Chemistry 346, Section M001 Fall 2009

class meets MWF 11:40-12:35 in 105 Life Sciences
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telephone ext 3035
office hours: M W F 2:00-3:00 and by appointment
textbook: Physical Chemistry, eighth edition by Peter Atkins & Julio de Paula (Freeman & Co., 2006).

SYLLABUS

This is the first course in physical chemistry. Physical chemistry is the branch of chemistry in which chemical phenomena are described and analyzed in a general way. It is not concerned with specific chemical reactions or particular properties of individual chemical substances. Rather, it is involved with the general laws about how matter behaves, on both the macroscopic and molecular levels. Since the laws are general and a little abstract, they are almost always in mathematical form. The good thing about mathematical laws, as compared to specific chemical properties, is that there is a lot less to remember. On the other hand, one always has to remember what the laws mean and what they refer to – they are not combinations between Greek and Roman letters.

The mathematics we need is mostly algebra, with a little trigonometry and a little calculus (like knowing how to differentiate and integrate, and understanding the difference between the two). However, some students have more trouble with the mathematics than with the subject matter itself. Somehow, mathematical manipulations seem more difficult when the variables are called S and T rather than x and y. Often, remembering what the symbols mean is helpful when deciding what to do with them. We will try to emphasize the meaning of equations and formulas when we present them and use them.

The branches of physical chemistry include thermodynamics, reaction kinetics, quantum chemistry, and statistical mechanics. In this first semester, CHE 346, we are concerned with thermodynamics and its chemical applications. Thermodynamics is the branch of chemistry (or physics) which describes the interactions of energy and matter or, if you take the name literally, the relation between heat and energy. Everybody has heard of the Laws of Thermodynamics, and we will have a lot to say about them in this course. We will try to emphasize their meaning by giving chemical applications. Although it is interesting to think about what the laws "really mean," understanding of the Laws comes more from using them than from thinking about them.

In fact, only when you can apply thermodynamics to specific problems can you say you really understand it. That is why problem sets are important. Eight problem set assignments (mostly involving problems from the textbook) will be made; the schedule below shows the dates they will be assigned. Each set will have a due date about a week later. Submitted problem sets will be graded (by the TA's from the physical chemistry lab), and the grades will count in the final grade (see below). However, it is fine for students to work together on problem sets, or come to me (or anyone else) for help with them. I require only that each student submit a *legible* set of solutions for grading; neither the TA's nor I will give credit for what we can't read. Of course, if a set isn't submitted, it gets a 0 grade.

There will be three one-hour examinations and a semi-comprehensive two-hour final exam (see schedule below). The final examination will be on Tuesday, December 15, from 7:15 to 9:15 PM, in our regular classroom, 105 Life Sciences. The exams will consist mostly of problems, like those on the problem sets but shorter; there will probably also be some short-answer or multiple-choice questions. I will grade the exams myself. Before each exam, I will try to give you a review sheet telling you what will be covered. The best way to study for an exam is to do problems, including the ones on the problem sets, the ones in the book, and the exercises worked out in the book.

Final course grades will be assigned based on total points earned. Each hour exam will have a total of 100 points. The final exam will count approximately 1½ times an hour exam, i.e. about 150 points. Each problem set will count between 10 and 15 points. Thus, it is anticipated that the total points available will be between 550 and 600.

The topics covered are shown in the course calendar below, with references to the sections in the textbook. We will be following the Atkins textbook pretty closely, except for the last subject, electrochemistry. I will be giving some additional material for that subject because I don't like the way the book presents it. The dates of exams (except for the final) as well as the dates on which specific topics are covered, should be considered as first approximations. The little numbers at the lower right of boxes are the numbers of the lectures – there are 38 of them. We will be covering most of the first seven chapters of the Atkins text book. The section numbers for each topic in the calendar refer to the textbook.

The class size is small enough so we can have discussion, or at least questions, in class. Don't hesitate to ask about things that are not clear. For more help or questions, contact me by telephone (443-3035), in person (preferably during office hours - see above), or by email (goodisma@syr.edu). If you can't come during my office hours, we can surely make an appointment for another time.

Approximate Calendar for this course is below
(numbers refer to sections in Atkins & DePaula)

Sunday	***Monday***	***Tu***	***Wednesday***	***Th***	***Friday***
August 30	Definitions, properties of gases 1.1 – 1.2		Ideal gas laws, molecular theory 1.2, 21.1		Molecular theory, real gases 21.1, 1.3 – 1.4

September 6	***Labor Day – no classes***		Energy, heat, & work 2.1 – 2.2 4		Work and heat in various processes 2.3 – 2.4 *1st problem set given*
September 13	Enthalpy and enthalpy changes 2.4 – 2.5		Adiabatic processes, thermochemistry 2.6 - 2.7 7		Hess' Law, standard enthalpy changes 2.7 – 2.8
September 20	**Eid Ul-Fitr – no classes**		Problems in thermochemistry 2.8 – 2.9 *2nd problem set given*		State functions & exact differentials 2.10 – 2.11 10
September 27	**Yom Kippur – no classes**		Changes in internal energy 2.11 – 2.12		**first examination**
October 4	Energy, entropy, and spontaneous change 3.1-3.2		Entropy changes, Carnot engine 3.2 – 3.3 13		Third Law of thermodynamics 3.4 *3rd problem set given*
October 11	Helmholtz and Gibbs energies 3.5		Gibbs energies of reaction, fundamental equation 3.6 – 3.7 16		Mathematics of thermodynamics 3.8 – 3.9 17
October 18	Phases and phase equilibria 4.1– 4.3 *4th problem set given*		One-component phase diagrams, Clausius-Clapeyron 4.3 – 4.5		Phase transitions, mixtures 4.5 – 4.7, 5.1 20
October 25	**second examination**		Partial molar quantities, mixing 5.1 – 5.3 *5th problem set given*		Solutions 5.4 22
November 1	Colligative properties 5.5		Osmotic pressure, activities of solvent 5.5 – 5.7 24		Non-ideal solutions, ionic solutions 5.8 – 5.9
November 8	Ionic activities and molalities, Debye-Hückel Law *5.9, 6.1*		Phases, Phase rule 6.1 – 6.2 *6th problem set given* 27		Two-component systems 6.3 – 6.4
November 15	Liquid-liquid phase diagrams 6.5 29		**third examination**		Liquid-solid phase diagrams 6.6 30
November 22	Equilibrium and equilib. constants 7.1 – 7.2		***Thanksgiving break – no classes***		***Thanksgiving break – no classes***

	7th problem set given				
November 29	Effect of changes in temperature and pressure 7.3		Equilibrium constant as function of temperature 7.4 33		*Electrochemical potentials, introduction to electrochemical cells*
December 6	Electrochemical cells and half-cells 7.5 *8th problem set given* 35		Electrochemical cells, EMF 7.6 – 7.7		Standard potentials 7.8 37
December 13	Applications of electrochemistry 7.9 38		***December 14 was the last day of classes***		***Final Exam is on Tue. Dec. 16, 7:15-9:15 PM***