

Analysis of Equilibrium Systems

Winter 2016

Chem 2011

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 **@heydebigale** (I tweet about chemistry, come follow along!)

Lectures: M, W, Th, F 9:00-9:50 AM STURM 134

Office Hours (Science and Engineering Center): Mon 10 AM, Tue 1 PM, Thur 8 AM (in STURM 134), Friday noon- 2 PM. **If you need to meet with me privately regarding a grade, please set up an appointment with me via email.**

Required Course Items:

Text: *Quantitative Chemical Analysis*, 9th Ed., by Daniel C. Harris (QCA). You are NOT required to have the 9th edition of the textbook. However, the lecture schedule below corresponds to the 9th edition of the book. You are responsible for this material.

An additional General Chemistry text is recommended. We will have supplemental reading assignments out of OpenStax:

Chemistry OpenStax College, 1st Ed. OpenStax is a **creative commons** publisher. This means that you can access your text book for **FREE!** Textbook content produced by OpenStax College is licensed under a Creative Commons Attribution License 4.0 license.

You can access the text for free here: <https://openstaxcollege.org/textbooks/chemistry>

Sapling Account: Homework will be performed online using the *Sapling* system This is required for purchase (\$36 for the quarter). Detailed instructions are posted on canvas.

Calculator: An inexpensive calculator is required. It should have the capabilities for square roots, logarithms, and exponential (scientific) notation operations. The calculator will be used for homework, quizzes, and exams. **Bring your calculator to class each day to work problems.** You are responsible for understanding how to use your own calculator.

Course Objectives:

- Understand the sources of error and uncertainty in chemical analysis
- Identify chemical species that exist in aqueous solutions based on equilibria principles
- Understand the significant role equilibria has on biological and environmental systems
- Understand principles and applications of zero- and first-order kinetics
- Understand quantitative relations in chemical reactions such as acid-base neutralization
- Understand relationship between equilibria and other chemical/physical properties.

Components of this Course:

Canvas: canvas.du.edu will be the website that you can find all of the online aspects of this course. Please look at the weekly checklist to keep track of tasks.

Lectures (Online and In-Class): A lecture schedule is below. For this course we will be watching an online lecture the prior to our scheduled class meetings. It is your responsibility to watch this lecture before class each day. I recommend taking notes while watching the online lectures to help absorb the material. There will be guiding questions and a quiz in canvas to gauge comprehension. Our scheduled class time will be dedicated time to go through problems associated with material in online lecture. ****IMPORTANT****- Some new material will be introduced during classtime. You will get the most out of this class by coming to class.

While in class we will work problem sets that I create and we may also allocate some time working through Sapling problems. So, please bring your laptop!


Readings: Assigned reading should be completed prior to lecture. Scheduled reading is listed in the schedule below.

Weekly Assignments: Each week, problems related to the lecture material will be assigned. You are required to submit problem sets via an online homework system called Sapling (<http://saplinglearning.com>). Assignments will be due every Friday at 6 PM. The assignments will lock exactly when they are due, so plan ahead. Late assignments may not be accepted for any credit. In some circumstances, an assignment may be accepted, but with significant grade penalty. Computer or internet problems are *not* valid excuses for lateness. A tech TA supplied by Sapling will be able to answer your technical questions about log-in issues or non-academic problems with homework questions. Email: support@saplinglearning.com

Chemistry Infographic/Information Literacy: This quarter you will be asked to create an infographic similar to infographics found at www.compoundchem.com. For this infographic you will work in pairs. The details of this assignment can be found on canvas.

Non graded problem sets: Problem solving is an important component of all chemistry and most science courses. For most students, successfully solving problems requires practice. In addition to completing the example exercises in the text, I will post problem sets to help you practice. These will not be graded, but the solutions will also be posted. Exam questions may be taken from, or may closely follow these problem sets. I strongly suggest that you consider these as mandatory work and I recommend that you finish all of them. In some cases during office hour discussions I may suggest that you complete these problems before I answer your questions in detail.

Science and Engineering Center: Need extra help? The Science and Engineering Learning Center is a collaborative space staffed by undergraduate and graduate learning assistants (LAs) trained to assist students with some first and second year biology, chemistry, physics, computer science and engineering courses. We offer support for both lecture and laboratory courses for chemistry, physics, and engineering courses and lecture only for computer science and biology. Our goal is to help students grow as problem solvers by assisting with homework sets, lab reports, and preparing for exams. The Science and Engineering Learning Center is **not** a one-on-one tutoring center, but is rather a support system where students can get guidance from LAs as well as their peers. This center is open to all DU students. All services are free. Located in the north-west corner of the first floor of the Anderson Academic Commons (west of the writing center).

