University of Wisconsin-Stevens Point

Welcome to

Quantitative Analysis!

CHEM 248, Spring 2017

Lecture:
Tuesday & Thursday, 12:00 – 12:50 PM (SCI A-121)

Laboratory:
Section 1: Monday & Wednesday, 8:00 – 10:50 AM (SCI D-114)
Section 2: Monday & Wednesday, 2:00 – 4:50 PM (SCI D-114) (Dr. Riha)
Section 3: Tuesday & Thursday, 2:00 – 4:50 PM (SCI D-114)

Dr. Dave Snyder
dave.snyder@uwsp.edu

Office Location: Science Building, D-143

715-346-2155

Please come and see me or contact me with your questions or concerns!

Table of Contents

Drop-in Office Hours	By Appointment Office Hours
Monday & Wednesday, 11:00 AM – 12:00 PM Tuesday & Thursday, 10:00 – 11:00 AM	Monday & Wednesday, 12:00 – 3:00 PM Fridays, 9:00 AM – 12:00 PM

My name is Dr. Dave Snyder, and I'm excited about working with you this spring. Quantitative Analysis was one of my favorite classes when I was a student and is one of my favorite courses to teach here at UWSP. During this semester, you will gain key laboratory skills along with the confidence to apply these skills to fundamental problems in analytical chemistry. Whether you plan on working in a laboratory or will be utilizing data derived from an analytical laboratory, a fundamental understanding of the practical and theoretical basis of chemical analysis will be critically important to you. This course will be challenging, but please be assured that I will be there to support you and guide you along the way. I think (and hope) you will be amazed at the transformation you will undergo during this term!

What is this course all about?

Pre-requisite: Successful completion of CHEM 106 or CHEM 117 (C+ or better highly recommended)

This course will provide you with the opportunity to learn the fundamental theories and methods of quantitative chemical analysis. The methods that you will learn in this course are currently employed by scientists and laboratory technicians around the world to analyze a wide variety of samples including environmental samples, food and pharmaceutical samples, and tissue samples critical in diagnosing diseases in humans, plants, and animals. Among the topics we will discuss are the effects of chemical equilibrium on quantitative separations, titration curves, polyprotic acid-base systems, and oxidation-reduction processes. You will also be given the opportunity to work with the UWSP Chemistry Department's state-of-the-art analytical instrumentation, including our gas chromatograph/mass spectrometer (GC/MS), high-performance liquid chromatograph (HPLC), and open-flame atomic absorption spectrometer (FAAS), along with more traditional analytical equipment and instruments.

Learning Outcomes 

Here's what you will be able to do after successfully completing this course:

1. Properly document and report the results of chemical analyses and report the relative error associated with these results
2. Predict the results of an analysis given information on the analytical technique employed and the nature of the sample
3. Identify errors associated with chemical analyses and describe and demonstrate methods of minimizing or eliminating these errors
4. Demonstrate the ability to accurately determine the amount of an analyte in a given sample using a variety of analytical techniques

Inclusive Excellence

I recognize that students in my classroom may have diverse racial, ethnic, cultural, and religious backgrounds, sexual orientations and gender identities. I further recognized that students in my classroom may face unique challenges due to health conditions, family obligations, current or past military service, and other situations that may result in significant obstacles to learning.

I am committed to providing a civil, respectful, and equitable classroom where all my students have the opportunity to succeed and feel safe and valued. I believe diversity should be celebrated and embraced because it helps to create an optimal environment for shared inquiry and the development of sophisticated graduates who recognize the value of diversity and human dignity.

I welcome your suggestions and ideas on how we can create and maintain an inclusive and equitable learning environment during the semester.

Course Format

Lecture

Lecture periods will be an interactive mix of discussion, problem solving, and presentation of concepts and examples. I expect you to be an *active* participant in class discussions and activities. I employ many different learning strategies that are research-based and have been shown to improve student learning, but no strategy works unless you are a willing and engaged participant! You are responsible for all material presented during lecture periods, and should take careful notes. As is customary in university courses, not all material will be covered in class, so be sure to complete all assigned reading activities and homework assignments. If anything is unclear to you, please come and see me! My role in this course is to facilitate your learning experience, and my favorite part of being a professor is meeting with you, whether it is in the classroom, lab, my office, or walking down the hallway or sidewalk. Don't ever think that you are bothering me when you come to see me – you are the reason why I am here!

