

Chemistry 1A Fall 2016: General information.

Instructors: **Professor Martin Head-Gordon**, 217 Gilman Hall, tel. 642-5957,
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MHG gives the 9AM and 11AM lectures
office hours: Tuesday 12-1PM / Thursday 5-6PM. Location TBA

Professor Teresa Head-Gordon 274 Stanley Hall, tel. 666-2744,
e-mail: thg@berkeley.edu
THG gives the 1PM lecture (apart from some Wednesdays!)
office hours: Wednesday 5-6PM. Location TBA

Textbook: The following textbook is required
Chemical Principles: The Quest for Insight
by Atkins, Jones and Laverman, 7th edition, Freeman 2016

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

Assessment: 45% for three 2-hour mid-term exams
40% for one 3-hour cumulative final exam.
5% for discussion section worksheets
10% for on-line homework

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. Doing these problems is essential to doing well in this class! 15% of your grade will come from them directly, but your success on the exams will depend on doing the problems.
- (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 1A 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 office hours, mid-term review sessions, learning center tutoring, etc. Delay is the usual cause of real problems. Our mid-terms come along about every 4 weeks...

Chemistry 1A Fall 2016: Course Outline.

Reading is from the class textbook (Chemical Principles, by Atkins et al)

1. A Reminder about Stoichiometry

8/24: Moles, molecular formulas and chemical equations.

8/26: Solutions, concentrations, Acid-base chemistry, redox reactions

Reading: Fundamentals

2. Quantum concepts & atomic structure

8/29: Waves, electromagnetic radiation, Planck & de Broglie relations

8/31: Quantization in atoms, the Bohr atom and atomic spectra

9/2: Particle in a 1-d box and the link between nodes and energy levels

Reading: 1A, 1B, 1C

3. Atomic structure.

9/5: No lecture: Labor Day.

9/7: Energy levels of 1-electron atoms, nodes, and periodic table

9/9: Energy levels of many-electron atoms, periodic trends.

Reading: 1D, 1E, 1F

4. Ionic and covalent bonding: the classical picture.

9/12: Ionic bonding, Coulomb's Law & the octet rule

9/14: Lewis structures for covalent bonding

9/16: Extensions for polar bonding, violations

Reading: 2A, 2B, 2C, 2D

5. Molecules and giant molecules.

9/19: Organic functional groups and polymers

Midterm 1: Tuesday Sept. 20 7-9PM

9/21: Biopolymers

9/23: VSEPR model for molecular shape

Reading: 11D, 11E, 2E

6. Molecular orbital theory & computation

9/26: MO's in diatomic molecules: node counting
9/28: MO's in polyatomics: more node counting!
9/30: Computing the energy and structure of molecules
Reading: 2F, 2G, Supplementary material supplied.

7. Experimentally probing molecules with radiation

10/3: Electronic energy levels: Photoionization & UV-vis spectroscopy
10/5: Microwave and infrared spectroscopy.
Reading: Supplementary material will be supplied.

8. Gases, liquids and solids

10/7: Macroscopic gas laws vs microscopic kinetic theory
10/10: Maxwell distribution, intermolecular forces & real gases
10/12: Liquids and phase transitions
10/14: Types of solids & their uses
Reading: 3A-H

9. Thermodynamics and the 1st Law

10/17: Introduction to thermodynamics and the 1st law
Mid-term 2: Tuesday Oct. 18 7-9PM
10/19: Enthalpy, thermochemistry & bond energies
10/21: Combustion and world energy usage
Reading: 4A-E

10. Spontaneous processes, disorder and the 2nd Law

10/24: Disorder and entropy
10/26: Entropy, the 2nd Law, and spontaneous processes
10/28: Gibbs free energy: reformulating the 2nd law
Reading: 4F-J

11. Free energy and equilibrium

10/31: Reaction quotients and equilibrium constants
11/2: Chemical equilibrium, mass action, equilibrium constants
11/4: Temperature dependence, homogeneous & heterogeneous equilibria
Reading: 5G-J

12. Acid-base equilibria

- 11/7: Acid/base classification, acid/base scales, weak acids
 - 11/9: Acid-base titration curves
 - 11/11: No lecture: Veteran's Day.
 - 11/14: Weak acids, buffers, polyprotic acids
- Reading: 6A-I

13. Electrochemistry

- Mid-term 3:** Tuesday Nov. 15 7-9PM
- 11/16: Electrochemical cells, cell potentials & Gibbs free energy
 - 11/18: Concentration effects, Nernst equation
 - 11/21: Batteries, fuel cells, natural & artificial light harvesting
 - 11/23: No lecture: Thanksgiving break
 - 11/25: No lecture: Thanksgiving break
- Reading: 6M-O

14. Chemical kinetics

- 11/28: Rates of reactions & elementary steps
 - 11/30: Reaction mechanisms & steady state approximation
 - 12/2: Temperature dependence and catalysis
- Reading: 7A-E