

Chemistry 214-001, Quantitative Analysis Laboratory

Fall 2016 Syllabus

Chem 214-001, Quantitative Analysis Laboratory (1 credit hour), August 29th through December 7th 2016
Mondays AND Wednesdays 2:45 – 5:30 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/Wednesdays 9:30-10:30 am,
OR by a scheduled appointment.

Teaching Assistant (TA): Jonny Hopwood

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Office Hours: Fridays 1:00-2:00 pm, OR 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. You, the student, are enrolled in Chem 214-001 on Monday/Wednesday and are NOT allowed to attend the Tuesday/Thursday lab under any circumstances. Students must have required materials and be properly dressed to perform experiments in the lab. Make-ups for Exam #1 and Exam #2 are not given [conflict? You must take it early.] 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 stipulations are listed later on pages 4 and 5 of this syllabus. If a make-up pre-lab quiz is granted, it must be completed outside of class time and before the next lab session. Students are required to initial a sign-in sheet on each day of lab, documenting/verifying their attendance. If you are present in lab but forget to sign-in, a safety point is deducted as accountability is important for safety. The sign-in sheet serves as a formal record. If an absence occurs, it is the student's responsibility to contact the Instructor ASAP.

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. This even applies to cleaning glassware!* Lab coats must be fully buttoned to be an effective shield against chemicals. Students will be sent home if proper clothing or footwear is not worn, this counts as an absence. A safety lecture will be given the 1st day of class; this lecture is required to perform lab experiments. Students will sign a lab safety sheet acknowledging their understanding and commitment to adherence of lab safety rules/policies. If a student is absent the 1st day and misses the safety lecture, he/she is not allowed to perform wet chemistry until the safety lecture is completed & safety sheet is signed. It is advised students do not wear contact lenses in the laboratory, as contact lens material may react with chemicals/chemical vapors if they get into the eye. 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 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. Printing issues on or off-campus are not accepted as excuses for lack of having a lab report. There are many on-campus options for printing items.

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 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 it be put away. Cell phones are distracting and should not be in use during 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, nor allowed to be used as a calculator during lab experiments.

Laboratory Procedures:

Instructor and TA explain the procedures and goals for each lab experiment/assignment prior to its execution. Students are given all handouts beforehand. Handouts will also be available in Sakai as a PDF. Students are expected to read the experiment procedures ahead of time in order to comprehend the work and complete it safely in the laboratory. In-class pre-lab quizzes assist in reinforcing this 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 will be posted in FH-313 and in Sakai. It is also at the end of this syllabus. Therefore, there is no excuse accepted with regard to not knowing what is required of you, the student, every day of lab. Any aspect of the schedule is subject to change. If change occurs, students are notified to write it on their copy as it is not reprinted [for sustainability reasons].

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 the 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.

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 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, to improve technique and 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. In order to accomplish this, **students MUST report experimental results for their unknowns via SAKAI as soon as possible [no later than 24 hours post finishing the entire 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 via a REDO 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. If the Instructor finds a calculation error in the student’s Sakai submission [either first attempt or REDO work], a **5 point deduction** is applied to the “fixed” [re-submitted work]. A student must submit revised data 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. All 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 nor are ‘redos’ allowed after the ‘redo’ deadline in the laboratory schedule. Following the time line of the laboratory schedule is required. 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, Refractive Index, and Polyprotic Acid) there is an *option* to work with one lab partner. Graded accuracy of laboratory work 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 11-12 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 each student must have written in their notebook:**

- 1) The date and title of the experiment and 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 6.11% of the overall course grade.

Laboratory Reports:

Lab reports must be computer generated and follow the format defined on page 9-11 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 Chem 214 lab manual. All experimental data must be included in the lab report. 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 KHP) for the Chem 214 lab manual is as follows:

Chem 214 Quantitative Analysis Laboratory Packet of Lab Experiment Procedures, Fall 2016.
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 (2:45 pm). After 3:00 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. 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 this 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 required listed no credit is given so a zero (0) is recorded and the student is offered an opportunity to turn in the corrected 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 (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) 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 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 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 #4: Polyprotic Acid pH Titration Curve (Titration Curve and Derivatives)**
- 3) Lab Experiment #5: Total Hardness (EDTA Titration and Chromatography)**

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 4-8**. 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’. Exam grades are final unless Instructor made a grading error [which must be brought to the Instructor’s attention *no later than 2 business days after* the 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 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 are 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 with the Instructor 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. 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 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 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 1.06% 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 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 2:45 pm – 5:30 pm, on Mondays AND Wednesdays. Students must leave the laboratory at 5:30 pm. Students are REQUIRED to begin cleaning their lab bench, equipment, and chemicals, no later than 5:20 pm every day of the schedule laboratory course. Students are not allowed to stay past 5:30 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 2:30 pm on Mondays AND Wednesdays to sign-in and prepare for the tasks for that day.