Laboratory

The laboratory component of this course is critical to your success in this course. During labs, you will analyze unknown samples and quantify the amount of specific substances, called analytes, using a variety of analytical techniques. You will work individually and at your own pace with the expectation that all experiments must be completed prior to the last day of lab. Your lab grade will depend on how closely your results match the actual amount of analyte in your unknown (known as the *true value*). *Success in lab depends on being organized and thoroughly prepared for each lab period*. Here are some suggestions that will help you to succeed:

1. **Know which experiment you will be working on at least two (2) lab periods in advance**. This will help you to gather, prepare, and organize necessary reagents and unknowns.

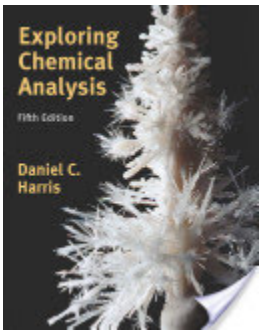
2. **Read the experimental procedure thoroughly before coming to lab** and be sure to speak with the instructor regarding any questions you have about the procedure.

3. **Prepare your laboratory notebook before coming to lab**. Write the purpose and procedure, and create data tables before coming to lab. Leave plenty of space for additional data and calculations.

4. **Use lab time for experimental work only**. Do calculations and write-ups outside of lab so that you can stay on, or ahead of, the lab schedule. *Lab time is best used for experimental work*.

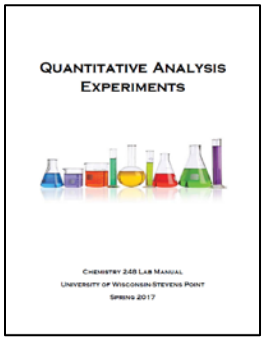
Learning Resources and Required Materials

Textbook



Exploring Chemical Analysis, 5th Edition, by Daniel C. Harris
Available through text rental at the University Store

Lab Manual



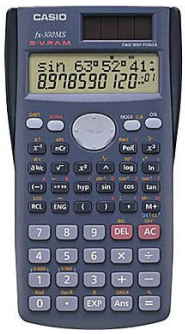
Quantitative Analysis Experiments, Fall 2015, by UWSP Dept. of Chemistry
Available for purchase at the University Store. This spring's version has a white cover!

Lab Notebook

You will need (2) permanently-bound notebooks, preferably quadrille ruled. The notebook shown at the left ("the original marble cover 80 sheets") is *available for purchase at the University Store* and is preferred.

Spiral notebooks, notebooks with detachable pages, and previously-used permanently-bound notebooks are not acceptable

Scientific Calculator

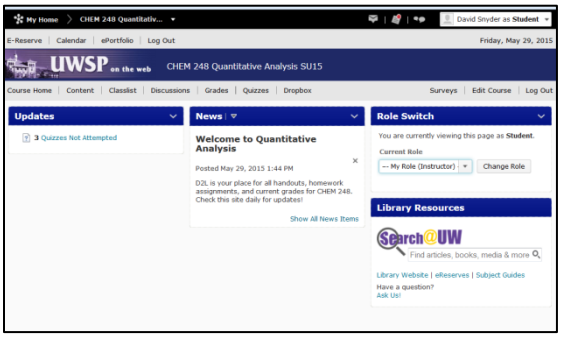


You will need a scientific calculator with log functions. It does not have to be a fancy, expensive one. My trusty Casio fx-300 ES solar (shown at left) costs $11.49 at Staples®, got me through college and graduate school, and never needs new batteries!

Time

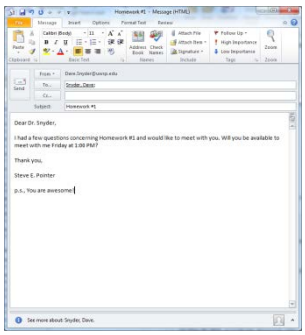
Your education is a significant investment that you should get the most out of. In order to get the most out of this class and earn a solid grade, you need to be willing (and able) to invest a significant amount of time and energy. How much time? Between readings, homework, and lab preparation/reporting, you will need to set *at least* aside 2 - 3 hours each day. If you have question about how to organize and use your time out of class wisely, please come a talk to me!

