CHEMISTRY 271 (CHEM 271), SECTIONS 22XX (2 CREDITS):
GENERAL CHEMISTRY AND ENERGETICS
SPRING, 2010: MW 12:00-12:50 P.M., CHEMISTRY 1407

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Contacting me: jdkahn@umd.edu much preferred to 301-405-0058. There are >200 of you: please include “CHEM271” in your subject line, and please quote any previous correspondence in your emails. Please do not drop in to my office or lab. I will set up appointments outside of office hours if necessary.

Web and email: The course web site is available through the ELMS system (http://elms.umd.edu). E-mail reflectors provided through Coursemail and/or ELMS will be used. It is your responsibility to make sure your e-mail address works.
The SmartWork web-based homework site is http://wwnorton.com/smartwork or http://smartwork.wwnorton.com/production/norton/smartwork/

Discussion TA: Sarah Sucayan (ssucayan@umd.edu), 405-1815 (see above for contact directions)
Office Hours: Tues. 3-4 p.m., Thurs. 3-4 p.m., Chemistry 2507

Discussion Sections: (see http://www.umd.edu/CampusMaps/)
2224(14033) Tu.....11:00am-11:50am (CHM 0127) [CHM = Chemistry]
2225(14034) Tu.....12:30pm- 1:20pm (HJP 1229) [HJP = HJ Patterson]
2227(14035) Tu..... 2:00pm- 2:50pm (CHM 0127)
2244(14036) Th.....11:00am-11:50am (CHM 0127)
2245(14037) Th.....12:30pm- 1:20pm (EGR 0135) [EGR = Martin Hall]
2247(14038) Th..... 2:00pm- 2:50pm (CHM 0127)

Course Description

Chemistry 271 is the fourth semester of our integrated introduction to general and organic chemistry. This course covers aspects of chemical thermodynamics and kinetics. Thermodynamics is the study of what is possible and the extent to which it is possible. Kinetics is the study of how rapidly the possible chemical transformations actually occur. The material covered here will help place your qualitative understanding of chemical reactivity from organic chemistry on a more quantitative basis. It is required for a fundamental understanding of biochemistry. Physical chemistry explores more of the underlying theories for the concepts developed here. The following areas will be emphasized:

- Chemical Equilibria: \(K_{eq}\), especially acid-base reactions; \(pK_a\), titrations, buffers. Ideal gas law.
- Thermodynamics: Enthalpy, entropy and free energy, 1\textsuperscript{st}, 2\textsuperscript{nd}, and 3\textsuperscript{rd} laws of thermodynamics.
- Relationships among thermodynamics and chemical equilibria: where does \(K_{eq}\) come from?
- Electrochemistry and oxidation-reduction reactions, and their connection to thermodynamics.
- Kinetics: Maxwell-Boltzmann distribution, reaction rates and orders, elementary reactions and mechanisms, the steady state approximation, activation energy, catalysis

There are two sections of Chemistry 271, each including different special topics that are extensions of the core material above. This section is the “bio-flavored” one, as I am a biophysical chemist. Time permitting, the special topics we will cover are listed below:
Acid-base: Modulation of protein folding and enzymatic activity and mechanism by pH.

Thermodynamics: Theory and application of DNA hybridization (duplex formation).

Redox: Real batteries and electrodes; alternative metabolic lifestyles among prokaryotes.

Kinetics: fundamental pharmacokinetics; blood as beaker.

**Relationship to Other Sections and Courses**

Prerequisites for this course include Chemistry 131, 231, and 241, all of which I hope you remember well. We will use some calculus as well, although you will not need to use it for assignments or exams. Some of this course may be review for you, but I think there will be new material for all.

The two lecture sections of Chemistry 271 (this one at 12 and Dr. Mignerey’s at 9) have independent schedules and will cover different material, especially in the extension sections. Exams are independent. You are strongly advised to attend the lectures for the section for which you are registered. The sections will have similar expectations of students, so your section choice should not affect your grade.

The Discussion sections for this class are required. There may be material that is presented in only in Discussion for which you will be responsible on exams. There will be two short required quizzes given in Discussion. You will be notified at least a week before each quiz. You are permitted to attend different discussion times if it is okay with Sarah, but as above you are strongly urged to remain with this section of the course rather than attending any of the 21xx discussions.

Many of you are concurrently taking the bioanalytical chemistry laboratory course, Chemistry 272, with Dr. Lee Friedman. Dr. Friedman and I have attempted to coordinate coverage between lab and lecture, but we may not always be successful. Chemistry 272 is a stand-alone course, and the grading policies and the curve or lack of same for the two classes are completely independent.

This course sequence is somewhat unusual, and we still are working the kinks out of the SmartWork system. Please bear with us as we continue to smooth rough edges, and feel free to send feedback: the best way to do this is to participate 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.

