

**Chemistry 301: Physical Chemistry I**  
Department of Chemistry & Biochemistry, Loyola University Chicago  
Fall 2013

Instructor: Dr. Dan Killelea  
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Office Hours: M: 10:10–11:30 and T: 10:30 – 11:30, or by appointment (FH 103)  
Lecture: TR 1:00 – 2:15 pm, Dumbach Hall, Room 228  
Discussion: MW 9:20 – 10:10 am, Mundelein Center, Room 304  
Text: Physical Chemistry, Atkins & De Paula, W.H. Freeman, 9<sup>th</sup> Edition  
Twitter: LUC\_PChem

Course Prerequisites: Chemistry 222 or 224/226 (Organic) and Physics 112K (College Physics w/ Calculus) and Math 263 (Multivariate Calculus). Math 264 (Ordinary Diff. Eq.) is strongly encouraged. If you have not completed the course prerequisites, you may be administratively dropped from the class. Please discuss this with the instructor immediately!

Please see the sakai site for up-to-date information and posts.

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### Course Overview

Welcome to Physical Chemistry! The objective of this course is for you to gain a firm understanding of the fundamentals behind the properties and behavior of macroscopic systems. Thermodynamics is the study of how systems behave at or near equilibrium, and is widely used in chemistry to quantify the energetics of chemical systems. We will start in the very physics world of The Three Laws Of Thermodynamics; we will then see how these concepts are manifest in chemistry and guide chemical reactions through concepts such as the Chemical Potential and Gibb's Free Energy. From there, we will focus on how the thermodynamic fundamentals give rise to the properties of solids, liquids, and gases and their mixtures and solutions. Towards the end of the semester, we will look at the microscopic properties of gases and briefly cover some basic chemical kinetics. Throughout the semester, we will explore how the concepts we are studying are relevant to the critical problems facing humanity as a whole. Of the great challenges facing our society, one of the most significant is one that chemists are well suited to solve, and that is the development of new energy sources. Thermodynamics is key to understanding the obstacles in the quest for plentiful, clean fuels. The overarching goal of this course is for you, the student, to be adept at using the concepts covered in this course to critically gauge the accuracy and potential efficacy of political and scientific (!) solutions to problems that, in your lifetime, will only grow in significance.

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### Course Structure

There are two 75-minute lectures (T, R) and two 50-minute discussion sections (M, W) per week. As valuable as lectures may be, you will gain much more by **completing** assigned reading and problem sets **BEFORE** the lecture. By coming to lecture prepared, you will be able to fill in any remaining gaps, and can *ask questions* to better comprehend the material. I cannot overstate how much more useful the lectures will be if you come into the room well prepared, and even better, with questions for me and your fellow classmates. The three keys to success in physical chemistry are reading the text, solving as many problems as possible, and *asking questions!* Ask me questions about the material in class and office hours and ask your classmates questions. Furthermore, use the twitter site to ask me and your classmates questions or for clarification.

As a courtesy to your classmates, please completely silence (not just vibrate mode) any audible devices you have with you before entering the classroom. The use of computers or whatnot during class is permitted, as long as it is silent, but is discouraged.

The discussion section will be small group work. You will work in small groups (3-6 people) on problems I provide that are similar to the assigned problems, with the goal of working with your classmates to learn the material. We will also probe the material in greater depth in a more informal setting.

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## Exams, Homework, and Grading

Your grade will be determined on a basis of 550 points.

**Exams** (400 points): There will be two in class exams this semester. Each exam is worth a total of 100 points.

There *may* be 'extra credit' on the exams. During the exam you may not use *any* electronic device (e.g. cell phones or computers) aside from a non-programmable scientific calculator. Please check the calculator with me if in doubt. If any banned device is observed, this will be construed as cheating and you will receive a zero for the exam.

**Homework** (100 points): Problem sets will be assigned throughout the semester. You must turn in your homework at the *start* of lecture the day it is due. Their total value will be 100 points.

**Participation and Evaluation** (50 points): Active participation in discussion is required; asking questions in lecture is strongly encouraged. Up to 40 points are possible for students who are regular and active participants. Finally, when you complete the course evaluation, provide a copy of the acknowledgement page for 10 points.

Late homework is *never* accepted for credit. *There will be no make-up exams given under virtually any circumstance.*

**Final Exam:** The College of Arts & Sciences schedules the final exam. The final will be held on:

**Thursday, December 12, 2013 at 1:00 pm**

in Dumbach 228 (regular room). You will have exactly 2 hours to complete the exam. Additional time will not be granted, even if you arrive late. There will be no make-up final exams given under any circumstance, and the exam will not be given early, either.

**Grading:** There is a maximum of 550 points, letter grades will be assigned as given below:

	A: > 90%	A-: 88-90%
B+: 86-88%	B: 80-86%	B-: 78-80%
C+: 76-78%	C: 70-76%	C-: 68-70%
D: 55-68%	F: < 55%	

### Supplementary Material

Companion site for Atkins Physical Chemistry: <http://bcs.whfreeman.com/pchem9e>

Physical Chemistry, 6<sup>th</sup> Ed., by Ira Levine

MIT Open Course Ware, Thermodynamics and Kinetics. (<http://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/>) Excellent note source with video lectures.

