CHEMISTRY 134 (CHEM 134, CHEMICAL PRINCIPLES FOR ENGINEERING), SPRING, 2017
Friday11:00 am–11:50 am, Physics 1412, University of Maryland, College Park
Assoc. Prof. Jason D. Kahn, Dept. of Chemistry & Biochemistry

Dr. Kahn: Chemistry 2500A, in Biochemistry, Wing 5 of the Chemistry complex (Bldg. 091)
Office hours: Mon. 1:00-2:00 p.m.; Weds. 2:00-3:00 p.m.; or by appointment.
Contacting me: jdkahn@umd.edu much preferred to 301-405-0058. There are ~150 of you: please include "CHEM134" in your subject line, quote any previous correspondence in your emails, and do not ask questions that are answered in this document. **Do not email me through ELMS!** Please do not drop in to my office or lab, but I make appointments outside of office hours.
TA: Owen Becette (obecette@umd.edu). Owen will have office hours in the Chemistry Atrium immediately after class, Friday 12-1. You can also attend office hours with my Chem 271 TA, Alessandra Zimmermann, who knows the material but not the specifics of what we do in class. Chemistry 0124, TuTh 1:30-2:00 and 3:00-3:30 p.m.

Please see me as early as possible with any questions or concerns: do not wait until an exam looms!

Web and links: The class web site is provided on ELMS at http://myelms.umd.edu. Grades will be posted. My personal site http://www.biochem.umd.edu/biochem/kahn has a repository of my old exams (for other courses) and other resources like Matlab programs. Notifications to the class go through ELMS or Coursemail. Change your ELMS Settings to receive announcements as they arrive rather than as a digest. Your university email address must work.
The Mastering Chemistry web-based homework site is http://masteringchemistry.com/. See directions below.
Videos: I plan to provide short videos on how to do the calculations for homework-style problems.

Course Description

Chemistry 134 is a one-credit course intended to supplement strong previous preparation (AP 4 or 5 or else Chemistry 131/146) in intro chemistry to provide a chemistry foundation comparable to that of Engineering students who have taken Chemistry 135. You cannot receive credit for both 134 and 135. The course does not replace Chemistry 271/6 but it covers some of the same ground. Because Engineering students will cover fundamental thermodynamics in their later courses, only chemical equilibrium is covered here.

- Ideal gas law, qualitative treatment of non-ideal gases.
- States of matter, intermolecular forces, heating curves, and simple phase equilibria
- Kinetics: Maxwell-Boltzmann distribution, reaction rates and orders, elementary reactions and mechanisms, the steady state approximation, activation energy, catalysis
- Chemical Equilibria: K_{eq}, especially acid-base reactions; pK_a, titrations, buffers.
- Electrochemistry and oxidation-reduction reactions. Batteries and electrolytic reactions.
- Fundamentals of organic chemistry and polymer chemistry.

Background Expectations:

- Prerequisites for this course include Chemistry 131/146 or equivalent, which I hope you remember. In particular, you should be familiar with the idea of atoms and molecules, bond energies, stoichiometry, and acids and bases. We will use calculus, although you will not need to use it for assignments or exams. You are expected to be able to do algebra easily and quickly. During the class we may use Microsoft Excel and Matlab, which are both downloadable for free from terpware.umd.edu.

Disclaimer:

- This is a relatively new course, and your input on how to improve is welcome.

Textbook and Other Materials

Required: N. V. Tro (2015). ***Chemistry: Structure and Properties—Third Custom Edition for University of Maryland—Chem 135*****. Pearson.** This is a custom reduced-cost soft cover Special Edition for this course and Chemistry 135, consisting of chapters 1-12, 15-17, 20, and 22 of the complete text. Chem 134 covers parts of chapters 11, 12, 15-17, 18(sigh), 20, and 22. Do not get the Chem 131 book by mistake! The text comes bundled with access to Mastering Chemistry, our on-line homework system (ISBN 9781323006573). If you already have the text, you can buy Mastering Chemistry access at a slightly reduced price directly from the publisher at http://www.pearsoncustom.com/md/umd_mastchem/. This is also your access point for registration. **The class access code for MC is MCKAHNS2017**. You can buy or rent the complete text at Amazon, but you will still need to buy Mastering access separately. **I do not recommend using any other versions of the text, as chapters and problems have been renumbered and some content has changed. I do not recommend third-party Mastering codes…just look at the Amazon reviews.**

