

Physical Chemistry I
Chem 4610, Fall 2023 (MY2L)

LECTURER:

Professor Andrzej Jarzecki
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OFFICE HOURS: *Mondays from 11:00 AM to 12:15 PM or by appointment.*

Lectures: *Mondays and Wednesdays 2:15 pm – 3:30 pm*
Lecture Room 113 IA

Prerequisites: Two semesters of physics and three semesters of calculus.

Required textbook: Ira Levine, Physical Chemistry, 6th Ed.

- pdf version (Chapters 1-12) is available on Blackboard in the Course Documents folder.

Recommended: Student Solution Manual for Physical Chemistry, 6th Ed.

Lab text: in the lab syllabus

The lecture course covers **Chaps. 1–12** of the textbook.

The course requires A LOT OF WORK, so make sure YOU DO NOT HAVE TOO HEAVY SCHOOL SCHEDULE AND/OR JOB TIME COMMITMENT.

EXAMS:

Midterm 1	100 pts, Wednesday, Sept. 20
Midterm 2	100 pts, Wednesday, October 18
Midterm 3	100 pts, Monday, November 15
Midterm 4	100 pts, Monday, December 4
Final (Cumulative)	150 pts, Monday, December 18 (1:00 PM – 3:00 PM)
2 Graded HW:	20 + 30 = 50 pts
Lab component:	200 pts (25%)
Total points	800 pts

In the past, many questions on exams have been problems closely related to the material of the lecture slides or that were assigned for homework. Reading material and solving assigned problems at HOME is essential for the course.

Final grades are not curved but are set according to the following scale:

95 or higher: A+ 760-800 pts	65-68: C+ 520-543 pts
82-95: A 656-759 pts	58-65: C 464- 519 pts
80-82: A- 640-655 pts	55-58: C- 440-463 pts
78-80: B+ 624-639 pts	50-55: D* 400-439 pts
72-78: B 576-623 pts	Less than 50: F < 399 pts
68-71: B- 544-575 pts	

***Note:** If you earn a grade of D, that is the grade you will receive.
Requests to change it to an F will not be honored.

Significant days for the semester:

August 31	Last day to add a course
September 4	College Closed
September 14	Last day to withdraw without a "W" grade
September 15-17	No Classes
September 25	No Classes
October 9	College Closed
October 10	CONVERSION DAY: Classes follow a Monday schedule
November 22	No Classes
November 23-24	College Closed
November 25-26	No Classes
December 11	Last day of classes, last day to withdraw from a course with a grade of "W"
December 12-13	Reading Day

Note that you do not need a C- in this course to get a BS degree in chemistry, but you do need a minimum of 24 credits in advanced chemistry courses with a grade of C- or higher.

Academic dishonesty is prohibited in the City University of New York.

Cheating, plagiarism, internet plagiarism, and obtaining unfair advantages violate academic integrity policies and are punishable by penalties, failing grades, suspension, and expulsion.

For more information about CUNY policy on academic integrity, see

<http://www.brooklyn.cuny.edu/bc/policies/pdt7CUNY%20PolicyAcademicIntegrity.pdf>

Student Disability Services

In order to receive disability-related academic accommodations students must first be registered with the Center for Student Disability Services. Students who have a documented disability or suspect they may have a disability are invited to set up an appointment with the Director of the Center for Student Disability Services, Ms. Valerie Stewart-Lovell at 718-951-5538. If you have already registered with the Center for Student Disability Services please provide your professor with the course accommodation form and discuss your specific accommodation with him/her

ESSENTIAL MATH SKILL IN THIS COURSE:

- **Functions and Graphs**
 - Functions and Science
 - Single and Multivariable Function
- **Differential Calculus:** notation and applications
 - Multivariable
 - Partial Derivatives
- **Integral Calculus:** notation and application
 - General Methods of Integration

 - Special Methods of Integration: Algebraic Substitution, *Partial Fractions* (*Chem 4620*)
- **Path-dependent and Path-independent Functions**
 - Visualization
 - Physical Interpretation
 - Euler's Condition
 - Integrating Factor
- **Preparation of Graphs**
 - Linear Regression

ASSIGNED READING AND PROBLEMS

Chapter 1: Thermodynamics

(1) Read Chap. 1.