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. For Fall 2016, students wishing to drop lecture, and have a mid-term grade of D or better, can seek assistance from the Department of Chemistry and Biochemistry office beginning Monday 10/31 at 9:00 am through Friday 11/4 at 4:00 pm. Students with a midterm grade of F must drop the co-req lab along with the lecture. No exceptions.

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%
Lab Reports (100pts/each)	300	12.21%
Pre-lab Quizzes (12pts/each)	96	3.91%
Lab Notebook	150	6.11%
Safety Points	26	1.06%
Social Justice Activity (Sakai, wksheet)	34	1.38%
Exams #1 & #2 (125pts/each)	250	10.18%
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, 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. Redistribution of points for each section 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
Name and section # on front of notebook	4
Table of Contents (2pt per experiment listed)	16
Title & Date of Experiment (2pt/experiment)	16
Introduction (must be signed, 3pts/experiment)	24
Results/Raw Data and Calculations (6pts/experiment)	48
Conclusion (4pts/experiment)	32
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 or thought about in terms of the field of science? We will ponder this question in-class during a discussion AND in Sakai *Forums*, with some prompts for content. An initial inquiry will be had on the first day of class. Three (3) forum posts in Sakai relating to the topic(s) will be required for each student. The Forum will be open all semester and close at 5:30 pm on the last day of class, Wednesday, December 7th 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 (19 points) students complete, will be accomplished. This work counts as 1.38% 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 of open conversation on topic. Speak your mind in posts but do not disrespect classmates if in disagreement.

<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 evaluation system. *Essential* and *Important* objectives have been selected by the Instructor which represent the goals/development to be achieved during and as a result 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. Learning appropriate methods for collecting, analyzing, and interpreting numerical information.

See the following pages for Lab Report and Notebook Requirements!

Lab Report Format and General Guidelines: Chem 214-001

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

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), 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 as a result of completing the lab experiment. MINIMUM length is 1 page, double-spaced. Maximum is 2 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 in complete sentence form. Do NOT copy the lab manual word for word. Procedure 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 preparatory 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 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!
- 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.: $M_1V_1=M_2V_2$ $12.0\text{ M} \times (v_1)=0.100\text{ M} \times (1000.00\text{ mL})$ $v_1=8.33\text{ mL}$
 - Please utilize leading zeros before the decimal point (0.1 mL and NOT .1 mL).
- **A required paragraph explaining the results must also be present** to show the student interpreted the experimental results/data shown in tables, figures, and/or graphs. Results include any preparation & standardization work AND the unknown analysis.

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

- The first sentence should state the purpose of the lab experiment. Then, state the unknown #, % composition/molarity of the unknown analyte, standard deviation, and 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 double-spaced; there is no maximum limit.

Additional Considerations

- The lab report components must follow the order as listed.
- Page numbers are 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 SUPERSSCRIPTS is required.

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 (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 actually 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. 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 3-point deduction per missing signature, per experiment, is applied.

III. Procedure (optional)

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. Results

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

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Chem 214-001, Quantitative Analysis Lab, Fall 2016 Tentative Semester Schedule

