

SYLLABUS**Introduction:**

We usually observe and interact with chemistry and chemical systems at the macroscopic level. Over the past several centuries of history, scientists have unraveled a series of laws that describe the behavior of these macroscopic systems at equilibrium. These laws and their applications comprise the field of *thermodynamics* - a fruitful subject which has enabled improvements in industrial chemistry, engines, materials, pharmaceuticals, cosmology, fuels, and other technologies that form the foundation of our society. Beneath thermodynamics, an examination of its microscopic foundations yields the fascinating but challenging subject of *statistical mechanics*. Additionally, the examination of systems out of equilibrium comprises the subject of *kinetics*. All of these subjects also accurately describe the operation of biological systems, including the human body.

The goal of this course is to form a basis of knowledge that will enable you to engage and even contribute to the vast array of science and technology that relies on the subject of physical chemistry.

Course: **Chemistry 325:** Physical Chemistry I – Thermodynamics and Kinetics

MWF 8:30 – 9:35 AM in Taylor Hall room 106

Lab Section 1: Tuesday 1:30 – 5:00 PM in Sator Hall room 208

Lab Section 2: Thursday 8:00 – 11:30 AM in Sator Hall room 208

Lab Section 3: Thursday 1:30 – 5:00 PM in Sator Hall room 208

Instructor:

Dr. Lane Votapka

Office location: Rohr Science room 305E

Office hours: MWF 10:30 – 12:00

Monday 3:00 – 4:30 and by appointment

Phone: 619-849-2270

Email: lvotapka@pointloma.edu

(I will be able to answer emails between 8 AM and 6 PM).

Text:

Thermodynamics, Statistical Thermodynamics, & Kinetics, Third Edition,
Thomas Engel and Philip Reid, Pearson Education, 2013.

MasteringChemistry course ID: MCVOTAPKA36138

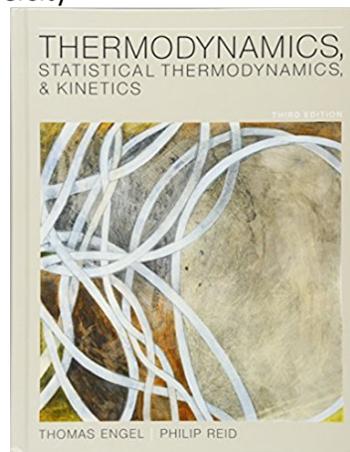
**Course
Description:**

Study of classical thermodynamics as it is applied to physical and chemical systems. Includes discussion of the three laws and their application to thermochemistry, reaction energetics and chemical equilibrium.

**Learning
Outcomes:**

Upon completing this course you will:

1. Have improved your understanding of the laws of thermodynamics, as well as concepts including energy, enthalpy, entropy, and free energy. You will develop skills in the usage of these quantities to predict the outcomes of chemical reactions and processes.
2. Understand the microscopic explanations of the laws, physical quantities, and the behavior of chemical systems.
3. Be able to apply the macroscopic results of the laws and concepts in order to construct simplifying models to solve physical and chemical problems.
4. Have acquired the necessary skills that will be useful for future work in science or science-related fields. These skills include: problem solving, the collection, analysis, and usage of data using computer software, and the articulation and presentation of experimental and theoretical results in written and oral form.

**Homework &
Quizzes:**

Homework will be essential to the learning process of this course's content; therefore, problems sets will be assigned regularly. Each assignment will be composed of two types of problems:

- Work problems: each problem will be graded with a +, ✓, -, or 0 and you may collaborate with other students on these problems.
- Quiz problems are mini take-home exams and you are all expected to do them individually.

I am available to help with both types of problems.

All homework and quizzes must be turned in by the beginning of class on the assigned due date. Usually homework and quizzes will be due every Wednesday.

**Lab Reports
and
Presentations**

There will be several experiments in total, one approximately every two weeks. Right before starting the next experiment, you will need to submit a lab report, make a presentation, conduct a "chalk talk", or another activity. More details about these assignments will be described in the first few lab sessions or through handouts, or both.

Participation:

Discussions and collaboration with your fellow student "colleagues" will be very helpful to facilitate everyone's understanding of physical chemistry. Small-group activities and problem-solving will be conducted frequently in class. Your participation score will be assigned based on engagement in in-class discussions.

