Thermochemistry
Chemistry 261

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Science Bldg. Room 304 x6274

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*). You probably should spend some time early on in the course re-reading your calculus text (or similar math methods text, which I can suggest other titles), 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 8 office hours where I will guarantee normally to be available in my office unless otherwise posted. These will be Monday from 9-10, Wednesday from 9-10, Friday from 9-10, Tuesday from 9-11, Wednesday from 3-4 and Thursday from 9-11. 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. 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 25 points each (including an exercise using Maple™ 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 kinetics. 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 on the laboratory of your choice the last week of the semester. There will be three one hour long tests each worth 150 points with problems taken primarily from the texts. *The tentative test days will be Wednesday, March 3rd; Monday, March 29th; and Wednesday, April 28th*. There will be a final exam worth

Assignment	Points each	Total Points
Homework (12)	10	120
Laboratory Write-ups (7)	30	210
Midterm Exams (3)	140	420
Final Exam	250	250
Grand Total		**1000**

250 points on Thursday, May 20th at 8 a.m. The final will be a cumulative ACS standardized exam on thermochemistry. This means there will be a total of about 965 points. The grading will be such that 91% is an A (910 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.

Thermochemistry - Chemistry 261

Chapter 0 - Introduction		
February 5th	Matter & Energy	Section 0.1 – 0.5
Chapter 1 – Properties of Gases		
Exercises	1.3a, 1.8b, 1.14b, 1.27b	
Problems	1.13, 1.17, 1.33, 1.39	Due 2/19
February 8th	The Perfect Gas	Section 1.1 – 1.3
February 10th, 12th	Optional review session with Teaching Assistant Dr. Baltisberger will be at NSF Review panel in Washington, D.C.	
Chapter 1 – Properties of Gases (continued)		
February 15th	Real Gases	1.4 – 1.6
Chapter 2 – The First Law: The Concepts		
Exercises	2.4a, 2.10a, 2.20b, 2.36b	
Problems	2.5, 2.11, 2.14, 2.25	Due 2/26
February 17th	Basic Concepts	Section 2.1 – 2.2
February 19th	Work and Heat	2.3 – 2.6
February 22nd	Thermochemistry	2.7 – 2.9
Chapter 3 - The First Law: The Machinery		
Exercises	3.4b, 3.13b	
Problems	3.2, 3.11, 3.26	Due 3/8
February 24th	Second law, Engines, Entropy	3.1 – 3.3
Chapter 4 – The Second Law: The Concepts		
Exercises	4.5a, 4.15a, 4.20b	
Problems	4.6, 4.12, 4.23, 4.30	Due 3/15
February 26th	The Direction of Spontaneous Change	4.1 – 4.5
March 1st	Optional review session with Teaching Assistant Dr. Baltisberger will be at Experimental NMR Conference in Orlando, FL	
Test 1	**Wednesday, March 3rd (keep test copy for Friday)**	**Chapters 0 - 3**

March 5st	Go over test problems as a group Dr. Baltisberger will be at Experimental NMR Conference in Orlando, FL	
Chapter 4 – The Second Law: The Concepts (continued)		
March 8th	Concentrating on the System	4.6 – 4.7
Chapter 5 – The Second Law: The Machinery		
Exercises	5.3b, 5.11b	
Problems	5.2, 5.11, 5.20, 5.29	Due 3/19
March 10th	Combining the First and Second Laws	5.1 – 5.3
March 12th	Real gases: The Fugacity	5.4 – 5.6
Chapter 6 – Physical Transformations of Pure Substances		
Exercises	6.3b, 6.9a	
Problems	6.5, 6.13	Due 3/29
March 15th	Phase Diagrams	6.1 – 6.3
March 17th	Phase Stability	6.4 – 6.7
March 19th	The Physical Liquid Surface	6.8 – 6.10
March 22nd – 28th		Spring Break (study chapters 1 – 6)
Test 2	**Monday, March 29th**	**Chapters 4 - 6**
Chapter 7 – Simple Mixtures		
Exercises	7.2b, 7.10b, 7.18a	
Problems	7.3, 7.10	Due 4/9
March 31st	The Thermodynamic Description of Mixtures	7.1 – 7.3
April 2nd	The Properties of Solutions	7.4 – 7.5
April 5th	Activities	7.6 – 7.7
Chapter 8 – Phase Diagrams		
Exercises	8.4a, 8.7b, 8.10a, 8.13b, 8.19b	
Problems	8.4, 8.13	Due 4/16
April 7th	Phase Rule	8.1 – 8.2
April 9th, 12th	Two-component Systems	8.3 – 8.7
Chapter 9 – Chemical Equilibrium		
Exercises	9.3b, 9.7b, 9.16a	
Problems	9.3, 9.6	Due 4/26
April 14th	Spontaneous Reactions	9.1
April 16th	Response of Equilibria to Conditions	9.2 – 9.3
April 19th	Applications	9.4 – 9.6
Chapter 10 – Equilibrium Electrochemistry		
Exercises	10.6a, 10.21a	
Problems	10.4, 10.18	Due 4/30
April 21st	Thermodynamic Properties of Ions in Solution	10.1 – 10.2
April 23rd	Electrochemical Cells	10.3 – 10.5
April 26th	Applications of Standard Potentials	10.6 – 10.9
Test 3	**Wednesday, April 28th**	**Chapters 7 - 10**
Chapter 24 – Molecules in Motion		
Exercises	24.7b, 24.13a	
Problems	24.6, 24.17	Due 5/10
April 30th	Motion in Gases & Liquids	24.1 – 24.9
May 3rd	Diffusion	24.10 – 24.13

Chapter 25 – The Rates of Chemical Reactions

Exercises	25.5b, 25.13b	
Problems	25.3, 25.11, 25.18	Due 5/1
May 5th	Empirical Kinetics	25.1 – 25.5
May 7th	Accounting for Rate Laws	25.6 – 25.8

Chapter 26 – The Kinetics of Complex Reactions

Exercises	26.2b, 26.7a	
Problems	26.3, 26.9	Not to be handed in
May 10th	Chain Reactions	26.1 – 26.3
May 12th	Polymerization & Catalysis	26.4 – 26.9

Final Exam **Standardized ACS Thermodynamics ExamThursday, May 20th, 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 students 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.