 REDOS*
Lab 2 Pre-Lab Quiz	3	5	Tuesday, February 02, 2016	**2) Determination of % Carbonate in an Unknown**	*Begin lab #2, check lab #1 NaOH molarity; OR lab #1 REDOS*
		6	Thursday, February 04, 2016	*Last day for lab #1 redos*	*Standardize HCl and titrate unknowns OR lab #1 REDOS*
Lab #1 (KHP) Lab Report Due	4	7	Tuesday, February 09, 2016		*Finish unknown titrations; OR Lab #2 REDOS*
Lab 3 Pre-Lab Quiz		8	Thursday, February 11, 2016	**3) Vitamin C Redox Titration**	*Complete in one session. Prepare, standardize iodine soln; titrate unkwn*
	5	9	Tuesday, February 16, 2016	*Last day for lab #2 redos*	*Finish lab #2 REDOS OR Start/finish lab #3 REDOS*
Lab 4 Pre-Lab Quiz		10	Thursday, February 18, 2016	**4) Gravimetric Analysis, Assay %SO3 via BaSO4**	*Prep unknowns (digest?). Empty crucible wts; Last day for lab #3 REDOS*
	6	11	Tuesday, February 23, 2016	*Last day for lab #3 redos*	*1.5 hr digestion. Then filter digested samples via crucibles*
		12	Thursday, February 25, 2016		*Re-digest if appl. Heat/weigh crucibles with product. CLEAN out crucibles*
Lab #3 (Vit C) Lab Report Due	7	13	Tuesday, March 01, 2016		*Begin lab #4 REDOS; Possibly prepare for lab #5; study for Exam #1*
EXAM #1		14	Thursday, March 03, 2016	**Exam #1 / Notebook Check #1**	*Bring Calculator and Notebook!* ***Assays for labs 1-4 must be in SAKAI by MIDNIGHT TONIGHT!***
	8	15	Tuesday, March 08, 2016	***Spring Break; NO CLASSES***	***No Class***
		16	Thursday, March 10, 2016	***Spring Break; NO CLASSES***	***No Class***
Lab 5 Pre-Lab Quiz	9	17	Tuesday, March 15, 2016	**5) Determination of Total Hardness (Ca & Mg) via EDTA Titration & Ion Chromatography**	*Prepare EDTA and CaCO3 solns; standardize EDTA. OR Cont. lab #5 REDOS*
Journal Article Assignment Due		18	Thursday, March 17, 2016	*Last day to finish lab #4 redos*	*Standardize EDTA; titrate unknown; prep unknwn IC dilution*
	10	19	Tuesday, March 22, 2016		*Titrate unknowns; Complete tititration calculations; Analyze IC results*
		20	Thursday, March 24, 2016	***Easter Break starts at 4:15; So NO CLASS***	***No Class***
Lab #4 (Gravimetric) Lab Report Due	11	21	Tuesday, March 29, 2016		*Analyze IC results; continue unknown titrations; Start lab #5 REDOS*
Lab 6 Pre-Lab Quiz		22	Thursday, March 31, 2016	**6) Polyprotic Acids pH Titration Curve**	*Restandardize NaOH from labs #1,2. OR Last day lab #5 REDOS.*
	12	23	Tuesday, April 05, 2016	*Last day for lab #5 redos*	*pH titration curve of unknown acid; graph data during lab! Derivatives*
		24	Thursday, April 07, 2016	*Last day for lab #6 redos*	*Lab #6 REDOS; Assign partners, clean vol. flasks for lab #7*
Lab 7 Pre-Lab Quiz ALL students	13	25	Tuesday, April 12, 2016	**7) Spectrophotometric Determination of Unknown Fe; 8) Refractive Index Quantification of %H2O in Unknown**	*Concurrent experiments! Partners (pairs) assigned lab #7 or lab #8. Once completed (redos too), complete the other experiment. Both one day labs*
Lab 8 Pre-Lab Quiz ALL students		26	Thursday, April 14, 2016		*Concurrent experiments continued; REDOS*
	14	27	Tuesday, April 19, 2016		*Concurrent experiments continued; swap experiments.*
		28	Thursday, April 21, 2016		*Concurrent experiments continued; REDOS*
	15	29	Tuesday, April 26, 2016	**9) Social Justice Disc.** & *Last day to complete wet chemistry*	*All chemistry finished by today's end! Glassware/Equipment Checkout.*
EXAM #2 ; Last Day of Lab		30	Thursday, April 28, 2016	**Exam #2 / Notebook Check #2 / Last Day of Lab**	*Bring Calculator and Notebook!* ***Assays for labs 5-8 must be in SAKAI by NOON TODAY!***

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

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

Emailed lab reports will NOT be accepted under any circumstances.

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

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

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 in which lecture requires to satisfactorily cover said topics. That being said, some material will be covered & discussed lab before lecture. Students will be prepared appropriately for the tasks at hand. After all, lab and lecture are two *different* courses.