To minimize distractions to both yourself and others, please don't use laptops or phones in class. It would be nearly impossible to take notes on physical chemistry using a laptop anyways.

Attendance:

Regular and punctual attendance at all classes is considered essential to optimum academic achievement. If the student is absent from more than 10 percent of class meetings, the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See [Academic Policies](#) in the Undergraduate Academic Catalog.

ADDITIONAL NOTE ABOUT LABS: The above paragraph is the official PLNU policy, but I think that the timing of this lab course can be a bit more flexible than usual. Everyone should plan to arrive at the beginning of the section time on the first day of an experiment for your fellow students' presentations and my instructions for how to conduct that week's experiment. After that, since equipment is scarce, we will have to take turns using equipment, and you are free to come and go if it isn't your turn to run the experiment. If you've already performed your experiment for that week, you don't have to come in, but I will try to accommodate you during that time to answer your questions or allow you to re-conduct your experiment if you desire to.

Grading:

Mid-term exam 1	15%
Mid-term exam 2	15%
Final exam	20%
Homework	10%
Quizzes	10%
Labs	25%
Participation	5%

A	90%	C	70%
A-	88%	C-	68%
B+	86%	D+	66%
B	80%	D	60%
B-	78%	D-	58%
C+	76%	F	< 58%

- PLNU Mission** To teach ~ to shape ~ to send
- Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.
- Final Examination Policy** Successful completion of this class requires taking the final examination on its scheduled day. The final examination schedule is posted on the [Class Schedules](#) site. No requests for early examinations or alternative days will be approved.
- PLNU copyright policy** Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.
- PLNU Academic Honesty Policy** Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See [Academic Policies](#) for definitions of kinds of academic dishonesty and for further policy information.
- PLNU Academic Accommodations policy** If you have a diagnosed disability, please contact PLNU's Disability Resource Center (DRC) within the first two weeks of class to demonstrate need and to register for accommodation by phone at 619-849-2486 or by e-mail at DRC@pointloma.edu. See [Disability Resource Center](#) for additional information.

Class Schedule –Tentative--:

Sessions	Topics	Readings
Jan 9, 10	Introduction: Fundamental Concepts of Thermodynamics	Chapter 1, sections 1.1-1.5
Jan 11	Special topic session (1:30 – 5:00 in Latter 2)	
Jan 12, 17, 19, 22	Heat, Work, Internal Energy, Enthalpy, and the First Law of Thermodynamics	Chapter 2, sections 2.1-2.11
Jan 24, 26, 29, 31	The Importance of State Functions: Internal Energy and Enthalpy	Chapter 3, sections 3.1-3.7
Feb 2, 5	Thermochemistry	Chapter 4, sections 4.1-4.5
Feb 7, 9, 12, 14, 16	Entropy and the Second and Third Laws of Thermodynamics	Chapter 5, sections 5.1-5.10, 5.12
Feb 19	Midterm Exam 1 (Chapters 1-5)	
Feb 21, 23, 26, 28	Chemical Equilibrium	Chapter 6, sections 6.1-6.14
March 2	The Properties of Real Gases	Chapter 7, sections 7.1-7.5
March 12, 14	Phase Diagrams and Stability of Solids, Liquids, and Gases	Chapter 8, sections 8.1, 8.2, 8.4-8.6, 8.8, 8.9
March 16	Ideal and Real Solutions	Chapter 9, sections 9.1-9.3, 9.10
March 19, 21	Electrolyte Solutions	Chapter 10, sections 10.1-10.5
March 23, 26	Probability	Chapter 12, sections 12.1-12.6
March 28	Midterm Exam 2 (Chapters 6-10, 12)	
April 4, 6	The Boltzmann Distribution	Chapter 13, sections 13.1-13.5
April 9, 11	Ensemble and Molecular Partition Functions	Chapter 14, sections 14.1-14.4, 14.8, 14.10
Apr 13, 16	Statistical Thermodynamics	Chapter 15, sections 15.1-15.7
Apr 18, 20	Transport Phenomena	Chapter 17, sections 17.1-17.3, 17.6-17.8
Apr 23, 25, 27	Elementary Chemical Kinetics	Chapter 18, sections 18.1-18.10, 18.13-18.15
May 2, 7:30 – 10:00 AM	Comprehensive Final Exam Final Exam: Wed. Dec 13, 7:30 AM – 10:00 AM, Taylor Hall room 106	

Lab Schedule TBA