Sections in Tro for background or amplification are specified for each lecture. You are not responsible for material covered only in the book unless this is specifically announced. You are, however, responsible for the methods used for any assigned homework questions.

Lecture Attendance, Notes, and Suggestions for Success

All lecture notes and ancillary files will be posted to ELMS, typically after the lecture. The lecture notes are sometimes quite detailed, as there may be material covered that is not in the text. They are also incomplete: I may give more or different examples on the board than in lecture. The PowerPoint is not a substitute for lecture attendance! If I could write a document that encapsulated the lecture experience it would be called a textbook…but if textbooks, Wikipedia, MOOCS, and YouTube could replace professors there would be no need for you and I to have this quality time together. A day may come when you can self-teach all of this material in an isolated electronic cave and set me loose on an ice floe, but it is not this day.

I recommend that you take notes in lecture, and then soon after the lecture go over or recopy them, combine the notes with the PowerPoint, and use the textbook/web to help with anything you don't understand. Then ask a friend or myself about anything that is not clear, ideally before the next lecture. There are few things more frustrating than sitting through a lecture that is incomprehensible because you lack the background to understand it. You are welcome to record lectures, and I will try to Panopto them, but Panopto often fails.

If I suggest that you work an example, that is a hint about what might be on an exam. Do any assigned problems well before the exam, so you will have time to read the problem set keys carefully. Sample exams will also be available. **KEEP UP WITH THE MATERIAL!**

"Muddy/Clear" Surveys

After each class, you will complete a short survey on ELMS covering some aspect of the class. I use this in lieu of clickers to try to stay calibrated on whether the class is appropriately paced or to identify ideas that need to be retaught. Answers are anonymous, but if I am sufficiently upset by a response I can find out who posted it. You get 50 points *in toto* for the surveys. These are basically free points: don't leave them on the table.

In-class participatory demonstrations

During some classes, I will ask students or groups of students to come up to the board to work problems. When I do this, I do not expect you to get the right answer. We are interested in the reasoning leading to an answer, and frequently I set you up to get interesting wrong answers. This should be a low-stress experience. You can always opt out. We will also do in-class experiments with Matlab or Excel, and if I ask you to explain the results of these experiments I similarly do not necessarily expect correct answers.

The Elevate program run by the TLTC on campus inspired me to do some of these exercises.

Suggestions for Success:

Attend every class even if you think you have seen some of the material before.
Read over and understand your notes (ideally, rework them) before the next lecture.
Create a framework of knowledge into which to fit facts, don't try to just memorize.
If you fall behind, it will just get worse. Stay engaged!
And…Allow yourself to enjoy the material!

Requirements, Grading, and Academic Honesty Policies:

The breakdown for points (450 points total for the class) is as follows:

Mastering Chemistry homework = 100 points.

Brief "Muddy/Clear" ELMS surveys, to be completed after each class. For these surveys, you must write one or two anonymous sentences about the class that day: 50 points.

Midterm exam (50 min): 100 points

Final exam (≤120 min): 200 points

Both exams are Major Graded Events!

I encourage questions, discussion, and participation in class, but these do not affect grading.

Your exam performance is highly correlated with the effort you put in on homework and practice exams.

ENGAGED ATTENTION, PARTICIPATION, AND THOUGHTFUL COMPLETION OF ALL ASSIGNED WORK, GRADED OR NOT, IS STRONGLY CORRELATED WITH OVERALL SUCCESS!

