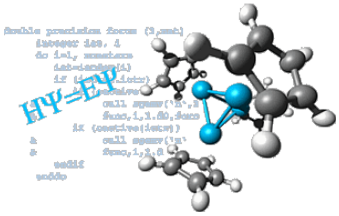
CHEM 165 – Introduction to Physical Chemistry



Time: 9:40-10:30 AM MWF

Room: Waterman 427

Lecturer: Jianing Li (uvm.pchem@gmail.com, Discovery W309)

Office Hour: Monday to Friday 4:30-5:05pm

Summary

Chem 165 is the first semester of the year-long course in physical chemistry. During this first semester, all aspects of physical chemistry will be covered at an introductory level. In broad strokes, the topics comprise: quantum mechanics, spectroscopy, thermodynamics, and kinetics.

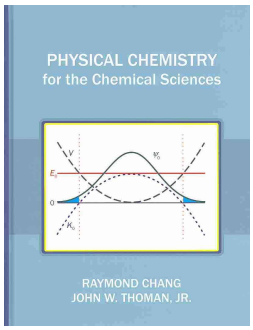
In physical chemistry, the general objective is to understand the underlying theory of many of the facts and rules you have learned in prior chemistry courses. This, in turn, requires math/physics familiarity, rather than knowledge of chemistry in the form of molecular formulas and their reactions. For example, it is a fact that atomic orbitals are the basis of bonding, but do you know why a p-orbital has a "dumbbell" shape? [This was not plucked out of thin air.] It is also a fact that the energy contained in bonds is the basis for chemical reactions, but do you know why two hydrogen atoms would rather get together to form a molecule than exist apart? [Saying that two orbitals "overlap" is fuzzy, and is not a real answer.] At the thermodynamics end, we know that spontaneity is connected to lowering entropy, but is that always true? (Think of amino acids spontaneously forming DNA.) And how did "entropy get invented anyway? Why do there seem to be two worlds, the macroscopic which we track with thermodynamics vs. the microscopic where quantum mechanics is the coin of the realm?

It is the goal of this course to help you to understand how a study of physical chemistry provides clear answers to the above questions, and in the process, demystify these subjects for you.

Textbooks

Required:

- *Physical Chemistry for the Chemical Sciences*, by Raymond Chang and John W. Thomas, JR



We will cover

Chapter 1: Properties of gases (kinetic theory, van der Waals equation)
Chapter 2: Kinetic Theory of Gases (Maxwell distribution)
Chapter 3: First law of thermodynamics (heat, work, enthalpy, and thermochemistry)
Chapter 4: Second law of thermodynamics (entropy, Gibbs free energy)
Chapter 5: Gibbs energy applications (phase equilibria, phase diagrams)
Chapter 6: Solutions (colligative properties, phase diagrams of mixtures)
Chapter 10: Quantum mechanics (classical physics, Schrodinger equation, particle in a box)
Chapter 12: Electron structure (the hydrogen atom, many-electron atoms)
Chapter 15: Chemical kinetics (experimental rates, reaction order, temperature dependence)

There are 40 lectures in the semester. On average, each of these 9 chapters will take about 4-5 lectures to cover.

While this textbook closely approximates my pedagogic approach, you should understand that for most upper level courses the textbook is an aid, not the "bible". Depending on the material/chapter, various sub-topics will not be covered in class (or the reverse). The rule of thumb to use in this course is that if a concept is not discussed in lecture, you don't need to know the corresponding passage of a chapter unless I assign some reading on your own. Conversely you are responsible for all material discussed in class.

Also, be aware that much of the content may be presented by me differently from the way the author has done a given topic. Having said all this, I want to emphasize that trying to learn the subtleties of physical chemistry just from attending lectures and reviewing my notes is probably not going to cut it. There is real value to reading a textbook with wording that is different from the way the instructor presents it – and it is a good book to reference for any future chemistry topic.

Homework

The content in this course is pretty challenging, and cannot be mastered without blood, sweat, and tears as you review the material and do the homework problems. Homework will be assigned at the beginning of each topic, and the graders will come to collect them before the class on the due day. They will be graded as follows:

Perfect or almost perfect, both in content and presentation (3 points)
Contains incorrect work, or was a sloppy presentation (2 points)
Contains incorrect work, and was a sloppy presentation (1 point)
Late submission by start of next lecture (score minus 1 point)
Did not turn in work by start of next lecture (0 points)

No late work will be graded. Answers will be posted on Blackboard. It goes without saying, however, that actually doing the problems on your own firms up the knowledge that is in your head. Work must be turned in on 8½ x 11 inch sheets off a pad of lined paper, and writing is to be only on one side of a sheet. One pad of such paper from the UVM Bookstore or Staples should last you all semester.

Student Learning Accommodations: In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact ACCESS, the office of Disability Services on campus. ACCESS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations via an accommodation letter to faculty with recommended accommodations as early as possible each semester.

Contact ACCESS: A170 Living/Learning Center; 802-656-7753; access@uvm.edu; www.uvm.edu/access

UVM's policy on disability certification and student support: www.uvm.edu/~uvmppg/ppg/student/disability.pdf

Religious Holidays: Students have the right to practice the religion of their choice. If you need to miss class to observe a religious holiday, please submit the dates of your absence to me in writing by the end of the second full week of classes. You will be permitted to make up work within a mutually agreed-upon time.

Academic Integrity: The policy addresses plagiarism, fabrication, collusion, and cheating. http://www.uvm.edu/~uvmppg/ppg/student/acadintegrity.pdf

Grade Appeals: If you would like to contest a grade, please follow the procedures outlined in this policy: http://www.uvm.edu/~uvmppg/ppg/student/gradeappeals.pdf

Grading: For information on grading and GPA calculation, go to www.uvm.edu/academics/catalogue and click on Policies for an A-Z listing.

Code of Student Rights and Responsibilities: www.uvm.edu/~uvmppg/ppg/student/studentcode.pdf

FERPA Rights Disclosure: The purpose of this policy is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974. http://www.uvm.edu/~uvmppg/ppg/student/ferpa.pdf

Promoting Health & Safety:
The University of Vermont's number one priority is to support a healthy and safe community:

> ***Center for Health and Wellbeing*** http://www.uvm.edu/~chwb/
> ***Counseling & Psychiatry Services (CAPS)*** Phone: (802) 656-3340
> ***C.A.R.E.*** If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by visiting the Dean of Students website at http://www.uvm.edu/~dos/

Final exam policy: The University final exam policy outlines expectations during final exams and explains timing and process of examination period. http://www.uvm.edu/academics/catalogue2013-14/?Page=allpolicies.php&SM=policymenu.html&policy=Exams