D2L Course Site



All course documents, including assignments, rubrics, the syllabus, and other supporting material, can be found on the course D2L site (login at https://uwsp.courses.wisconsin.edu). Your exam, quiz, assignment, and lab grades, along with your overall course grade, can be found on this site as well. I will post content and update grades almost every day, so be sure to check D2L often.

E-Mail



Please feel free to e-mail me at dave.snyder@uwsp.edu if you have any questions or concerns during the semester. While I may not be able to reply to your messages instantly, I will do my best to reply as quickly as possible. E-mail messages should be professionally formatted, should include an appropriate salutation (e.g., “Dear Dr. Snyder”), an appropriate closing (“Sincerely, Steve E. Pointer”), and should be written in Standard English. Sending me e-mails is a good opportunity to develop or improve your professional communication skills. Remember, the university is a professional environment, and university e-mails are public records that can be requested by the public (including potential/current employers) for years to come!

Support and Help is Available!

Instructor and Tutoring Support

- **Instructor Office Hours**: During office hours, I am available to assist you in all aspects of this course. You do not need to make an appointment to stop by during "drop-in" office hours but should contact me in advance for appointments at other times (see page 2 of this syllabus for the weekly schedule for "drop-in" office hours and "by appointment" office hours). I expect that you will need help with this course and am always happy to work with you.
- **Group Tutoring**: Mr. Paul Nowak will be leading group tutoring this semester. Days and times for these sessions will be announced in class and via e-mail by the third week of the semester.
- **Individual Tutoring**: Drop-in tutoring is available through the UWSP Tutoring/Learning Center (TLC). Schedules and locations for tutoring can be found on the TLC website: http://www.uwsp.edu/tlc

Disability Services

The University of Wisconsin Stevens Point is committed to providing students with disabilities the academic accommodations and auxiliary aids necessary to ensure access to all university services, programs and activities. In addition to the university's campus wide efforts to promote access and inclusion, students with disabilities are further accommodated based on specific individual needs. The Disability and Assistive Technology Center (DATC) is responsible for determining these accommodations. They provide services and assistance to enrolled students who are either permanently or temporarily disabled.

- The registration process can take up to 3 weeks to complete, so if you believe you will require accommodations, begin the process as soon as possible. To start the process, contact The Disability and Assistive Technology Center (DATC) at 715-346-3365 or emailing datctr@uwsp.edu
- UWSP has many services for students offered by various offices. Although decisions regarding disability specific accommodations are made on a case by case basis.
- Visit the Disability and Assistive Technology Center (DATC) website at: http://www.uwsp.edu/disability/Pages/default.aspx for information on services offered to students with specific disabilities

Course Policies

Participation and Attendance Policy

You are expected to actively participant in all classroom and laboratory activities. In order to get the most out of these activities, you must come to class prepared having completed all reading assignments, homework sets, and pre-laboratory work. Course activities have been carefully designed to help you to achieve the learning goals for this course, so missing class or failing to engage in classroom activities will negatively impact your ability to learn course content and achieve a passing grade.

Academic Integrity Policy

The Board of Regents, administrators, faculty, academic staff, and students of the University of Wisconsin system believe that academic honesty and integrity are fundamental to the mission of higher education and of the University of Wisconsin system. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. Students who violate these standards will be confronted and must accept the consequences of their actions. **Please be aware that the penalties for academic misconduct can include suspension or expulsion from the university.** More information on UWSP academic standards and disciplinary procedures pertaining to academic misconduct can be found at: http://www.uwsp.edu/admin/stuaffairs/rights/rightsChap14.pdf

