

Thermochemistry—Chemistry 361

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In this course I hope to introduce you to the fundamentals of thermodynamics. The primary text we will use is a very comprehensive and mathematically rigorous physical chemistry textbook (Peter Atkins, *Physical Chemistry, 6th edition*). The optional textbook is the supplemental applied mathematics text (Barrante, *Applied Mathematics for Physical Chemistry*). Two other thermodynamics/statistical mechanics textbooks are available at the bookstore for purchase. These will not be used directly but if you plan on doing advanced work in chemistry, it is useful to have multiple texts on a given topic. You probably should spend some time early on in the course rereading your calculus text (or similar math methods text such as Barrante), as your mathematics skills are critical for success in this course. We meet Monday, Wednesday and Friday in Room 306 at 10:00 - 11:00 AM. Lab will meet there as well on Tuesday from 3:00 to 6:00 PM. I will hold 9 office hours where I will guarantee normally to be available in my office unless otherwise posted. These will be Monday, Tuesday, Wednesday and Friday from 8-9, Monday from 2-4, Tuesday from 1-2, and Wednesday from 2-4. Any other times that my door is open I am available for questions or comments.

The grading policy will be based on the following tentative schedule. You will be required to hand in 9 homework problem sets which will account for 10 points each and due after we finish each chapter (see outline below for dates). Each assignment will be graded based upon completeness more than accuracy. Late homework will be given a 3 point per class period deduction for each class past the first that it is late. If you fail to turn in a homework for a given chapter you will be given a minimum score of -5 points. Thus if you cannot get your homework done, at least turn in a blank sheet to tell me that you failed to do the work. It is imperative that you do the minimum homework assigned, but this is by no means the minimum that should be done to do well in the course. I expect that you will work many additional problems outside of the homework assignments and I will guarantee you will see non-homework problems from the text on the tests. Also, each day in class a student will be randomly selected to present a problem at the board. This should already be completed before class and will be from the current section in Atkins. Any student selected in this fashion who fails to have a problem completed will be docked 5 points for each incident after the first. There will be 7 laboratory assignments worth 40 points each (including an exercise using Maple™ if not previously completed and a literature review exercise). The literature review exercise will consist of a 20 minute oral review of a paper selected from a chemistry journal in the field of thermochemistry or a *Journal of Chemical Education* laboratory suitable for this course. For the first experimental laboratory assignment you will turn in a 5-8 page formal laboratory report. The remaining laboratories will be graded based on evaluation of your laboratory notebook and a second oral presentation to the class

Assignment	Points each	Total Points
Homework (9)	12	108
Laboratory Write-ups (7)	40	280
Midterm Exams (3)	110	330
Final Exam	300	300
Grand Total		1000

on the laboratory of your choice the last week of the semester. There will be three one hour long tests each worth 110 points with problems taken primarily from the texts. *The tentative test days will be Monday, March 5th; Wednesday, April 4th; and Monday, April 30th.* There will be a final exam worth 300 points on Tuesday, May 22nd at 8 a.m. The final will be a cumulative ACS standardized exam on thermochemistry. This means there will be a total of 1000 points. The grading will be such that 92% is an A (920 points), 77% is a B (770 points), 60% is a C (600 points), 50% is a D (500 points). For each midterm exam you will be allowed a single sheet (double sided) with any information on it you like.

The attendance policy shall be that all labs must be completed, including laboratory write-ups and oral exams. Also, it is expected that the student attend all lectures. Up to two days may be missed without excuse, any subsequent absences will lead to a 15 point deduction from your total score for each additional missed day. Absence shall not be an excuse for failure to learn information covered in the course examinations. In cases involving extended absences for a good reason (i.e. hospitalization, emergency at home, etc.) a special arrangement will be made between myself and the student as to how to make up the missed material or exams.

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Chapter 0 - Introduction

February 7 th	Matter & Energy	Section 0.1 – 0.5
February 9 th	Review mathematics skills	

Chapter 1 – Properties of Gases

Exercises	1.2a, 1.10a, 1.13b, 1.22b, 1.30a	
Problems	1.4, 1.10, 1.19, 1.29, 1.41	Due 2/23
February 12 th	The Perfect Gas	Section 1.1 – 1.3
February 14 th	Real Gases	1.4 – 1.6
February 16 th	Problem Solving from Chapter 1	

Chapter 2 – The First Law: The Concepts

Exercises	2.2b, 2.6a, 2.12a, 2.19a, 2.32a	
Problems	2.3, 2.8, 2.13, 2.20, 2.26	Due 2/28
February 19 th	Basic Concepts	Section 2.1 – 2.2
February 21 st	Work and Heat	2.3 – 2.6
February 23 rd	Thermochemistry	2.7 – 2.9

Chapter 3 - The First Law: The Machinery

Exercises	3.2a, 3.6b, 3.12b	
Problems	3.3, 3.8, 3.14, 3.21	Due 3/2
February 26 th	Second law, Engines, Entropy	3.1 – 3.3

Chapter 4 – The Second Law: The Concepts

Exercises	4.1a, 4.8a, 4.15b, 4.23a	
Problems	4.5, 4.10, 4.19, 4.25, 4.31	Due 3/16
February 28 th	The Direction of Spontaneous Change	4.1 – 4.5
March 2 nd	Problem Solving from Chapter 3 & 4	

Test 1 Monday, March 5th Chapters 0 - 3

Chapter 4 – The Second Law: The Concepts (continued)