Chem 214-001 Quantitative Analysis Schedule* (Fall 2016)					
Assignment Dates	Week #	Class #	Date	Proposed Experiment	Proposed Tasks**
First Day. Check-in, Etc.	1	1	Monday, August 29, 2016	Syllabus, Safety, SF/Equipment, S.J., locker check-in	Syllabus. Safety. Sig fig/Equip review. Check-in. Social Justice. Lab 1 prep.
Lab 1 Prelab Quiz		2	Wednesday, August 31, 2016	1) Determination of % KHP in an Unknown	Prepare AND standardize NaOH solution
	2	3	Monday, September 05, 2016	LABOR DAY; NO CLASS	NO CLASS
		4	Wednesday, September 07, 2016		Titrate unknowns, complete calculations, submit to Sakai
Lab 2 Prelab Quiz	3	5	Monday, September 12, 2016		Finish unknowns, complete calculations, submit to Sakai; lab #1 REDOS
		6	Wednesday, September 14, 2016	2) Determination of % Sodium Carbonate in an Unknown	Begin lab #2, check lab #1 NaOH molarity; OR continue lab #1 REDOS
Lab #1 (KHP) Lab Report Due	4	7	Monday, September 19, 2016	Last day for lab #1 redos	Standardize HCl and titrate unknowns OR finish lab #1 REDOS
Lab 3 Prelab Quiz	5	8	Wednesday, September 21, 2016		Finish unknown titrations; submit to Sakai; OR start lab #2 REDOS; prep lab #3
		9	Monday, September 26, 2016	3) Gravimetric Analysis, Assay % SO ₃ via BaSO ₄	Prep unknown samples (digest?). Obtain empty crucible wts; OR lab #2 REDOS
		10	Wednesday, September 28, 2016	Last day for lab #2 redos	Must do 1.5 hr digestion. If time, filter digested samples via crucibles
		11	Monday, October 03, 2016		Re-digest if appl. & filter. Heat/weigh crucibles with product. CLEAN crucibles
		12	Wednesday, October 05, 2016		Heat/weigh crucibles with product; CLEAN out crucibles; OR start lab #3 REDOS
	7	13	Monday, October 10, 2016	FALL BREAK; NO CLASS	NO CLASS
EXAM #1		14	Wednesday, October 12, 2016	Exam #1 / Notebook Check #1 / Continue lab work	Bring Calculator and Notebook! RESULTS for labs 1-3 must be in SAKAI BY MIDNIGHT TONIGHT! After exam continue lab #3 REDOS; prep for lab #4
Lab 4 Prelab Quiz	8	15	Monday, October 17, 2016	4) Polyprotic Acids pH Titration Curve	Pick partner. Restandardize NaOH from labs #1,2 or prep new; cont lab #3 REDOS
		16	Wednesday, October 19, 2016	Last day for lab #3 redos	pH titration curve of unknown acid; graph data during lab! Derivatives
		17	Monday, October 24, 2016	Last day for lab #4 redos	Start and Finish lab #4 REDOS; prepare for lab #5
Lab 5 Prelab Quiz ; Lab #4 (Polyprotic Acid) Lab Report Due		18	Wednesday, October 26, 2016	5) Determination of Total Hardness (Ca & Mg) via EDTA Titration and Ion Chromatography	Prepare EDTA and CaCO ₃ solutions; standardize EDTA.
		19	Monday, October 31, 2016		Finish EDTA standardization; titrate unknown; prep unknown IC dilution
		20	Wednesday, November 02, 2016		Titrate unknowns; Complete titration calculations; Analyze IC results
		21	Monday, November 07, 2016		Analyze IC results; finish unknown titrations; OR start lab #5 REDOS
Lab 6 Prelab Quiz		22	Wednesday, November 09, 2016	6) Vitamin C Redox Titration	Complete in 1 session. Prep, standardize iodine soln; titrate unknown OR lab #5 REDOS
Lab #5 (EDTA) Lab Report Due	12	23	Monday, November 14, 2016	Last day for lab #5 and #6 redos	Finish lab #5 REDOS OR Start/finish lab #6 REDOS
Lab 7 Prelab Quiz ALL students		24	Wednesday, November 16, 2016	7) Spectrophotometric Determination of Iron OR 8) Water Determination via Refractive Index	Concurrent experiments! Partners (pairs) assigned lab #7 or lab #8. Once completed (redos too), complete the other experiment. Both are one day labs
Lab 8 Prelab Quiz ALL students	13	25	Monday, November 21, 2016	Last day for lab #7 or 8 (respective) redo	Concurrent experiments continued; start/finish REDOS
		26	Wednesday, November 23, 2016	THANKSGIVING BREAK; NO CLASS	NO CLASS
		27	Monday, November 28, 2016		Concurrent experiments continued; swap experiments.
		28	Wednesday, November 30, 2016	Last day for lab #7 or 8 (respective) redo	Concurrent experiments continued; start/finish REDOS
		29	Monday, December 05, 2016	9) Social Justice in Chemistry Disc. / Equipment Checkout	S.J. points earned relies on attendance; finish all remaining lab work TODAY!
EXAM #2 ; Last Day.		30	Wednesday, December 07, 2016	Exam #2 / Notebook Check #2 / Last day of quant lab!	Bring Calculator and Notebook! Clean glassware; Equipment Checkout. RESULTS for labs 4-8 must be in SAKAI BY NOON TODAY! Finish S.J. forum by 5:30pm today.

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

Lab is scheduled from 2:45pm to 5:30pm, M/W. Everyday attendance is expected. NO extra time will be given [cannot stay past 5:30pm] nor extra days. Clean-up begins at 5:20pm.

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 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.