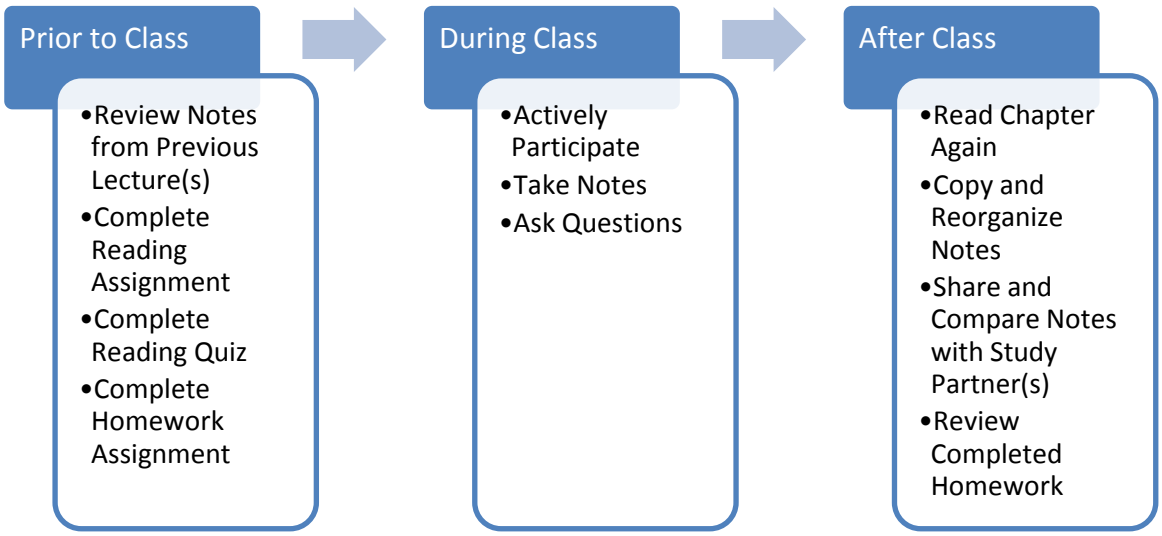
Late Homework /Missed Quiz and Exam Policy

Meeting deadlines, completing work in a timely manner, and working efficiently are important life and career skills. Additionally, staying on-track with your work reduces stress. For this course, you are expected to complete all assignments, quizzes, and exams on schedule. If you have a personal situation that prevents you from completing your work on time, you will need to discuss this with me *before* the due date. Extensions are granted at my discretion and typically only for extraordinary circumstances.

Electronics use Policy

A detailed electronics use policy will be handed out during the first class meeting and is available on D2L. The purpose of this policy is to provide a distraction-free learning environment for all students in this class. Please respect the needs of your fellow students by following this policy.

Your Learning Experience: Lecture



Homework Assignments

Homework assignments are designed to give you the opportunity to practice and demonstrate your mastery of skills taught in class and lab. In order for homework to be an effective learning tool, you must write complete solutions to all of your problems, including detailed explanations for your solutions where appropriate. Homework assignments will include textbook readings and questions based on these readings. When you received your graded homework from me, it is vitally important that you review and correct any problems you missed.

In order to receive credit for homework assignments, you must:

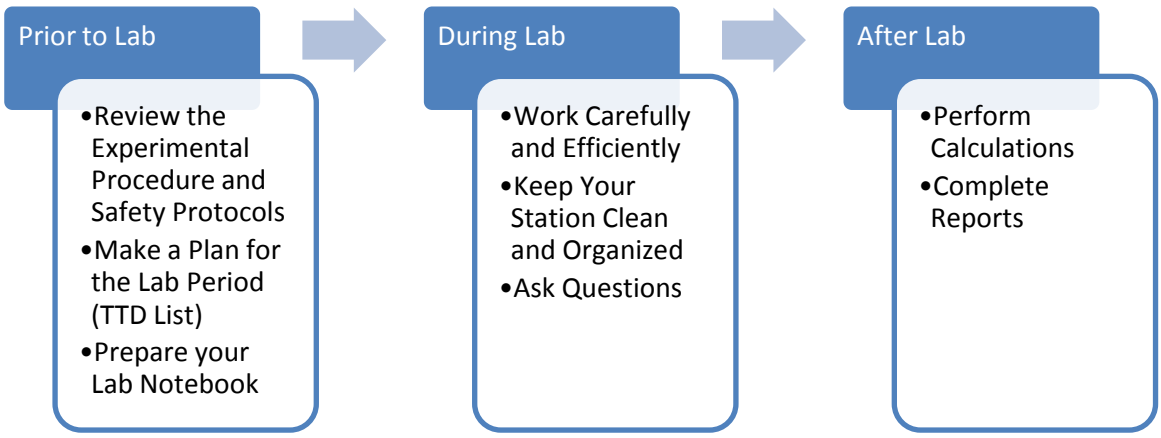
1. Submit your answers electronically to D2L. There will be a specific format required of your answers, so be sure to pay close attention to this as you will not receive credit for answers submitted incorrectly. Answers are worth a maximum of 7 points.
2. Hand in your complete solutions in class. Complete solutions are worth a maximum of 3 points.