See <http://portfolio.du.edu/sec> for a complete schedule. Please also follow on Twitter for the most up-to-date announcements:  [@SELCatDU](#)

Exams:

- a) There will be three one-hour midterm exams and a two-hour final exam.
- b) If anyone for any reason had to take the exam outside of the scheduled time, arrangements need to be made with the instructor at least one week in advance. Instructor approval of the situation is necessary for any adjustment in exam schedule to occur.
- c) If any student is a member of the DSP or LEP programs and feels they need special accommodations for exams, please contact the instructor.
- d) **All exams will be comprehensive encompassing lecture materials, assignments, and in-class assignments. The exams are designed to test your ability to apply the concepts covered in the lecture.**
- e) **If your grade on your final exam is higher than one of your midterm exams, your final exam will be counted twice to replace your lowest midterm grade.**

Grading:

The breakdown of the course grades is as follows:

| | |
|-----------------------|-------------------|
| Sapling/other HW | 100 points |
| Infographic | 100 points |
| Review Assignment | 10 points |
| Quizzes/in-class work | 90 points |
| Exam 1 | 100 points |
| Exam 2 | 100 points |
| Exam 3 | 100 points |
| Final Exam | 100 points |
| TOTAL | 700 points |

Grades will be based on the following approximate grade scale:

| | | | |
|-----|----|------|----|
| 93% | A | 74% | C |
| 90% | A- | 70% | C- |
| 87% | B+ | 67% | D+ |
| 84% | B | 64% | D |
| 80% | B- | 60% | D- |
| 77% | C+ | <60% | F |

Students who earn at least 93% of the possible points are guaranteed an A in this class; however, it may not be necessary to earn 93% to receive an A since this scale may be modified downward at the discretion of the instructor. Scores will be recorded on Canvas as they are graded. Each student should check Canvas frequently to make sure scores are recorded correctly. Complaints on grading or recording errors should be made within two weeks of each exam.

Help

Students who need help in this class have several options:

- (1) The Science and Engineering Center, located on the first floor of the library, is a great resource! TAs are available throughout the week to answer questions on both lecture and lab material. A schedule is available on canvas and on the Science and Engineering Center portfolio site: <http://portfolio.du.edu/sec>
- (2) The instructor has office hours for consultation. If you cannot make the set office hours, you can schedule an appointment.

(3) Peers (Study Groups): Take opportunities to help those around you and to ask for help. You can learn a lot from your fellow classmates. If you come to the Science and Engineering Center, perhaps you will find a group of classmates to study with!

TAs and the instructor are willing to help anyone in need. There is no excuse for not getting help. Your best help may come from your fellow students. Meeting regularly with a study group, for discussing ideas and working together on homework will be one of the best helps in learning and understanding the material. Even if you don't think you need the help from others, you will often find that teachers learn more than the students.

Formula for Success (a partial list):

- 1.) Study topics in textbook before class
- 2.) Attend class regularly
- 3.) Be ready to ask questions... and ask them!
- 4.) Take notes on content learned in lecture
- 5.) Follow to-do list on Canvas.
- 6.) Study with other students in the class
- 7.) Get help from course instructor
- 8.) Don't get behind

Other Policies

Students with Disabilities/Medical Issues

If you qualify for academic accommodations because of a disability or medical issue please submit a Faculty Letter to me from **Disability Services Program (DSP)** in a timely manner so that your needs may be addressed. DSP is located on the 4th floor of Ruffatto Hall; 1999 E. Evans Ave. 303.871. / 2372 / 2278 / 7432. Information is also available on line at <http://www.du.edu/disability/dsp>; see the *Handbook for Students with Disabilities*.

Students with Caregiving Responsibilities

If you are a student who has caregiving responsibilities (caring for a child, parent, or other dependent) and need accommodations, please let me know. I am happy to give accommodations to students who need them based on responsibilities outside of the classroom.

Title IX

Gender violence can happen to anyone regardless of race, class, age, appearance, gender identity, or sexual orientation. The University of Denver is committed to providing an environment free of discrimination on the basis of sex (gender), including sexual misconduct, sexual assault, relationship violence, and stalking. The Center for Advocacy, Prevention and Empowerment (CAPE) provides programs and resources to help promote healthy relationships, teach non-violence and equality, and foster a respectful and safe environment for all members of the University of Denver community. All services are confidential and free of charge.

For assistance during business hours, call 303-871-3853 and ask to speak to the Director of CAPE. After hours, please call the Emergency & Crisis Dispatch Line at 303-871-3000 and ask to speak to the CAPE advocate on call.

Religious Accommodations Policy

University policy grants students excused absences from class or other organized activities or observance of religious holy days, unless the accommodation would create an undue hardship. You must notify me by the end of the first week of classes if you have any conflicts that may require an absence. It is your responsibility to make arrangements with me in advance to make up any missed work or in-class material.

Honor Code/Academic Integrity

All work submitted in this course must be your own and produced exclusively for this course. The use of sources (ideas, quotations, paraphrases) must be properly acknowledged and documented. For the consequences of violating the Academic Misconduct policy, refer to the University of Denver website on the Honor Code (www.du.edu/honorcode). See also <http://www.du.edu/studentconduct> for general information about conduct expectations from the Office of Student Conduct.