Problems: 1.1, 1.2, 1.3, 1.5a, 1.6, 1.7, 1.9, 1.11, 1.16a, 1.17, 1.18, 1.19, 1.23, 1.25, 1.28, 1.32, 1.35, 1.37, 1.38, 1.41, 1.42, 1.43c, 1.44a, 1.50, 1.60, 1.62, 1.60, 1.61, 1.62, 1.63, 1.64, 1.65, 1.67, 1.69, 1.71,

Chapter 2: The First Law of Thermodynamics

(2) Read Secs. 2.1-2.5.

Problems: 2.1, 2.2, 2.3, 2.7, 2.8, 2.9, 2.12, 2.13, 2.14, 2.16, 2.20, 2.24, 2.25.

(3) Read Secs. 2.6-2.9.

Problems: 2.29, 2.30, 2.31, 2.32, 2.36, 2.37, 2.38, 2.39, 2.40, 2.41, 2.42, 2.43, 2.44, 2.45, 2.46, 2.47, 2.48, 2.49

(4) Read Secs. 2.10-2.13.

Problems: 2.50, 2.51, 2.52, 2.53, 2.59, 2.61, 2.62, 2.63, 2.64, 2.65, 2.66, 2.67, 2.69, 2.70, 2.71.

Chapter 3: The Second Law of Thermodynamics

(5) Read Secs. 3.1, 3.2, 3.3, 3.4, 3.5.

Problems: 3.1, 3.2, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17.

(6) Read Secs. 3.6, 3.7, 3.8, 3.9.

Problems: 3.20, 3.21, 3.22, 3.28, 3.30, 3.31, 3.32, 3.33, 3.34, 3.39, 3.40, 3.41.

Chapter 4: Material Equilibrium

(7) Read Secs. 4.1, 4.2, 4.3, 4.4, 4.5, 4.6.

Problems: R3.1, R3.2, R3.4, R3.5, R3.7, R3.11, 4.1, 4.2, 4.3, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.16, 4.19a,b,e,f.

(8) Read Secs. 4.6, 4.7, 4.8, 4.9, 4.10, 4.11.

Problems: 4.24, 4.25, 4.26, 4.27, 4.28, 4.31, 4.35, 4.38, 4.39, 4.40, 4.41, 4.42, 4.43, 4.44, 4.45, 4.47, 4.48, 4.49, 4.50, 4.51, 4.52, 4.55, 4.56, 4.57, 4.58.

Chapter 5: Standard Thermodynamics Functions of Reaction

(9) Read Secs. 5.1, 5.2, 5.3, 5.4, 5.5.

Problems: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.10a,b, 5.11, 5.13, 5.14, 5.15, 5.16, (5.17—optional), 5.18, 5.21, 5.23, 5.24a, 5.25—semi-optional; you need not do the problem in detail, but make sure you know how to do it.

(10) Read Secs. 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12.

Problems: 5.26, **5.27**, 5.30, 5.31, 5.32, 5.36, 5.37a, 5.41, 5.42—do only the first reaction, 5.45, 5.50, 5.56, 5.59, 5.61, 5.62, 5.64, 5.65, 5.66.

GRADED HOMEWORK #1: It is worth 20 points. Solve problem 5.27-like using data of the assigned molecule (see below and the attached table with thermodynamic data). As an example, follow problem **5.27** with O₂. (Assignment on Blackboard: Due Oct. 27)

Chapter 6: Reaction Equilibrium in Ideal Gas Mixtures

(11) Read Secs. 6.1–6.4.

Problems: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.8, 6.9, 6.10, 6.12, 6.13a, 6.14, 6.16a, 6.20, 6.23.

(12) Read Secs. 6.5, 6.6, 6.7.