Failure to submit answers or solutions will result in a score of zero for the assignment.

Exams

Homework assignments are an example of *formative* assessments and are designed to help you to learn. Exams are examples of *summative* assessments and are designed for you to demonstrate what you have learned. You will be given three (3) exams during the course of this semester. Each exam will cover material from material covered in lecture *and* information from experiments you have completed in lab (in other words, material covered in lab is fair game for an exam).

Your Learning Experience: Laboratory



Laboratory Results (Accuracy Scores)

You will be graded on the accuracy of your results for each experiment, i.e., how close your experimentally determined value is to the "true" value for the unknown you analyzed. The details of laboratory grading can be found later in this syllabus and on page 149 of the lab manual. It is possible to *redo* a lab with a new unknown if time permits, and it is also possible to *recalculate* the results of your experiment if you have a calculation error.

1. *Redo*: An experiment may be repeated once with a new unknown if time permits. The grade for the experiment will be the average of the two scores, and the lab report must be submitted.

2. *Recalculate*: In the case of a calculation error, a new report must be submitted along with an indication in your lab notebook of where the error occurred and a new set of calculations. Errors in judgment may not be used to recalculate a result. For example, you may not change your result to a median value from a mean or vice versa. You should discuss recalculations with your lab instructor. Your new score will be determined by subtracting up to five points from your "recalculated" score. *Recalculations must be submitted within one week after the lab has been graded and returned to you.*

3. *Due Date Extensions/ Late Reports*: If you are not able to meet the deadline for a laboratory report, speak with your lab instructor about an extension. Together, you and your instructor will set a new due date. Late lab reports will incur a five (5) point penalty for each lab period that it is late.

Laboratory Notebook

Your lab notebook is an important record of the work that you have performed. Your lab notebook will be collected and evaluated after each experiment is completed, and *laboratory results will not be accepted unless they are accompanied by a complete notebook entry*. We will be discussing how to properly prepare and keep a lab notebook during the first week of class. The rubric I will be using to evaluate your notebook appears at the end of this syllabus.

Laboratory Quizzes

Three laboratory quizzes are available on D2L. The *Basic Lab Certification Quiz* must be completed before the Soda Ash unknown is issued. The *Cyanide Safety Quiz*, must be completed before the Limestone unknown is issued, and the *Dichromate Safety Quiz* must be completed before the Ethanol by Titration unknown is issued. Details on these quizzes can be found in the lab manual. You must score 100% on all three quizzes in order to receive credit for them and receive your unknown. You may take these quizzes as many times as you need.

Grading Information

The final course grade will be determined as a weighted percent by category as shown below. The approximate percent per item is based on the number of items in each category (shown in parentheses). Note that grading is evenly split between lecture activates and lab activities.

Category (Items)	Approx. % per Item	% of Final Grade
Exams (3)	13	40
Homework* (10)	1	10
Laboratory Quizzes (3)	0.5	2
Lab Results (10)	3.8	38
Lab Notebook (10)	0.5	5
Formal Lab Report (1)	0.5	5
Total		**100**

*Includes in-class exercises

Grading Scale

The following scale will be used to assign letter grades:

Grade	Percent Range	Grade	Percent Range
A	100 – 93	C+	79 – 76
A-	92 – 90	C	75 – 73
B+	89 – 86	C-	72 – 70
B	85 – 83	D+	69 – 66
B-	82 - 80	D	65 – 64
		F	63 - 0

A Note about Final Course Grades

I invite you to come and discuss your grade with me at any time during the semester. I welcome these conversations, and I am more than happy to help you to develop study strategies that can assist you in becoming a better thinker, learner and problem solver – skills that can help you to improve your grade. Additionally, if I have made a mistake in grading an assignment (it happens – I am not perfect), I want to know right away so that I can correct the error. However, unless a mistake has been made in calculating your final grade, course grades posted after the final exam are final and not subject to change. I do not "bump" students up to a higher grade, provide extra credit or work opportunities, or change the grading scale after the final exam has been completed.

