Chemistry 4A Fall 2014: General information.

Instructors: **Professor K. Birgitta Whaley**, 219 Gilman Hall
e-mail: whaley@berkeley.edu
office hours: Monday 4-5 pm, Wednesday 3-4 pm
Prof. Whaley is the instructor for the first half of this class

Professor Martin Head-Gordon 217 Gilman Hall
e-mail: mhg@berkeley.edu
office hours: Monday 4-5 pm, Wednesday 3-4 pm
Prof. Head-Gordon is the instructor for the second half of this class.

Class meeting time/location: Monday, Wednesday, Friday 12:00 – 1:00 PM / 1 Pimentel

Discussion Section: Tuesday 7:30 – 9:30 PM / 120 Latimer

Class web site: hosted at http://bcourses.berkeley.edu

Textbooks: We will make use of two textbooks during the semester.
(1) *Principles of Modern Chemistry*,
Oxtoby, Gillis and Campion, 7th edition, Cengage Learning 2012
(required)
(2) *Quantitative Chemical Analysis*,
Harris, 8th edition, Freeman 2010
(recommended)
(3) Student Lab Notebook or equivalent with pressure copy paper

Lab Manual: Prelab reading and lab instructions/write-ups will be located on bCourses

Assessment: 30% for three 1-hour mid-term exams (in class)
30% for one 3-hour cumulative final exam.
35% for laboratory (see Lab page on bCourses for details)
5% for weekly homework (graded on a 0 to 2 scale)

Exam Dates: 9/22 – Midterm 1
10/17 – Midterm 2
11/14 – Midterm 3
12/15 – Final Exam

***If you are unable to make these dates, please let the instructors know as soon as possible so accomodations can be made**

TA Office Hours: See on bCourses

General comments:

(1) Weekly reading: There is weekly assigned reading, which is given in this hand-out. Do this reading on a steady basis **before** lectures (20-30 minutes/lecture) to help you get more out of the lectures (which don't duplicate the book!).
(2) Weekly homework: There is a weekly set of assigned homework problems. These will generally be collected before lecture on the Monday of the following week. They will be graded on a scale of 0 to 2. Doing these problems is essential to doing well in this class! 5% of your grade will come from them directly, but your success on the exams will depend on doing the problems. Homework solutions will be posted on the web site.
(3) Work expectations – plan to spend *at least* 2 hours reading/problem solving per hour lecture, and stick to it. Steady work is the pathway to good progress. Lack of sustained work is a pretty sure guarantee of trouble.
(4) Grade expectations – we grade on an absolute scale, so everyone can do well!
(5) Get help early when you need it: Chem 4A goes fast, and your first semester at Cal also goes by fast! So, if you need help, use the available resources as soon as possible – TA and faculty office hours, mid-term review sessions, learning center/undergraduate chemistry tutoring, etc. Delay is the usual cause of real problems. Our mid-terms come along about every 4 weeks…
(6) Lab policies: Be on time for lab. GSIs have the right to dismiss you from lab if they feel you are not on time. If you cannot make a lab, please let your GSI know right away so we can schedule you to another section. If you fail to attend lab without a valid excuse, you will receive a zero for the day. Each subsequent miss will drop your grade by a full letter.

Chemistry 4A Fall 2013: Honor Code

The student community at UC Berkeley has adopted the following Honor Code: *"As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others."* The expectation is that you will adhere to this code.

Collaboration and Independence: Reviewing lecture and reading materials and studying for exams can be enjoyable and enriching things to do with fellow students. This is recommended. However, unless otherwise instructed, homework assignments are to be completed independently and materials submitted as homework should be the result of one's own independent work.

Cheating: A good lifetime strategy is always to act in such a way that no one would ever imagine that you would even consider cheating. Anyone caught cheating on a quiz or exam in this course will receive a failing grade in the course and will also be reported to the University Center for Student Conduct. In order to guarantee that you are not suspected of cheating, please keep your eyes on your own materials and do not converse with others during the quizzes and exams.

Plagiarism: To copy text or ideas from another source without appropriate reference is plagiarism and will result in a failing grade for your assignment and usually further disciplinary action. It is assumed that a list of any external references used will be provided by the student for any assignment in Chemistry 4A. For additional information on plagiarism and how to avoid it, see, for example:
http://www.lib.berkeley.edu/instruct/guides/citations.html#Plagiarism

Academic Integrity and Ethics: Cheating on exams and plagiarism are two common examples of dishonest, unethical behavior. Honesty and integrity are of great importance in all facets of life. Ethical behavior builds self-confidence and is crucial to building trust within relationships, whether personal or professional. There is no tolerance for dishonesty in the academic world, for it undermines what we are dedicated to doing – furthering knowledge for the benefit of humanity.