Problems: 6.24, 6.25, 6.26b, 6.28, 6.29, 6.36, 6.41, 6.42, 6.43a, **6.47**, 6.48, 6.53, 6.54, 6.55, 6.56, 6.65, 6.67, R6.1, R6.5, R6.11.

GRADED HOMEWORK #2: It is worth 30 points —Problem 6.47b and c at the temperature next to your name (**Read Subchapter 6.5 "Simultaneous Equilibria" for help**). **Remember to use log scale on horizontal axis!!** To solve the problem, you must find the thermodynamic values corresponding to your assigned temperature in NIST-JANAF table or other reliable sources. (Assignment on Blackboard: Due Nov. 22)

You must work individually on this without anyone's help. If you get help from someone else, your grade will be zero on this assignment.

Chapter 7: One-Component Phase Equilibrium and Surfaces

(13) Read Secs. 7.1–7.4, 7.10

Problems: 7.1, 7.2, 7.4, 7.5, 7.10, 7.11, 7.12, 7.13, 7.14, 7.16, 7.17, 7.21, 7.22, 7.23, 7.24, 7.27, 7.28, 7.29a,b, 7.36, 7.37, 7.71, 7.73.

Chapter 8: Real Gases

(14) Read Chapter 8, but OMIT Sec. 8.5.

Problems: 8.1, 8.2, 8.3, 8.7, 8.10a, 8.19, 8.28, 8.29, 8.30, 8.31, 8.32, 8.40, 8.42, 8.45.

Chapter 9: Solutions

(15) Read Secs. 9.1–9.2 (OMIT integral and differential heats of solution).

Problems: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.10, 9.11.

(16) Read Secs. 9.3–9.9.

Problems: 9.12, 9.13, 9.14, 9.15, 9.18, 9.19, 9.22, 9.23, 9.25, 9.32, 9.33, 9.34, 9.35, 9.36, 9.37, 9.38, 9.39, 9.43, 9.45, 9.48, 9.49, 9.68, 9.69, 9.70. R9.1, R9.3, R9.4, R9.5, R9.6, R9.7, R9.8, R9.10, R9.12, R9.13.

Chapter 10: Nonideal Solutions

(17) Read Secs. 10.1, 10.2, 10.3, 10.4.

Problems: 10.1, 10.2, 10.6, 10.7, 10.8, 10.12, 10.20, 10.20, 10.21,

(18) Read Secs. 10.1, 10.2, 10.3, 10.4.

Problems: 10.1, 10.2, 10.6, 10.7, 10.8, 10.12, 10.20, 10.20, 10.21,

(19) Read Secs. 10.5, 10.6, and 10.7.

Problems: 10.24, 10.25, 10.26, 10.27, 10.28, 10.29.

(20) Reads Secs. 10.8 10.9 (don't worry about details in Sec. 10.9), 10.10, 10.11, 11.1, 11.2, 11.3.

Problems: 10.35, 10.36, 10.37, 10.38, 10.42, 10.48, 10.49, 10.50, 10.60, 10.61, 10.63a, 10.72, 10.73, 11.1, 11.2, 11.3, 11.4.

Chapter 11: Reaction Equilibrium in Nonideal Systems

(21) Read Secs. 11.4–11.10

Problems: 11.7, 11.8, 11.10, 11.12 11.23, 11.24, 11.25, 11.26, 11.31, 11.32, 11.33, 11.37, 11.38, 11.39, 11.47

Chapter 12: Multicomponent Phase Equilibrium

(22) Read Secs. 12.1–12.4.

Problems: 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.8.

(23) Read Secs. 12.5–12.8.

Probs. 12.11, 12.16a,b, 12.17, 12.18, 12.19, 12.28, 12.29, 12.31, 12.32, 12.34, 12.36, 12.37, 12.38, 12.40.

(24) Read Sec. 12.9–12.12; 7.6, 7.7.

Probs. Chap.12: 43, 47, 49, 53, 60, 75, R12.1, R12.2, R12.4, R12.5, R12.6, R12.13;
Ch 7: 7.45, 7.46.