Scoring of Laboratory Experiments

Your lab accuracy score is based on how close you come to the "true" or accepted value for your unknown. This is calculated using the following formula:

$$\text{Accuracy Score } = \left|\frac{\Delta x}{\Delta x_{100}}\right|$$

ΔX is the difference between your reported answer and the "true" or accepted value and represents the accuracy of your experimental results. In other words, $\Delta X = (\text{your value} - \text{"true" value})$

ΔX_{100} is the maximum ΔX allowed for a grade of 100% or 50 points (see page 149 in your lab manual).

Your grade depends on the number of ΔX_{100}'s you are from the correct answer. For example, suppose you determine that the percent sodium carbonate in your soda ash unknown in 35.65% and the "true" value for your unknown is 35.40%.

$$\Delta x = (\text{your value} - \text{"true" value}) = (35.65\% - 35.40\%) = \mathbf{+0.25}\%$$

The **ΔX_{100}** value for soda ash is 0.20% (this value can be found on page 149 of your lab manual), so the accuracy score is calculated as follows:

$$\text{Accuracy Score } = \left|\frac{\Delta x}{\Delta x_{100}}\right| = \left|\frac{0.25}{0.20}\right| = \mathbf{1.25}$$

The accuracy score is then converted to a percent and point score using the following scale:

	Accuracy Score	Grade (%)	Grade (Points)
Your score falls in this range →	1 or less	100	50
	1 to 1.5	90	45
	1.5 to 2	80	40
	2 to 3	70	35
	3 to 5	60	30
	5 to 8	50	25
	8 to 12	40	20
	12 to 20	30	15
	20 or more	20	10

Accordingly, your accuracy score would earn you a grade of 90% or 45 points.

Tentative Course Outline

Session	Date	Topic(s)	Chapter in Text
1	1/24	Course Introduction	Syllabus
2	1/26	Chemical Measurements	0, 1, 2
3	1/31	Statistical Approaches to Error[1]	3
4	2/2	Statistical Approaches to Data Analysis	4
5	2/7	Data Analysis & QA/QC	4, 5
6	2/9	Quality Assurance/Quality Control	5
7	2/14	Titrimetric Analysis	6
8	2/16	Gravimetric Analysis	7
9	2/21	Exam Review	
10	2/23	Acid-Base Equilibrium	8
PM EXAM	2/23	**Exam #1**, 7:00 – 9:00 PM, A-121	
11	2/28	Buffers	9
12	3/2	Acid-Base Titrations	10
13	3/7	Acid-Base Titrations	10
14	3/9	Polyprotic Acid-Base Equilibrium	11
15	3/14	Polyprotic Acid-Base Titrations	11
16	3/16	Solubility Equilibrium	-
17	3/28	Ionic Strength and Activity	12
18	3/30	Complex Equilibria	12
19	4/4	Exam Review	
20	4/6	Selective Precipitation[2]	-
PM EXAM	4/6	**Exam #2**, 7:00 – 9:00 PM, A-121	
21	4/11	Electrochemical Reactions	-
22	4/13	Electrode Potentials	14
23	4/18	Electrode Measurements	15
24	4/20	Redox Titrations	16
25	4/25	Electrochemical Methods	17
26	4/27	Spectrophotometry	18
27	5/2	Spectrophotometry	19 & 20
28	5/4	Separation Methods	21 & 22
29	5/9	Separation Methods	21 & 22
30	May 11th	Exam Review	
FINAL EXAM	May 18th	**EXAM 3**, 12:30 – 2:30 PM, A-121	

