# Chemistry 329
# Spring 2017

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**Instructor: Professor Robert Hamers**
Office: 3345 Chemistry
Office Hours, Room 3345
Mondays. 2:25-3:25 PM
Tuesdays 5:30-6:30 PM
Email: rjhamers@wisc.edu
Web Site: https://learnuw.wisc.edu/

**Class Times**
Lecture: MW 11:00 am
Phone: 262-6371

Labs: 1:20-5:25 TR

**TAs:**
Kyle Brown
Zihui (Jerry) Li
Ben Kasting
Vila Rajaratnam
Uzma Zakai

Discussion: 11:00-11:50 F

**Lab Director: Dr. Pam Doolittle**
Office: 2303 A Chemistry
Office Hours by appointment
Email: pam.doolittle@wisc.edu

## REQUIRED MATERIALS

**Textbook:** Harris, Daniel C., *Quantitative Chemical Analysis*, 8th ed., W.H. Freeman and Company, 2010. This is available for free on-line. You do not need to purchase any hard-copy textbook.

**Lab Manual:** *A Manual of Experiments for Analytical Chemistry*, *Spring 2017*, Department of Chemistry, UW-Madison; sold in Chemistry building lobby by Alpha Chi Sigma for $20, NO CASH SALES. You must use your WiscCard to purchase the lab manual.

**Lab Notebook:** Carbonless lab notebook, available at local bookstores and in Chemistry lobby.

**Safety Goggles:** Splash-proof, indirectly vented safety goggles are required at all times when you are in the lab.

**Lab Coat:** A lab coat, which fully covers your arms, midsection, and upper thigh area must be worn when performing wet chemistry in the laboratory. Lab coats can be purchased at the same time and place where you purchase the lab manual. Lab coats should be stored in a one gallon plastic bag (available from the stockroom) and kept in your lab drawer.

**Calculator:** A scientific or graphing calculator is required. The calculator will be used extensively on lab, homework, and exams. Only calculators that are permitted on SAT or ACT tests may be used on exams. You may NOT use any stored information, programs, or applications on exams unless given explicit permission.

**Optional:** The *Solutions Manual* for the text book is available for purchase and is also on reserve in the Analytical TA Office, room 2303a.

**Course Web Site:** You should frequently consult the course web-site on Learn@UW. Lecture notes, homework, handouts, and some announcements will all be posted. You will also use the web site to complete online Pre-lab Quizzes and view grades.

## LECTURE AND DISCUSSION

**Lectures:** Attendance at lecture is required. Lectures are used to organize the material, outline goals, cover both basic principles and more difficult concepts, and provide illustrations and occasional demonstrations. While in some parts of the course I will follow the textbook presentation, in general I do not teach out the book. In cases where I do assign specific reading assignments, I will assume that you have read this material so that I do not have to cover details during the lecture period.

**Discussion:** Attendance at discussion is required. Your TA will present important pre-lab information, provide opportunities for problem solving, and answer questions about labs, homework, or lecture material. You should bring your lab notebook and manual to discussion.

**Homework:** There will be ~8 problem sets during the semester. You may collaborate with others or work independently. If you choose to collaborate with others, you must still work out and hand in your own solutions. You must indicate on your paper with whom you worked.

Homework will be due at the ***beginning*** of the specified period. To discourage late submissions, 4 points will be deducted from homework turned in later the same day. Homework turned in the next day is subject to an 8 point penalty. After that, it will not be accepted at all. If you have extenuating circumstances (serious illness, family emergency, etc) email Prof. Hamers (and copy your TA) as soon as possible. Prof. Hamers will consider extensions for extenuating circumstances.

**Classroom Etiquette:** Cell phones should be silenced. While laptops are not prohibited in class, you will not have any need for them during lecture. Using the computer or other devices during class for activities not related to the class (such as surfing the web, playing video games, texting, etc.) is both rude and very distracting, not only for you but for those who are sitting nearby.

## LABORATORY

Quantitative chemical analysis is an experimental science and therefore the laboratory is a significant part of the course. You will perform twelve standard labs involving chemical analyses aimed at teaching you specific skills. The procedures for these experiments are provided in the lab manual. You will also spend about four weeks designing and conducting your own experiments for a Project Lab. ***In order to pass the class you must complete all labs, and you must earn a passing grade in the lab.***

**Project Lab:** For the Project Lab, you will investigate the chemistry important to fate of lithium-ion battery materials in the environment. You will work in a small group of about 4 or 5 students. In the first part of the project, your group will develop your own method for measuring cations, such as, nickel, manganese and cobalt in an aqueous environment. Your group will use your developed method in part two of the project, to measure the release of these cations from nanosheets designed to mimic the expired cathode materials of a lithium-ion battery You will have ~3 weeks (6 lab periods) in the middle of the semester to conduct your experiments. Your group will present your results in both a written report and an oral presentation before the instructors. More information on the project will be provided during the semester.