Student Athletes

If you are a student-athlete, you should inform me of any class days to be missed due to DU sponsored varsity athletic events in which you are participating. Please provide me with an absence policy form by the end of the first week of class. You will need to make up any missed lectures, assignments, and/or exams.

Use of Technology in the Classroom

Access to the Internet can be a valuable aid to the classroom learning environment. You may be encouraged to use a laptop, smart phone, or other device to explore concepts related to course discussions and in-class activity. Keep in mind, however, that these technologies can be distracting – not only for you, but to others in the class. Please avoid the temptation of Facebook, texting, or other off-topic diversions.

TENTATIVE LECTURE SCHEDULE (Winter 2016)

****All reading is from Harris QCA unless labeled "OS" (OpenStax)****

| DATE | Lect # | TOPIC | Read-9 th Ed | Read-8 th Ed |
|---|---|---|------------------------------|------------------------------|
| WEEK 1 | EXPIRIMENTAL ERROR AND STATISTICS | | | |
| January 4 | 1 | Introduction/Types of Error | 3.1–3.5 | 3.1–3.5 |
| 6 | 2 | Gaussian Distribution, CI | 4.1–4.3 | 4.1–4.3 |
| 8 | 3 | Calibration Curves | 4.4–4.9 | 4.4–4.9 |
| WEEK 2 | AQUEOUS SOLUTIONS AND INTRO TO EQUILIBRIA | | | |
| Jan 11 | 4 | Q test, statistical significance | 4.4–4.9 | 4.4–4.9 |
| 13 | 5 | Intro to Equilibria, Thermodyamics | 6.1-6.4, OS 13.1-13.4 | 6.1-6.4, OS 13.1-13.4 |
| 15 | 6 | ICE Tables | OS :13.5 | OS :13.5 |
| WEEK 3 | LECHATELIER'S PRINCIPLE | | | |
| Jan 18 | Martin Luther King Jr day-NO CLASS | | | |
| 20 | 7 | LeChatelier's/ Common Ion Effect | 6.2–6.3 | 6.2–6.3 |
| 22 | 8 | Solubility Equilibria | 6.3, OS :15.2 | 6.3, OS :15.2 |
| WEEK 4 | INTRO TO ACIDS AND BASES | | | |
| Jan 25 | HOUR EXAM I (Covers Lectures 1–6) | | | |
| 27 | 9 | Acid/Base Review, pH, pOH, etc. | 6.5–6.7 OS :14.2–14.4 | 6.5–6.7 OS :14.2–14.4 |
| 29 | 10 | Weak Acids, pKa scale | 6.5–6.7 | 6.5–6.7 |
| WEEK 5 | TITRATIONS & EQUILIBRIA OF ACIDS AND BASES | | | |
| Feb 1 | 11 | Introduction to Titrations | 7.1–7.5 | 10.1–10.6 |
| 3 | 12 | Systematic Treatment of Equilibria & Activity | 8.1–8.5 | 7.1–8.5 |
| 5 | 13 | Dilute Strong Acid/Base | 9.1 | 8.1 |
| WEEK 6 | ACID BASE EQUILIBRIA | | | |
| Feb 8 | 14 | Weak Acid/Base Equilibria | 9.1–9.4 | 8.1–8.4 |
| 10 | 15 | Buffers/Henderson-Hasselbach | 9.5 | 8.5 |
| 12 | HOUR EXAM II (Covers Lectures 1–15) | | | |
| WEEK 7 | COMPLEX EQUILIBRIA | | | |
| Feb 15 | 16 | Diprotic acids and bases/buffers | 10.1–10.2 | 9.1–9.2 |
| 17 | 17 | Polyprotic acids and buffers | 10.3–10.6 | 9.3–9.6 |
| 19 | 18 | Titrations, monoprotic and polyprotic | 11.1–11.6,11.10 | 10.1–10.6, 10.1 |
| WEEK 8 | CHELATION EQUILIBRIA & INTRO TO KINETICS | | | |
| Feb 22 | 19 | Titrations, continued | 11.1–11.6,11.10 | 10.1–10.6, 10.10 |
| 24 | 20 | EDTA Titrations, Complex Equilib | 6.4, 12.1–12.3 | 6.4, 11.1–11.3 |
| 26 | 21 | Intro to Kinetics, reaction rates | OS : 12.1–12.3 | OS : 12.1–12.3 |
| WEEK 9 | KINETICS ... CONTINUED | | | |
| Feb 29 | 22 | Rate Laws | OS : 12.4 | OS : 12.4 |
| Mar 2 | 23 | Integrated Rate Laws | OS : 12.5 | OS : 12.5 |
| Mar 4 | HOUR EXAM III (Covers Lectures 1–21) | | | |
| WEEK 10 | KINETIC THEORIES AND MECHANISMS | | | |
| Mar 7 | 24 | Mechanisms and Catalysts | OS : 12.6–12.8 | OS : 12.6–12.8 |
| Mar 9 | REVIEW FOR FINAL | | | |
| March 12 (Saturday!) FINAL EXAM (OLIN 105): 8AM to 9:50AM (Cumulative) | | | | |