Notes: 1. The last day to "clear" drop is Wednesday, Feb 1st

2. The last day to "W" drop is Friday, April 7th

Laboratory Schedule

Session	Date	Experiments	Pages in Lab Manual	Due Dates
1	1/23 - 1/24	Check-In		
2	1/25 - 1/26	Calibration of Buret and Pipets	41 – 42	
3	1/30 - 1/31	Calibration of Buret and Pipets	41 – 42	
4	2/1 - 2/2	Finish Calibrations	41 – 42	
5	2/6 – 2/7	Sodium Carbonate in Soda Ash	43 – 53	Soda Ash Due 2/15 – 2/16
6	2/8 – 2/9	Sodium Carbonate in Soda Ash	43 – 53	
7	2/13 – 2/14	Nickel in Nickel Oxide	55 – 61	Nickel Due 2/22 – 2/23
8	2/15 – 2/16	Nickel in Nickel Oxide	55 – 61	
9	2/20 – 2/21	Manganese in Steel	63 – 82	Manganese Due 3/6 – 3/7
10	2/22 – 2/23	Manganese in Steel	63 – 82	
11	2/27 – 2/28	Manganese in Steel	63 – 82	
12	3/1 – 3/2	Vanillin in Vanilla Extract	83 – 88	First Draft Due 3/29 – 3/30
13	3/6 – 3/7	Vanillin in Vanilla Extract	83 – 88	
14	3/8 – 3/9	Vanillin in Vanilla Extract	83 – 88	
15	3/13 – 3/14	Vanillin in Vanilla Extract	83 – 88	
16	3/15 – 3/16	Iron in Limestone	89 – 100	Iron Due 4/3 – 4/4
17	3/27 – 3/28	Iron in Limestone	89 – 100	
18	3/29 – 3/30	Mg and Ca in Limestone	89 – 100	Mg/Ca Due 4/10 – 4/11
19	4/3 – 4/4	Mg and Ca in Limestone	89 – 100	
20	4/5 – 4/6	Titration of an Acid Mixture	101 – 106	Acid Mix Due 4/17 – 4/18
21	4/10 – 4/11	Titration of an Acid Mixture	101 – 106	
22	4/12 – 4/13	Ethanol by Titration	107 – 114	Ethanol Due 4/24 – 4/25
23	4/17 – 4/18	Ethanol by Titration	107 – 114	
24	4/19 – 4/20	Ethanol by GC	115 – 122	GC Due 5/1 – 5/2
25	4/24 – 4/25	Ethanol by GC	115 – 122	
26	4/26 – 4/27	Cu-Zn by Atomic Absorption	123 – 128	Cu/Zn Due 5/8 – 5/9
27	5/1 – 5/2	Cu-Zn by Atomic Absorption	123 – 128	
28	5/3 – 5/4	Bleach by Coulometry	129 – 136	Coulometry Due 5/10 – 5/11
29	5/8 – 5/9	Bleach by Coulometry	129 – 136	
30	5/10 – 5/11	Check-Out		

No late lab reports or recalculations will be accepted after Tuesday, May 16th

Lab Notebook Grading Checklist

Item	√	Point Deduction (Page)
All entries made in ink		
All entries legible		
Updated table of contents		
Updated page numbers (right hand pages only)		
Date and signature present at the top of each page where data is collected		
Experiment *title*		
Experiment *purpose*		
Experiment *procedure*		
Experiment *procedure* contains appropriate amount of information		
Annotated chemical equations		
Reagents listed along with their purpose		
Safety/disposal information present		
All data presented in tables with titles, headings, and units		
Data appears to be written in the notebook as collected		
Data errors appropriately labeled and footnoted		
Pertinent calibration curves/chromatograms pasted in notebook		
Graph axes labeled and with appropriate units		
Sample calculations present and labeled		
Printed results sheet		
Conclusions		
No pages removed from notebook		
Typed-written report submitted		
Points Possible		**5.00**
Total Deduction		
Points Earned		

NOTES:

1. In general, a 0.25 pt. deduction will be taken for each missing/incorrect item. If items are recurrently missing, the instructor may deduct up to 1 point per item (yes, a negative score is possible).
2. Points may be deducted if subsequent lab entries are not noted in the table of contents and page numbers in subsequent lab entries are missing/incorrect.