Exams will be about 50% relatively easy questions, testing your comprehension of lecture material, and about 50% more difficult questions, testing your ability to apply and extend this basic knowledge. Each exam will explicitly cover mostly the recent part of the course but will inevitably draw on older material. My exams tend to be difficult: they are intended to stretch your thinking, not reward casual effort. Old exams for previous and related courses (Chem 271) can be found at http://www.biochem.umd.edu/biochem/kahn. Exams may require calculators (of any sort that handles logs), and no other aids will be permitted, but formulas and equations will be provided. If you have a disability issue handled through DSS, please let me know as soon as possible so that accommodations can be made.

Your final grade will be based on your performance relative to the class and to my expectations (*i.e.* it's curved, but I draw the lines between grades depending on how the class as a whole performed). Letter grades will not be assigned on the midterm exam but I will give feedback on the curve. You do not need to score 90 % to get an A—when in real life do we ever really expect to approach perfection? I anticipate roughly 30:30:30:10 A:B:C:D, with D's and F's given only as needed but without hesitation. Plus/minus grades will be given. Exam grades and your totals from Mastering Chemistry will be available on ELMS.

Grade Adjustments: Students often ask whether improvement counts, and someone is often one point below any cutoff. My grading policies takes these issues into account in an objective way as follows: (1) I assign cutoffs (just as a concrete example, the A/B line might be at 430 points and the B/C line at 360). Anyone whose overall point total is above the cutoff receives the higher grade. (2) Anyone whose score is less than 15 points below the cutoff is assessed individually. If his/her final exam score is greater than or equal to the average of the final exam scores of the students scoring at the grade level above the cutoff, the higher grade is awarded. In our example, if the average final exam score among students scoring between 360 and 430 happened to be 126.3, then anyone having a point total between 345-360 and scoring ≥ 127 points on the final would earn a B–. (3) Otherwise, anyone who scores anywhere in the B/C/D range who achieves the average final exam score of the A/B/C group respectively will get a B+/C+/C–. Otherwise, +/- grades are assigned according to cutoffs assigned according to breaks in the curve. Finally, (4) in spite of all of the above, anyone who scores above the median on the final will get at least a C–. I have had to make good on this last promise approximately twice in 23 years.

Regrades: If there is clerical error or a mismarked multiple choice question on an exam, just let me know and we will fix it. If you believe there is a substantive grading error, you may submit the exam to me for regrading, along with a note describing the issue. Do not alter the exam itself in any way. I reserve the right to regrade the entire exam, so it is only worth your while to ask for a regrade if you feel truly underappreciated. My exams are still graded by humans, so there are always a few points that could be argued about, which is a waste of time and effort. Therefore, **only regrade changes of 5 or more points will actually be applied, except for clerical errors.** Regrade requests will be accepted up to one week following the return of the exam.

Missed Exams: If you absolutely must miss a quiz or an hour exam, you must call me in advance or within 24 hours after the exam, and you must also present a valid University excuse (please secure a note from the Health Services if possible). You will then be permitted to take a make-up exam, or, preferably, assigned a grade based on the remaining exams and homework. If you have undocumented absences for the final exam or both hour exams, you will fail the class. All quizzes and exams are Major Graded Events.

Cheating will not be tolerated. The University's Honor Council sets high standards for academic integrity, and I support its efforts. Please note in this regard the University Honor Pledge: "I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination." You will be asked to write out and sign the pledge statement on all exams (http://www.shc.umd.edu/SHC/HonorPledgeUse.aspx). I expect adherence to the Code of Academic Integrity (http://www.ugst.umd.edu/courserelatedpolicies.html). You are also hereby specifically directed to read my personal statement on plagiarism at http://www.biochem.umd.edu/biochem/kahn/plagiarism.html, as a condition of taking this course. Cell phones must be turned off and stored out of reach and sight during exams, and headphones may not be used.

Finally, the campus Senate has approved a variety of detailed policies and procedures covering your rights and responsibilities. These can be found at http://www.ugst.umd.edu/courserelatedpolicies.html. Please let me know if you think anything in this document substantively conflicts with University policy.

