

Physical Chemistry – Thermodynamics and Kinetics

Spring 2022

MWF 12:00-12:50 pm

CAV 223

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Office Hours: MWF 1 – 2 pm, T 11 am – 12 pm

Required Materials

Engel/Reid - Physical Chemistry, 4e, with Modified Mastering: ISBN 9780134813813

A scientific calculator is strongly recommended.

A laboratory notebook. A cheap composition book works very well.

Course Description

To quote a textbook, “Physical chemistry is the study of the underlying physical principles that govern the properties and behavior of chemical systems.” In this class, we will be studying thermodynamics and kinetics, two important areas of physical chemistry. Thermodynamics provides a description of matter on a macroscopic or large scale using bulk properties such as pressure, volume, and temperature. Kinetics is the study of how things change over time, including chemical reactions, diffusion, and the flow of energy. These topics are complex and we will use calculus extensively in our studies.

Lecture Schedule

Week of	Topic
Jan. 18	Monday, Jan. 17 Holiday Chapter 1 <i>Fundamental Concepts of Thermodynamics</i>
Jan. 24	Chapter 2 <i>Heat, Work, Internal Energy, Enthalpy, and The First Law of Thermodynamics</i>
Jan. 31	Chapter 3 <i>The Importance of State Functions: Internal Energy and Enthalpy</i>
Feb. 7	Chapter 4 <i>Thermochemistry</i> Chapter 5 <i>Entropy and the Second and Third Laws of Thermodynamics</i>
Feb. 14	Chapter 5 <i>Entropy and the Second and Third Laws of Thermodynamics</i> Chapter 6 <i>Chemical Equilibrium</i> Exam 1: Wednesday Feb. 15
Feb. 21	Chapter 6 <i>Chemical Equilibrium</i>
Feb. 28	Chapter 7 <i>Properties of Real Gasses</i>

	Chapter 8 <i>Phase Diagrams and the Relative Stability of Solids, Liquids, and Gasses</i>
Mar. 7	Chapter 8 <i>Phase Diagrams and the Relative Stability of Solids, Liquids, and Gasses</i> Chapter 9 <i>Real and Ideal Solutions</i>
Mar. 14	Spring Break
Mar. 21	Chapter 9 <i>Real and Ideal Solutions</i> Exam 2: Wednesday, Mar. 23
Mar. 28	Chapter 10 <i>Electrolyte Solutions</i>
Apr. 4	Chapter 11 <i>Electrochemical Cells, Batteries, and Fuel Cells</i>
Apr. 11	Chapter 33 <i>Kinetic Theory of Gasses</i> Chapter 34 <i>Transport Phenomena</i>
Apr. 18	Chapter 35 <i>Elementary Chemical Kinetics</i>
Apr. 25	Chapter 35 <i>Elementary Chemical Kinetics</i> Chapter 36 <i>Complex Reaction Mechanisms</i> Exam 3: Wednesday, Apr. 27
May 2	Chapter 36 <i>Complex Reaction Mechanisms</i>
May 9	Final: Monday, May 9 1:00 – 3:00 pm

Topics covered:

Classical Thermodynamics – Chapters 1-10
Electrochemistry – Chapter 11
Kinetics – Chapters 33-36

Lecture Grading Scale:

Mastering Homework	10%
Weekly Quizzes	10%
Exam 1	20%
Exam 2	20%
Exam 3	20%
Final Exam	20%
Total	100%

Laboratory Grading Scale:

Lab Reports	50%
Independent Projects	50%
Total	100%

Total Grading Scale:

Lecture	75%
Laboratory	25%
Total	100%

The Mastering Homework will be assigned on a weekly basis and will cover material from that same week. Late work will generally *not* be accepted. Registration for

Mastering can be done at this website: <http://www.pearsonmylabandmastering.com/>. The code to enroll will be available in Blackboard.

There will be approximately 11 Friday quizzes throughout the semester. The content of these quizzes will be based on lectures and weekly homework assignments.

The exams, including the final, will cover material since the last exam, although many concepts carry throughout the course.

Student Learning Outcomes

After completion of this course, students will be able to:

- Demonstrate technical and analytical skills in the area of physical chemistry
 - Students will be able to determine the dependence of reaction rates on chemical concentrations and temperature.
 - Students will be able to use phase diagrams to predict states of matter for various external conditions.
- Analyze complex chemical problems and draw logical conclusions.
 - Students will be able to predict reaction mechanisms from rate law data.
 - Students will be able to use the laws of thermodynamics to predict connections between energy and work.
 - Students will be able to use the laws of thermodynamics to predict spontaneity in physical and chemical systems.
- Employ mathematics in the analysis of chemical problems.
 - Students will be able to derive integrated rate laws from differential rate laws.
 - Students will be able to calculate reaction rates from experimental data.
 - Students will be able to calculate values for thermodynamic state functions for various processes.

Evaluation of Student Learning Outcomes

The student learning outcomes will all be evaluated by performance on online homework, Friday quizzes, and exams.

Honor Code / Academic Dishonesty

Angelo State University expects its students to maintain complete honesty and integrity in their academic pursuits. Students are responsible for understanding the Academic Honor Code, which is to be found in the Student Handbook (www.angelo.edu/cstudent/). The penalty for ANY sort of dishonesty, cheating, or plagiarism can range from a grade of zero on the assignment to an F in the course and disciplinary action warranted in accordance with university guidelines. Don't even consider it.

Disabilities

Persons with disabilities which may warrant academic accommodations must contact the Student Life Office, Room 112 in the University Center, in order to request and to implement academic accommodations.

Physical Chemistry Laboratory

The laboratory sections are complimentary to the lecture section and offer a more hands-on experience. We will use ideas and concepts from the lecture to probe the relationship between theory and experiment.

Laboratory Sections

Section	Days	Meeting Time	Instructor	Lab Room	Class Room
02Z	T	2:00 pm – 4:50 pm	Dr. Smith	CAV 209	CAV 200

Laboratory Schedule

Week of	Laboratory
Jan. 18	Extra Credit Week
Jan. 24	Heat-Capacity Ratio for Gasses
Jan. 31	Heat-Capacity Ratio for Gasses
Feb. 7	Heats of Combustion
Feb. 14	Heats of Combustion
Feb. 21	Phase Diagrams
Feb. 28	Iodine Clock
Mar. 7	Iodine Clock – Independent Project Proposals Due
Mar. 14	Spring Break
Mar. 21	Independent Projects
Mar. 28	Independent Projects – Progress Report 1 Due
Apr. 4	Independent Projects
Apr. 11	Independent Projects – Progress Report 2 Due
Apr. 18	Independent Projects
Apr. 25	Independent Projects – Progress Report 3 Due
May 2	Poster Presentations
May 9	Finals week: no labs

Lab Reports

One week after finishing the lab work, calculations are due for that lab. One week after that, the full lab report is due. Each lab report should read like a journal article, each with an abstract, introduction, experimental, discussion, and conclusion section. We will talk more about this in class. The final lab will be presented as an oral presentation during lab finals week. Late work will not be accepted, except for extenuating circumstances. Each lab, worksheet, and presentation count equally for your final grade in the lab.

Laboratory Attire

Beginning on the first day of lab, everyone **MUST** have **approved goggles, long-sleeved shirts which cover the midriff, long pants, and shoes with closed toes and heels** (no sandals, slides, etc.). (Basically, you should have as little exposed skin as possible.) Anyone not wearing the appropriate attire will not be allowed into lab.