Physical Chemistry, Harcourt Brace Jovanovich College Outline Series, by J. Edmund White. Unfortunately, this seems like it is out of print, but is available used. Very useful distillation of the course material for both semesters of Physical Chemistry with numerous problems.

Chemical Thermodynamics by Klotz & Rosenberg. A textbook with in-depth thermodynamic derivations.

Other texts may be put on reserve in the library

## Schedule

Note: The instructor reserves the right to make changes to the schedule, the outline below will give you an idea of the material we will cover. Any changes will be announced in class or on blackboard.

Reading assignments are from Atkins & De Paula unless noted otherwise.

Week	Date	Lecture Topics	Reading to complete	Other
1	27 Aug	Fundamentals; what is physical chemistry?	Fundamentals	
	29 Aug	Gases	Ch. 1	
2	3 Sep	1st Law	Ch. 2	No M disc
	5 Sep	More 1 <sup>st</sup> Law		
3	10 Sep	State functions, thermodynamic processes		HW 1 due
	12 Sep	Manipulation and derivation of thermodynamic equations		
4	17 Sep	Need for a 2 <sup>nd</sup> Law	Ch. 3	HW 2 due
	19 Sep	2 <sup>nd</sup> Law and 3 <sup>rd</sup> Law		
5	24 Sep	More Entropy		HW 3 due
	26 Sep	Criteria for spontaneity		
6	1 Oct	Phase Changes, ice and helium	4.1 – 4.3	HW 4 due
	3 Oct	Exam I		
7		<i>no class – mid-semester break</i>		No M disc
	10 Oct	Phases!	4.4 – 4.6	
8	15 Oct			
	17 Oct	Mixtures	Ch. 5	
9	22 Oct			HW 5 due
	24 Oct			
10	29 Oct	Chemical Equilibria	Ch. 6	HW 6 due
	31 Oct			
11	5 Nov	Microscopic treatment of gases	Ch. 20	HW 7 due
	7 Nov	A bit of kinetics	Ch. 21	
12	12 Nov			HW 8 due
	14 Nov	Exam II		
14	19 Nov	Introduction to Statistical Thermodynamics	Ch. 15	
	21 Nov			
15	26 Nov	Partition functions and heat capacity	Ch. 16	HW 9 due
		<i>no class – Thanksgiving Holiday!</i>		No W disc
16	3 Dec	Properties of Solids	Ch. 19	HW 10 due
	5 Dec	Course Overview		

**Thursday, 12 Dec: FINAL EXAM, 1:00pm to 3:00pm**

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## Academic Integrity

All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, that can be viewed at: [http://www.luc.edu/cas/pdfs/CAS\\_Academic\\_Integrity\\_Statement\\_December\\_07.pdf](http://www.luc.edu/cas/pdfs/CAS_Academic_Integrity_Statement_December_07.pdf)

Anything you submit that is incorporated as part of your grade in this course (e.g. quiz, examination, homework, lab report) must represent your own work. Any students caught cheating will, at the very minimum, receive a grade of "zero" for the item that was submitted and this grade cannot be dropped. If the cheating occurred during a course exam, the incident will be reported to the Chemistry Department Chair and the Office of the CAS Dean. Depending on the seriousness of the incident, additional sanctions may be imposed.

Any instance of dishonesty as detailed on the website provided above will result in a grade of zero for that particular item, be it homework or an exam. The Dean and Chair of The Department of Chemistry will also be notified. I truly hope to never have to invoke these processes. Please be honest with your work.

**Teamwork:** I strongly encourage you (the class) to work together to solve assigned and unassigned problems. In order to learn and excel in Physical Chemistry, you should work through problems. The assigned problems are a minimum. Work together with your classmates, if you don't understand something, someone else may. You will also find that explaining a solution to your classmate will cement the information in your mind, and make you a better student.

When working as a group, if each member contributes to the discussion, and you each hand in very similar work, that is perfectly acceptable given the nature of the assignments. On the other hand, if someone simply copies an assignment from someone else, that is plagiarism, and will be treated as such.

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## Students with Disabilities

If you have any special needs, please let me know in the first week of classes. The university provides services for students with disabilities. Any student who would like to use any of these university services should contact the Services for Students with Disabilities (SSWD), Sullivan Center, (773) 508-3700. Further information is available at <http://www.luc.edu/sswd/>.

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## Tutoring

Loyola maintains a Center for Academic Excellence & Tutoring (<http://www.luc.edu/tutoring/>). Again, this is a service included in your tuition, so I encourage you to utilize their assistance.

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## Your well-being

If there are events occurring in your life that cause school to diminish in its priority, please discuss this with me or contact the Wellness Center (<http://www.luc.edu/wellness/index.shtml>) or the dean of students ([http://www.luc.edu/studentlife/dean\\_of\\_students\\_office.shtml](http://www.luc.edu/studentlife/dean_of_students_office.shtml)) for assistance. These are services that your tuition pays for and can be invaluable for your personal health and maintaining progress towards your degree.