**Standard Labs:** The standard labs are typically worth 15 points and have three components that will be graded. You will do an on-line Pre-lab Quiz (worth 6 pts) on the Learn@UW web site prior to coming to lab. You will also be graded on the accuracy of your results (5 pts). Finally, your lab notebook will be graded (4 pts) for completeness and clarity. ***Please note that each lab section has a different lab schedule, especially later in the semester***. Be sure to check the schedule at the end of this syllabus so that you prepare for the appropriate lab.

**Pre-lab Quizzes (for Standard Labs):** You should read and understand the lab as much as possible before attempting the on-line Pre-lab Quiz. ***Please note that there is a time limit (usually 30 minutes) for the quiz.*** The clock begins once you start the quiz and you cannot stop the clock and return later in the day to finish. So you should be prepared to complete the entire quiz before you begin. If you are not

satisfied with your score from your first attempt, you may take the quiz a second time. ***The higher score from your two attempts will appear in the grade book.*** Most quizzes have questions that involve calculations, so you should have a calculator, scratch paper, pencil, and your lab manual available when you begin a quiz. Pre-lab Quizzes must be completed prior to your scheduled lab time.

**Lab Notebook:** Your lab notebook should include: 1) an overview or purpose statement; 2) an outline of the procedure followed; 3) any relevant chemical reactions; 4) raw data from all measurements; 5) one complete sample calculation including units and proper significant figures; and 6) a results and summary section. The first three items and tables for the raw data should be prepared ahead of time as much as possible. Sample calculations can even be outlined ahead of time. Your results and summary section should be brief. In addition to your final results, it should include comments on whether your data are reasonable and/or any problems that occurred that could affect your results. Someone else should be able to repeat the experiment based on what you've written in the notebook. For more guidelines on proper record keeping, consult the lab manual and section 2-2 of the textbook. Copy of lab data from another student, unless explicitly part of a group project, is academic misconduct.

**Lab Reports:** Your lab report will consist of the carbonless copies of the relevant pages from your lab notebook and the completed summary sheet from the lab manual. You will be graded on both the accuracy of your results and the quality of your notebook record. ***In most cases, the report will be due no later than the beginning of the lab period that follows the student's completion of the experiment.*** A penalty of one point per meeting day will be deducted if you submit your report late.

**Lab Conduct:** Safety goggles and proper attire must be worn at all times in the laboratory. Labs start at 1:20 PM and/or 5:45 PM and you are expected to be on time. Points may be deducted from your lab score for unsafe or sloppy lab practices (such as not wearing goggles or not cleaning up spills) or arriving late. Notify your TA as soon as possible if you must miss a lab for any reason. Labs are very difficult to make up and in all cases must be made up as soon as possible after missing a lab for any reason.

**GRADES**

**Intended Grading Scale:** Letter grades will be assigned at the end of the semester based on the following grading scale:

A 90.0 – 100 %
A/B 86.0 – 89.9 %
B 80.0 – 85.9 %
B/C 76.0 – 79.9 %
C 70.0 – 75.9 %
D 60.0 – 69.9 %
F < 59.99 %

This scale may be adjusted downward at the end of the semester, depending on the overall class average. It will not be adjusted upward. For example, if you earn a grade of 89.0%, you are guaranteed to get at least an "AB", and it is possible that you might get an "A". But you will not get a "B".

**Graded Items:** You will earn points based on how well you do on exams, homework, and labs. Below are the tentative point values of various items that will be graded. Adjustments to graded items and point values might be made during the semester if needed.

Exams: 3 exams @ 150 pts each = 450 pts.
Homework: ~8 problem sets = 235 pts.
Laboratory: labs and pre-lab quizzes = 190 pts.
Lab Project: = 115 pts.
TA evaluation: = 10 pts.
***Total: 1000 pts***.

If no changes are made to the point values above, the total possible points at the end of the semester will be 1000. Your letter grade will be determined by calculating your final percentage using the formula:
% score = [(total points earned) / (total possible points)] x 100.

**Exams:** You will have three exams for this course. Exam 3 (the Final Exam) will primarily focus on the material after Exam #2, but because the knowledge is cumulative you will be expected to remember materials covered earlier in the course. Many of the concepts covered build on each other and a good understanding of earlier material is required for mastering later material.

Exam 1: Tuesday, Feb. 28, during lab period
Exam 2: Tuesday, April 11, during lab period
Exam 3: Saturday, May 6, 7:45-9:45 AM.

**Review Your Grades:** Your grades will be entered promptly and available for review on the Learn@UW course website. Be sure to review your scores regularly and notify your TA promptly of any discrepancies. Any request for re-grades of exams, problem sets, or labs must be done within 1 week of getting them back from your TA. Do not wait until the end of the semester to request corrections.