March 7 th	Go over test	
March 9 th	Concentrating on the System	4.6 – 4.7

Chapter 5 – The Second Law: The Machinery

Exercises	5.2a, 5.6b, 5.11a	
Problems	5.4, 5.7, 5.22, 5.25	Due 3/21
March 12 th	No Class (Jay will be at ENC in Orlando FL)	
March 14 th	No Class (Jay will be at ENC in Orlando FL)	
March 16 th	Combining the First and Second Laws	5.1 – 5.3
March 19 th	Real gases: The Fugacity	5.4 – 5.6

Chapter 6 – Physical Transformations of Pure Substances

Exercises	6.4b, 6.11b	
Problems	6.7, 6.11, 6.17	Due 4/6
March 21 st	Phase Diagrams	6.1 – 6.3
March 23 rd	Phase Stability	6.4 – 6.7
March 26 th –30 th	Spring Break (study chapters 1 – 6)	
April 2 nd	The Physical Liquid Surface	6.8 – 6.10

Test 2 Wednesday, April 4th Chapters 4 - 6

Chapter 7 – Simple Mixtures

Exercises	7.3a, 7.9a, 7.17b	
Problems	7.2, 7.11, 7.17	Due 4/16
April 6 th	The Thermodynamic Description of Mixtures	7.1 – 7.3
April 9 th	The Properties of Solutions	7.4 – 7.5
April 11 th	Activities	7.6 – 7.7

Chapter 8 – Phase Diagrams

Exercises	8.3a, 8.6b, 8.12a, 8.16a	
Problems	8.1, 8.2, 8.7	Due 4/25
April 13 th	Phase Rule	8.1 – 8.2
April 16 th , 18 th	Two-component Systems	8.3 – 8.7

Chapter 9 – Chemical Equilibrium

Exercises	9.6b, 9.8a, 9.18b	
Problems	9.1, 9.8, 9.12	Due 5/2
April 20 th	Spontaneous Reactions	9.1
April 23 rd	Response of Equilibria to Conditions	9.2 – 9.3
April 25 th	Applications	9.4 – 9.6
April 27 th	Problem Solving from Chapter 8 & 9	

Test 3

Monday, April 30th

Chapters 7 - 9

Chapter 10 – Equilibrium Electrochemistry

May 2 nd	Thermodynamic Properties of Ions in Solution	10.1 – 10.2
May 4 th	Electrochemical Cells	10.3 – 10.5
May 7 th	AUREMN Conference in Brazil	
May 9 th	AUREMN Conference in Brazil	
May 11 th	AUREMN Conference in Brazil	
May 13 th	Applications of Standard Potentials	10.6 – 10.9
May 16 th	Problem Solving from Chapter 1 through 10	
May 18 th	Reading Day	

Final Exam

Standardized ACS Thermodynamics Exam

Tuesday, May 22nd, 8 AM

Chemistry Department Oral Communication Evaluation Form

Student's Name _____

Date _____

Venue _____

Evaluator _____

Each of the following should be rated as being at a *distinguished*, D, *proficient*, P, *apprentice*, A, or *novice*, N level. The attached form describes these ratings.

Communication Skill Assessment

- A. Presence- (voice, pace, eye contact, confidence, body language) _____
- B. Use of supplementary material- (chalkboards, handouts, overheads) _____
- C. Clarity of talk - (outline, organization, conclusion, appropriate for audience) _____
- D. Response to questions- _____

General Comments

Specific Recommendations for Communication Skill Improvement

Technical Assessment

- A. Understanding of material _____
- B. Explanation of material (appropriate for level of audience, educational) _____
- C. Substance- (technically correct) _____
- D. Response to questions _____

General Comments

Specific Recommendations for Improving Technical Content

Overall Rating of Presentation

Distinguished _____ Proficient _____ Apprentice _____ Novice _____

Explanation of Rating Scale

Distinguished- The oral communication skills of the student are near perfect. The presentation was well-rehearsed with an exceptionally clear thesis and outline. Appropriate use has been made of supplementary material- writing on the chalkboard or overheads is legible, handouts add significantly to the presentation. Voice projection, the pace of the presentation are fine. Technically, the student has taken the material beyond a mere literature review or research summary by adding additional interpretation or making comparisons not present in the original literature.

Proficient - The oral skills of the student are at an acceptable level. Appropriate use has been made of supplementary material- writing on the chalkboard or overheads is legible, handouts add significantly to the presentation. Voice projection, the pace of the presentation are fine. The only minor errors that are present, if any, could be improved through additional practice. NO technical errors are present. The student has presented the reviewed material concisely, accurately, and at an appropriate level for the audience.

Apprentice - Key features of oral communication are evident, but capable of additional development. No more than one major flaw is contained in the presentation such as lack of voice projection, poor overhead usage, inappropriate body language, poor quality of supplementary material. The thesis and outline of the talk are obvious. Technically the presentation contains few flaws, however, the material is still not quite understandable at the level of the audience. Understanding could be improved through the use of more appropriate supplementary material, simplification of diagrams and figures, or by spending more time explaining each figure. It is apparent that the student has some understanding of the material.

Novice - Essential elements of effective oral communication are not evident. Poor grammar is evident throughout the presentation as shown through poor word choice, sentence structure, and pronunciation problems. No thesis or outline is apparent. Communication aids are not used effectively and are more of a hindrance than a help. The use of a chalkboard, overheads, or other auxiliary material is very awkward. Technically, the report contains numerous scientific errors showing some misunderstanding of the project. The purpose of the research is not evident and it is not presented on a level understandable by the audience.