PLEASE DO NOT USE A LAPTOP DURING CLASS: They are too much of a distraction for you and your neighbors. I can't stop you from texting, but **YOU CAN'T LEARN AND TEXT AT THE SAME TIME: PICK ONE**.

Approximate Lecture Schedule (Exam dates are fixed). ALL READINGS REFER TO TRO

1.	Introduction, gas laws and the meaning of temperature; Tro, Chapter 11	F, 1/27/17
2.	Intermolecular forces and states of matter, heating curves. Chapter 12	F, 2/3/17
3.	Dynamic equilibrium. The Maxwell-Boltzmann distribution. Chapter 15	F, 2/10/17
4.	Reaction rates, reaction order, rate constants, Arrhenius equation	F, 2/17/17
5.	Chemical equilibrium and LeChatelier's principle; Chapter 16	F, 2/24/17
6.	Chemical equilibrium calculations	F, 3/3/17
→ EXAM I ← Covers through Lecture 6		**F, 3/10/17**
7.	Eyring theory, free energy reaction coordinate diagrams, catalysis	F, 3/17/17
→ Spring Break 3/19-3/26		
8.	Acid-base reactions and the pH scale; Chapter 17	F, 3/31/17
9.	K_a, pK_a, K_w, K_b, pK_b, Lewis acids and bases, buffers and titrations	F, 4/7/17
10.	Electrochemical cells and standard reduction potentials; Chapter 20	F, 4/14/17
11.	The Nernst equation, batteries	F, 4/21/17
12.	Organic Chemistry; Chapter 22	F, 4/28/17
13.	Polymers	F, 5/5/17

→ FINAL EXAM ← **Tuesday, 5/16/17, 8:00 a.m.–10:00 a.m.**

The final is comprehensive in principle, but it will emphasize the last part of the course.

Please let me know ASAP if you have a scheduling conflict with the final exam!!!

Learning Outcomes

What do we want you to get out of this class?

In any Chemistry course, you will learn many details that will need to be memorized, and therefore can be rapidly forgotten. The Arrhenius equation will always be a click away on Wikipedia—why memorize it? If that is all there is to chemistry, then why is it that someone typically other than yourself has decided that you must take this course? There must be some skill you retain after taking this course that cannot simply be mimicked by Googling. The answer is that the details and the approaches of chemistry are needed to assemble a way of thinking, and we want that way of thinking to stay with you after the details have faded into nostalgia.

What are the tenets of the chemistry way of thinking? Here are some: The universe operates subject to fundamental physical/chemical principles. To understand how the material world behaves, we have to understand molecular-level properties and how they translate to bulk properties. Chemistry is the central science, and the principles of chemical bonding and reactivity, redox, kinetics, and thermodynamics are essential to understanding physics, biology, materials science, and engineering.

The meta-question is why society believes that the natural sciences and engineering are worth supporting even in the face of many other competing priorities. Besides just curiosity, the obvious answer is that all of us want to live longer, healthier, more productive lives. We want to use chemical knowledge to help improve our food, technology, environmental stewardship, and society. To be an informed citizen in the 21st century you need to know some chemistry, so I want you to retain enough of what we learn here to make well-reasoned decisions about the technical, ethical, and moral opportunities and hazards of new advances.

This course is relatively new, and we seek continuous improvement. Please help us by sending feedback: the best way to do this is by doing the daily surveys, providing me with constructive suggestions during or after the semester, and participating in the CourseEvalUM program as described by the Provost:

> Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process.

In particular, it will be useful to us if you continue to stay in touch as you move through the Engineering curriculum. Please let me know if you think there is excessive overlap or disagreement among classes, and which topics should be added to or subtracted from Chemistry 134 (and 135).

When you fill out your CourseEvalUM evaluations, please reflect on how well the material you actually learned is aligned with these ambitious goals.

Syllabus Date and version: January 27, 2017, v. 1.00