**Academic Misconduct:** It is expected that all students will conduct themselves with honesty, integrity, and professionalism. Any student caught engaging in academic misconduct on an exam will receive an F in the course and a written report on their permanent UW record, with possible expulsion from the university. These penalties will also apply for anyone altering an exam after it has been graded and then submitting it for re-grading, or any other form of misrepresentation on an exam. Similarly, copying or fabrication of lab data (unless expressly permitted as part of a group project) or problem sets is prohibited. Any student caught engaging in academic misconduct on a lab, homework, or quiz (for instance, copying another person's work or fabricating data) will receive a zero for that assignment and a written report on their record. A second infraction will result in an F for the course. More information on what constitutes academic misconduct and UW policies on handling misconduct can be found at: http://www.wisc.edu/students/saja/misconduct/UWS14.html

**SUGGESTIONS FOR SUCCESS**

Most students find Chemistry 329 both challenging and rewarding. It is a four-credit honors course and you can expect to work hard. As an experienced college student you have likely developed a style of learning that has worked well for you. Below are some additional tips that might help you succeed in this course.

- Attend all lectures, labs, and discussions.
- Read the related material in the text book *before* lecture. Some students find it helpful to take notes on what they've read.
- The textbook is not a novel! If you try to read it as such, you will likely fall asleep. The trick to successfully reading a technical book is to be an "active" reader. Have paper and pencil nearby and use it to take notes and solve problems as you read. Try working examples first without looking at the solutions.
- In the event that you must miss an occasional lecture, be sure to review the TA lecture notes that will be posted on the website. It is also a good idea to borrow notes from a classmate. Every attempt is made to have TA notes posted within 48 hours of lecture; however, occasional delays may occur. These notes are intended to supplement (not replace!) your own notes.
- Review your notes after lectures. Reread the related material in the text book. If there are parts you don't understand, seek help from an instructor or classmate.
- Solve lots of problems! Do all the homework plus extra practice problems. You will become more proficient and do better on exams if you have worked through lots of problems.
- If you often work in a group to do homework problems, be sure to balance that time with independent problem solving. You won't have the group with you during exams!
- Make good use of office hours of Prof. Hamers and your TA.
- Seek help promptly if you are confused or have questions. Your confusion will only be compounded by letting it slide. Keep up with the material as last minute cramming is not effective.

**Students with Disabilities**: Students with documented disabilities (McBurney Students) or any special concerns should contact Prof. Hamers as soon as possible at the beginning of the semester. Accommodations can be arranged when appropriate for lecture, laboratory, discussion, or exams.

**SCHEDULES**

The lecture and lab schedules are posted on the course website. The lecture schedule is flexible and will be adjusted as needed during the semester.

**Chem 329**
**Spring 2017**
**Prof. Robert Hamers**
**Lecture Schedule***

| Week | Lecture Dates | Day | Topic | Reading |
|---|---|---|---|---|
| 1 | Jan. 18 | W | Introduction, Sig. Figs | 0,1,2,3-1, 3-2 |
| 2 | Jan. 23 | M | Errors & Uncertainty | 3 |
| | Jan. 25 | W | Uncertainty, Statistics | Appendix 3, handouts |
| 3 | Jan. 30 | M | Statistics | 4 |
| | Feb. 1 | W | Spectrophotometry | 17 |
| 4 | Feb. 6 | M | Spectrophotometry | 17, 18-1 |
| | Feb. 8 | W | Fluorescence | 19.1-19.4 |
| 5 | Feb. 13 | M | Equilibrium | 6 |
| | Feb. 15 | W | Ionic Strength/ Project Intro | 7.1 |
| 6 | Feb. 20 | M | Systematic Treatment of Equilibria | 7.1-7.3 |
| | Feb. 22 | W | Weak Acids, Bases | 8.1-8.4 |
| 7 | Feb. 27 | M | Buffers | 8.5 |
| | **Feb. 28** | **T** | **Exam 1 (During Lab)** | |
| | Mar. 1 | W | Polyprotics + Speciation | 9 |
| 8 | Mar. 6 | M | Polyprotics + modeling | 12 + more |
| | Mar. 8 | W | Electron Microscopy | |
| 10 | Mar. 13 | M | Project Intro | Handout |
| | Mar. 15 | W | Complexation | 11 |
| 11 | Mar. 27 | M | EDTA | 11 |
| | Mar. 29 | W | Electrochemistry Intro | 13 |
| 12 | Apr. 3 | M | Electrochem and Renewable Energy | 13, 14 |
| | Apr. 5 | W | Projects II | |
| 13 | Apr. 10 | M | Electrochemical Analysis | 14 |
| | **April 11** | **T** | **EXAM 2 (During lab)** | |
| | Apr. 12 | W | Potentiometry | 14 |
| 14 | Apr. 17 | M | Potentiostat, Coulometric | 16 |
| | Apr. 19 | W | Cyclic Voltammetry | 16 |
| 15 | Apr. 24 | M | Separations | 22 |
| 17 | Apr. 26 | W | Separation & GC | 23 |
| | May 1 | M | HPLC | 24 |
| | May 3 | W | Review | |
| | May 6 | Sat. | **Exam 3 (Final exam) 7:45-9:45 AM** | |