Your experience as a student at UC Berkeley will be fueled by a passion for learning and rewarding activities, but we also appreciate that being a student can be stressful. There may be times when there is temptation to engage in some kind of cheating in order to improve a grade or otherwise advance your career. This could be as blatant as having someone else sit for you in an exam, or submitting a written assignment that has been copied from another source. And it could be as subtle as glancing at a fellow student's exam when you are unsure of an answer to a question and are looking for some confirmation. By becoming a member of the academic community at Berkeley you have agreed to eschew such behavior for your own personal growth and the community as a whole.

Chemistry 4A Fall 2014: Course Outline

Readings are from the two textbooks Oxtoby et al, (O) and Harris (H), with chapters denoted as, e.g., O2 for Ch. 2 of Oxtoby.

1. A Reminder about Stoichiometry

8/29: Moles, molecular formulas and chemical equations.
Week 1 reading: O1, O2

2. Elementary ideas of chemical bonding

9/1: Labor Day Holiday (no lecture)
9/3: Electronegativity and ionic bonding
9/5: Covalent bonding and Lewis structures
Week 2 reading: O3

3. Quantum concepts – I

9/8: Molecular shape
9/10: Waves, electromagnetic radiation, blackbody radiation, Planck relation
9/12: Photoelectric effect, quantization in atoms, the Bohr atom and atomic spectra
Week 3 reading: O4.1-O4.3

4. Quantum concepts - II

9/15: Diffraction and the de Broglie relation
9/17: Schrodinger equation and quantum mechanics of a particle in a 1-d box
9/19: Particles confined in 2-d/3-d and the harmonic oscillator
Week 4 reading: O4.4-O4.6

5. Atomic structure.

9/22: **Mid-term 1**
9/24: Energy levels of 1-electron atoms
9/26: Energy levels of many-electron atoms, periodicity
Week 5 reading: O4.7 and 5

6. Chemical bonding in molecules - I

9/29: Intro. to molecular bonding – Born-Oppenheimer, H_2^+, molecular orbitals
10/1: MO description of diatomic molecules
10/3: MO description of heteronuclear diatomic molecules
Week 6 reading: O6

7. Chemical bonding in molecules - II – and spectroscopy

10/6: Orbital Hybridization (VSEPR) and MO diagrams for polyatomic molecules
10/8: Bonding in organic molecules and aromaticity
10/10: Electronic Spectroscopy

Week 7 reading: O6, O7.1 – O7.5

8. Molecular Spectroscopy (contd)

10/13: Molecular vibrational/rotational energy levels and spectroscopy
10/15: Transition Metal Complexes and their spectroscopy
10/17: **Mid-term 2**
Week 8 reading: O20.1-20.2, 20.5, O8

9. Gases & intermolecular forces

10/20: Macroscopic perspective: ideal gas laws
10/22: Microscopic perspective: kinetic theory of gases and absolute temperature
10/24: Real gases, intermolecular forces, and phase transitions
Week 9 reading: O9, O10.1-10.2

10. Phase transitions and colligative properties

10/27: Phase diagrams and their applications
10/29: Solutions and colligative properties, Raoult's and Henry's Law
Week 10 reading: O10.3-10.6, O11.5-O11.7

11. Thermodynamics and the 1st law

10/31: Introduction to thermodynamics and the 1st law
11/3: Heat capacity, ideal gases, and enthalpy
11/5: Thermochemistry
11/7: Specific heat, bond energies and applications
Week 11 reading: O12

12. Spontaneous processes, disorder and the 2nd law

11/10: Disorder and entropy
11/12: Entropy, the 2nd Law, and spontaneous processes
11/14: **Mid-term 3 (IN CLASS)**
Week 12 reading: O13

13. Free energy and equilibrium

11/17: Gibbs free energy: reformulating the 2nd law
11/19: Chemical equilibrium, mass action, equilibrium constants
11/21: Temperature dependence, homogeneous & heterogeneous equilibria
Week 13 reading: O14 (H6-H7)

14. Acid-base equilibria

11/24: Acid/base classification, acid/base scales, weak acids
11/26: Buffers and acid-base titration curves
11/28: **THANKSGIVING HOLIDAY**
Week 14 reading: O15 (H8-H12)

15. Electrochemistry

12/1: Electrochemical cells, cell potentials & Gibbs free energy
12/3: Concentration effects, Nernst equation, cyclic voltammetry
12/5: Batteries, fuel cells, artificial light harvesting
Week 15 reading: O17 (H13-H17)

16. RRR Week

12/8 – 12/12: REVIEW WEEK

Final Exam: Cumulative

Monday December 15 3-6 pm
Location to be announced