**Assignments, Procedures, and Grading**

The breakdown for points (500 total for the class) is as follows:

Quizzes and homework: 100 points. I anticipate one graded problem set (20 points), two discussion quizzes × 15 points each, and a total of 50 points awarded for SmartWork homework. I will also assign ungraded problems. Thoughtful completion of all assigned work, whether or not it is graded, is strongly correlated with overall success!

Hour exam 1: 100 points
Hour exam 2: 100 points
Final exam: 200 points

The exams will be difficult. You are not expected to get 90% to get an A. When in real life do we ever really expect to approach perfection? Formal letter grades will not be assigned for individual exams, only at the end of the course. Final grades will be based on a curve, with a distribution of about 25:30:30:15 A:B:C:D/F, with some adjustment possible depending on how the class as a whole performs. Thus the median will probably be a B−. D’s and F’s will be given only as needed, but given without hesitation: I would be thrilled to give none, but typically I am forced to give about 10-15% D’s and F’s (~20% including W’s). Plus/minus grades will be given, with the lines drawn by eye. Exam, quiz, and homework
grades will be available on ELMS. Exams will require calculators, and no other aids will be permitted.

Students always ask whether improvement counts, and someone is always one point below any cutoff. My grading policy is intended to take these circumstances into account in an objective way. The procedure is as follows: (1) I assign cutoffs (just as a concrete example, the A/B line might be 330 points and the B/C line at 290). Anyone whose overall point total is above the cutoff receives the higher grade. (2) Anyone whose score is within 15 points below the cutoff is assessed individually. If the 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. So, if the average final exam score among students scoring between 290 and 330 happened to be 126.3, then anyone scoring ≥ 127 points on the final and having a point total between 275-290 would earn a B−.

If there is clerical error on an exam grade, just let me know and we will fix it. If you believe there is a substantive grading error, you may submit the exam for regrading along with a very brief note describing the issue. Do not alter your exam in any way. I reserve the right to regrade the entire exam, not just the problem in question, so it is probably worth your while to ask for a regrade only if you feel truly underappreciated. Rergrade requests will be accepted up to one week following the return of the exam.

If you absolutely must miss 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 can then either be assigned a grade based on the remaining exams and homework or else take a comprehensive makeup exam at the end of the semester. If you miss the final or both hour exams, you will fail the class. If you have a disability issue handled through DSS, please let me know as soon as possible so that accommodations can be made.

Cheating will not be tolerated: I expect and enforce adherence to the University’s Code of Academic Integrity, found at http://www.studenthonorcouncil.umd.edu/code.html and incorporated here by reference. I will expect you to write out and sign the University honor pledge on each exam: “I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination.” Cell phones must be turned off and stored out of reach and sight during exams, and headphones may not be used. As a condition of remaining in the class you are also specifically directed to read my plagiarism web page: http://www.biochem.umd.edu/biochem/kahn/plagiarism.html.

Please try to be on time for class. Please make sure that your cell phone does not ring during class. If you use a laptop during class, make sure the material on it does not distract your neighbors. I can’t realistically stop you from texting, but you can’t realistically learn and text at the same time: pick one.

Textbooks

Required: T.R. Gilbert, R.V. Kirss, N. Foster, and G. Davies (2009). Chemistry: The Science in Context. 2nd edition. W.W. Norton & Company, New York. The supporting text web site is http://www.wwnorton.com/college/chemistry/gilbert2/welcome.asp We will also use the SmartWork homework system (see below). The bookstore has stocked a reduced-cost softcover Special Edition for this course consisting of chapters 5 and 10-20 (the same as the edition that was used last semester) bundled with e-book access to the entire text and SmartWork registration. The bundle is ISBN 978-0-3-9319601-6. You are free to buy a used custom text or the complete hardcover version, ISBN 978-0-393-92649-1, but you will need to buy SmartWork access in addition, ISBN 978-0-3-9311359-4. Sections in Gilbert containing relevant material to be read for background or amplification are specified for each lecture. Try to read ahead. You are not responsible on exams 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, whether or not the homework is graded.

Any undergraduate biochemistry textbook will be a useful resource for Special Topics I, II, and III.

**Lecture Notes and Suggestions for Success**

All lecture notes will be posted to ELMS, typically after the lecture, as PowerPoints and/or PDFs. The lecture notes are quite detailed, as there is material 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, and YouTube could replace professors there would be no need for you and I and Sarah to have this quality time together.

I recommend that you take notes in lecture and then soon after the lecture go over the notes, compare them to or combine them with the PowerPoint, and flag anything that you don’t understand. Ask Sarah or myself as soon as possible about anything that is not clear. If I suggest in lecture that you work an example or think about something, that is a hint about what might be on an exam.

Do the assigned problems well before the exam, so you will have time to read the problem set key carefully. Sample exams will also be available. Keep up with the material!

