Chemistry 353 Fall 2009

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Course page: http://chemweb.calpoly.edu/jhagen/353.htm. You will be able to check your grades on the Blackboard website at the Cal Poly Portal: http://my.calpoly.edu.

Office hours: Mondays and Wednesdays 3:10-4:00, Tuesdays 2:10-3:00, Thursdays 4:10-5:00, and Fridays 12:10-1:00. You may also call or email me for an appointment.

Texts: *Quantum Chemistry and Spectroscopy*, Engel

Tests: There will be three tests and a comprehensive final. If you must miss an exam, notify me well in advance by phone or email; you will also need to document your excuse.

Email: I will email the course distribution list, so it is a requirement of this course that you check your Cal Poly email.

Homework: The best way to learn physical chemistry is by working many problems. After leaving class, do the exercises that accompany the chem-activity you have completed in class. At this point, you should also read the relevant sections in your book. As you read the text, verify the examples given; don't just read passively. Do the problems in the back of each chapter your book. Keep working until you understand each problem completely. **I will put at least one problem from the homework on each test.**

Ethics: It is Cal Poly policy that students who cheat must be expelled from the course and receive an *F in the course* (Campus Administrative Manual, section 684.2). I must also send a letter to the department chair and to the office of the Vice-President for Student Affairs. Cheating of any form, *including plagiarism*, will not be tolerated.

Letter grade cut-offs: You are guaranteed <u>at least</u> the grade shown.

93	A
90	A-
87	B+
83	B
80	B-
77	C+
73	C
70	C-
67	D+
63	D
60	D-

Calculation of grade:

Exam I	22 %
Exam II	22 %
Exam III	22 %
Final	34 %
Total	100%

Dynamic Course Schedule

Details and homework will be added as we approach each chapter. Check the website for the updated version.

Week	Topic	Chapter	Homework
1	Introduction: No class today, **but you should read chapter 1**. It is partially review from general chemistry, but you will find it very helpful. You should be able to: interconvert between wavelength and energy and calculate de Broglie wavelengths.		
	You should be able to: explain why bound systems are quantized, normalize a wavefunction, show two wavefunctions are orthogonal, and calculate an eigenvalue of an eigenfunction of an operator	1	Q1-5, 10 P2, 4, 6, 10, 15, 19, 21
	The Schrodinger Equation Eigenfunctions, Eigenvalues, and Operators and Observables	2	P, 10, 12, 14, 16, 18, 22, 26
2	Measurement and Expectation Values	3	
	1 D particle in a box	4	P, 3, 8, 11, 13
	1 D particle in a box	4	P7, 21, 23
3	3 D particle in a box, applications	4, 5.8	P.3 and 5.4
	Particle in a square well and Tunneling	5, 6	Q1, 2, 7
	FURLOUGH		
4	**Exam 1: Chapters 1-4, 5.8**		
	Commutation and the Heisenberg Uncertainty Principle	6	

	The Harmonic Oscillator	7	P1, 4, 11, 14, 15, 16
5	The 2-D Rigid Rotor/Particle on a Ring	7	18
	The 3-D Rigid Rotor/Particle on a Sphere	7	19, 20, 24, 29
	Rotational Spectroscopy You should be able to calculate the relative population of different energy levels, calculate the wavenumber for a rotational transition from the bond length, and apply the gross and specific selection rules for microwave spectroscopy.	8	14-18, 20
6	Vibrational Spectroscopy You should be able to calculate a spring constant for a bond given the wavenumber of the absorption, distinguish IR-active from IR inactive vibrational modes, apply the specific section rule, and apply the Boltzmann distribution to vibrational energy levels.	8	1-3, 8
	Rotational-Vibrational Spectroscopy; Ramen Spectroscopy	8	
	Hydrogen Atom You should be able to calculate the energies of the different orbitals, determine the number of radial and angular nodes of a wavefunction, for a bond given the wavenumber, and sketch the various orbitals.	9	Q2, 8 P1-4, 5, 6, 11, 14, 15, 21
7	Spin You should be able to calculate possible values of spin angular momentum for particles with different values of s, and generate antisymmetric wavefunctions using a slater determinate.	10	P2 and 6
	Exam 2: Chapters 5-8		
	Variation Method You should be able to apply the variation method	10	

8	STOs, the Self-Consistent Field method, and periodic trends. You should be able to construct STOs, and justify periodic trends using effective nuclear charge.	10	13, 28, 29
	Holiday: Veteran's Day		
	Atomic term symbols. You should be able to calculate spin and angular momentum quantum numbers, and determine term symbols for 1 and 2 electron configurations.	10	12, 15, 18, 20, 21, 26
9	Atomic Spectroscopy: Selection rules, absorption, emission, fluorescence, phosphorescence, and lasers. You should be able to put atomic terms in order of energy, apply selection rules, and interpret Grotrian diagrams.	11	Q2 P3, 12
	Bonding: VB and MO theory	12	1. Explain the Born-Oppenheimer approximation. 2. Explain the difference between the valence and molecular orbital bonding models.
	Molecular Orbitals and Diatomic Molecules	13	5-13, 15
10	**Exam 3: Chapters 9-11**		
	Holiday: Thanksgiving		
11	**FURLOUGH**		
	Molecular Orbitals and Diatomic Molecules	13	5-13, 15
	Molecular Term Symbols, Transitions, Fluorescence, and Phosphorescence	15	Q1, 4, 6, 8, 13, 14
Comprehensive ACS Final Wednesday, December 9, 10:10am-1:00pm			

How to study for this course

Would you like a good grade in this course? Of course! Doing well in physical chemistry is completely straightforward. Not easy, but straightforward. Just follow the instructions below. They won't guarantee an *A*, but if you don't follow them, an *A* is extremely unlikely.

1. Forget about learning the necessary information the night before an exam. Cramming doesn't work, and for good reason. When we learn, we are changing the physical structure of our brains. This process cannot be rushed. It's not like downloading software—it's more like growing a plant. You will not learn unless you pace your study sessions. One hour every night is **much, much** better then one 20-hour cram session before the exam.

2. Read ahead before every lecture. You will not understand perfectly, but it will help you to understand the lecture.

3. Re-read the chapter after the lecture, and compare your lecture notes with the textbook. Do they agree? Make sure you understand. Still confused? Write down your questions and come to office hours.

4. Work problems. Work examples from lecture. Work problems in the book.

5. Check your answers. When you are done working, test yourself. You should be able to do all the problems from scratch, without flipping back through the chapter. If not, work more problems.