***This is a guide only. Topics and dates of lectures may change as needed.**

Chemistry 329-2 (Hamers) Spring 2017 Draft Lab Schedule

| Week | Date | 631--Kyle Brown | 632--Zihui Li | 633--Feng Pan | 634--Uzma Zakai | 635-Vila Rajaratnam |
|---|---|---|---|---|---|---|
| 1 | 17-Jan | Check-in/Weighing | Check-in/Weighing | Check-in/Weighing | Check-in/Weighing | Check-in/Weighing |
| | 19-Jan | Volumetric Apparatus | Volumetric Apparatus | Volumetric Apparatus | Volumetric Apparatus | Volumetric Apparatus |
| 2 | 24-Jan | Standardization of HCl | Standardization of HCl | Standardization of HCl | Standardization of HCl | Standardization of HCl |
| | 26-Jan | Standardization of NaOH | Standardization of NaOH | Standardization of NaOH | Standardization of NaOH | Standardization of NaOH |
| 3 | 31-Jan | Determination of % KHP | Determination of % KHP | Determination of % KHP | Determination of % KHP | Determination of % KHP |
| | 2-Feb | Spectrophotometric Det. of a Mixture | Spectrophotometric Det. of a Mixture | Spectrophotometric Det. of a Mixture | Spectrophotometric Det. of a Mixture | Spectrophotometric Det. of a Mixture |
| 4 | 7-Feb | Hardness of Water | Hardness of Water | Hardness of Water | Hardness of Water | Hardness of Water |
| | 9-Feb | Chemical Oxygen Demand | A Study of Fluorescein | Chemical Oxygen Demand | A Study of Fluorescein | Chemical Oxygen Demand |
| 5 | 14-Feb | A Study of Fluorescein | Chemical Oxygen Demand | A Study of Fluorescein | Chemical Oxygen Demand | A Study of Fluorescein |
| | 16-Feb | Adventures with Buffers | Adventures with Buffers | Adventures with Buffers | Adventures with Buffers | Adventures with Buffers |
| 6 | 21-Feb | Project--Measuring Ni, Mn, Co | Project--Measuring Ni, Mn, Co | Project--Measuring Ni, Mn, Co | Project--Measuring Ni, Mn, Co | Project--Measuring Ni, Mn, Co |
| | 23-Feb | Project continued | Project continued | Project continued | Project continued | Project continued |
| 7 | 28-Feb | *Exam 1* | | | | |
| | 2-Mar | Project continued | Project continued | Project continued | Project continued | Project continued |
| 8 | 7-Mar | Project continued | Project continued | Project continued | Project continued | Project continued |
| | 9-Mar | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid | ID of an Unknown Weak Acid |
| 9 | 14-Mar | Bromocresol Green | Bromocresol Green | Bromocresol Green | Bromocresol Green | Bromocresol Green |
| | 16-Mar | Practice with ImageJ | Practice with ImageJ | Practice with ImageJ | Practice with ImageJ | Practice with ImageJ |
| -- | 21-Mar | Spring Break | | | | |
| | 23-Mar | | | | | |
| 10 | 28-Mar | Project | Project | Project | Project | Project |
| | 30-Mar | Project | Project | Project | Project | Project |
| 11 | 4-Apr | Project | Project | Project | Project | Project |
| | 6-Apr | Project | Project | Project | Project | Project |
| 12 | 11-Apr | *Exam 2* | | | | |
| | 13-Apr | Project | Project | Project | Project | Project |
| 13 | 18-Apr | Project | Project | Project | Project | Project |
| | 20-Apr | Project | Project | Project | Project | High Pressure Liquid Chromatography |
| 14 | 25-Apr | Fluoride ISE | High Pressure Liquid Chromatography | Fluoride ISE | Ag Electrode | Project |
| | 27-Apr | Ag Electrode | Ag Electrode Study | High Pressure Liquid Chromatography | Fluoride ISE | Fluoride ISE |
| 15 | 2-May | ***Project Presentation*** | ***Project Presentation*** | Ag Electrode Study | High Pressure Liquid Chromatography | Ag Electrode |
| | 4-May | High Pressure Liquid Chromatography | Fluoride ISE | ***Project Presentation*** | ***Project Presentation*** | ***Project Presentation*** |
| | | | | | | |