**Tentative Lecture Schedule: Exam dates are firm, quizzes and p-sets may change**

### I. Chemical Equilibria, especially acid-base

1. Introduction, review of gas laws and the meaning of temperature  
   M, 1/25/10
2. Chemical equilibrium and LeChatelier’s principle; Gilbert, Chapter 15.1, 15.7  
   W, 1/27/10
3. The Equilibrium Constant and calculations using it. 15.2-15.4, 15.8  
   M, 2/1/10
4. Acid-base reactions and the pH scale; 16.1-16.3  
   W, 2/3/10
5. $K_a$, $pK_a$, $K_w$, Lewis acids and bases; 16.4-16.6, 17.1-17.4  
   M, 2/8/10
6. Henderson-Hasselbach equation, buffers and titrations; 16.8-16.10  
   W, 2/10/10
7. Catch up and review acid-base  
   M, 2/15/10
   → Quiz I (15 pts) will be given in Discussion this week (2/16 and 2/18)
8. Special Topic I: Ionizable groups in proteins and enzymes  
   W, 2/17/10
9. Protonation/deprotonation in enzymatic reactions, pH and enzymatic activity  
   M, 2/22/10

### II. Thermodynamics

10. Review of thermochemistry; Chapter 5  
    W, 2/24/10

→ **EXAM I ← Covers through Lecture 10 (before EW grades March 4)**  
    M, 3/1/10

    W, 3/3/10
12. Free energy and chemical equilibrium; 13.4-13.6, 15.5, 15.9  
    M, 3/8/10
13. Review Statistical thermodynamics and chemical equilibrium  
    W, 3/10/10
   → Spring Break, 3/15-3/19
14. Special Topic II: DNA hybridization and its applications (Graded Problem Set, 20 pts)  
    M, 3/22/10
15. DNA hybridization thermodynamics  
    W, 3/24/10
III. Electrochemistry

16. Electrochemical cells and standard reduction potentials; 18.1-18.2  
   M, 3/29/10

17. The Nernst equation and calculation of equilibrium constants; 18.3-18.6  
   W, 3/31/10

18. Catch-up and review of electrochemistry  
   M, 4/5/10

→ EXAM II ← Covers through Lecture 18 (before drop date 4/9/10)  
   W, 4/7/10

19. Special Topic III: Redox reactions in biochemistry; 13.6  
   M, 4/12/10

IV. Chemical Kinetics

20. Maxwell-Boltzmann distribution, review dynamic equilibrium  
   W, 4/14/10

21. Reaction rates, reaction order, rate constants; 14.1-14.2  
   M, 4/19/10

22. Differential and integrated rate laws; 14.3  
   W, 4/21/10

23. Reaction mechanisms, steady-state approximation; 14.4-14.5  
   M, 4/26/10

→ Quiz II (15 pts) will be given in Discussion this week (4/27 and 4/29)

24. Eyring theory, free energy reaction coordinate diagrams, catalysis; 14.6  
   W, 4/28/10

25. Special Topic IV: Pharmacokinetics  
   M, 5/3/10

26. Catch-up and review of kinetics  
   W, 5/5/10

27. Overall wrap up; thermodynamics and economics of climate change  
   M, 5/10/10

→ COMPREHENSIVE FINAL EXAM ←  
   Friday, 5/14/10, 10:30 a.m.-12:30 p.m.

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

SmartWork System (50 points)

The SmartWork system is an on-line version of the problems in the textbook. SmartWork problem sets will be assigned periodically, along with ungraded problems. You are given some hints to help you solve the problems. Note that the SmartWork system is quite finicky about the formatting of answers, so it takes some getting used to. The system keeps track of your performance. You can try problems as often as you want and still get full credit, but if the assignment is submitted late you will be marked off 20%. The main point of the on-line homework is to encourage you to keep up with the material and the problem sets. The only way to learn chemistry is to solve problems.

See the next page for the SmartWork enrollment information provided by the publisher.

**WHEN YOU FINISH A SMARTWORK ASSIGNMENT YOU MUST CLICK ON THE “SUBMIT ALL” BUTTON OR THE SYSTEM WILL NOT RECORD YOUR SCORE.**

The class enrollment code for SmartWork is GILBERT627

This document will always be on ELMS, so there should be no need to reprint it.
To enroll in SmartWork you will need an Enrollment Key (provided by your instructor), a valid email address, and a Registration Code from W. W. Norton.

MY ENROLLMENT KEY IS:

Registration codes are contained within SmartWork folders; these are bundled with new books at your instructor's request. If you do not have a registration code, you may purchase one at wwnorton.com/students.

All students have free access to SmartWork for a two-week trial period. After that, you must enter a registration code to access your coursework.

1. Go to wwnorton.com/smartwork and log in
2. Select “Create an account”
3. Fill out all fields and click “Create my new Account.”

Don’t forget to record your account information for future reference!

4. You will be sent a confirmation email from no-reply@wwnorton.com. Retrieve the message.
5. Click “Courses” and select your instructor's course section from the list provided. When prompted, enter the Enrollment Key provided by your instructor.
6. To complete the enrollment process, log in and click “Fully enroll now” (top right of page). Enter your registration code and click “Register Me.”

DON'T FORGET TO RECORD YOUR USERNAME AND PASSWORD FOR FUTURE REFERENCE.