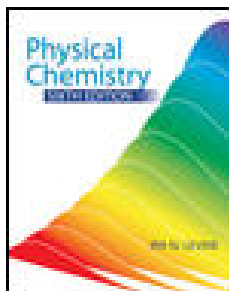


Chemistry 302

Tentative Course Syllabus, Spring, 2010

Instructor: S.K. Knudson; **Office:** ISC 1050-A; **Hours:** R: 7, tba, and by appt. **email:** skknud@wm.edu



Text: Levine, *Physical Chemistry*, 6th Ed., McGraw-Hill (Required)

Objectives: An understanding of the principles and applications of physical chemistry, including thermodynamics and equilibrium, kinetics, quantum mechanics, statistical mechanics, and spectroscopy. This semester the last three topics are undertaken.

Grading: Three hour exams (18% each), comprehensive final exam (40%), and quizzes.

Website: <http://www.wm.edu/chemistry/courses/chem302>

Problems: are assigned for each chapter. Your ability to solve problems materially affects your understanding of the concepts, and your grade in the course, so working the problems is **critical**.

Tentative Schedule

| <i>Wk</i> | <i>Date</i> | <i>Topic</i> | <i>Text</i> |
|-----------|-----------------|--------------------------------------|-----------------------|
| 0 | | Review | Chap. 1.9; Chap. 2.12 |
| 1 | Jan. 20, 22 | Quantum Ideas & Models | Chap. 17.1-7 |
| 2 | Jan. 25, 27, 29 | Quantum Models: PIB | 17.8-11 |
| 3 | Feb. 1, 3, 5 | Models: HO, POR, POSS | 17.12-14 |
| 4 | Feb. 8, 10, 12 | Some QM Formalism; One last Model | 17.15-17; 18.1-5 |
| 5 | Feb. 15, 17, 19 | Atomic Structure & Electron Spin; | 18.6-10; |
| 6 | Feb. 21, 24, 26 | Molecular Electronic Structure | 19.1-4; |
| 7 | Mar. 1, 3, 5 | Molecular Electronic Structure | 19.5-8 |
| 8 | Mar. 8, 10, 12 | Spring Break | |
| 9 | Mar. 15, 17, 19 | Spectroscopy; General Principles; IR | 20.1-4 |
| 10 | Mar. 22, 24, 26 | Spectroscopy: Microwave; IR; Raman | 20.6-10 |
| 11 | Mar. 29, 31, 2 | Spectroscopy: UV; | 20.11; |
| 12 | Apr. 5, 7, 9 | Intro. to Statistical Mechanics | 21.1,2 |
| 13 | Apr. 12, 14, 16 | Thermo. Props. of IG | 21.3-5 |
| 14 | Apr. 19, 21, 23 | More Props; Application to Reactions | 21.6 |
| 15 | Apr. 26, 28, 30 | Application to Reactions; Lasers | 21.6 |

Final Examination: Monday, May 3, 9 am

Examinations

| # | Topics | Chapters | ?Date? |
|---|--|----------|---------------|
| 1 | Quantum Chemistry: Principles and Models | 17 & TBA | about Feb. 18 |
| 2 | Atomic Structure and Spectra: | TBA | about Mar. 20 |
| 3 | Molecular Spectra; Stat. Mech. | TBA | |

Tentative Lectures

| # | Title | Topic | Ref | Date |
|----|---|-----------------------------|----------|---------|
| 1 | Experiments Show Failure of Classical Mechanics Steps to Quantum Mechanics | The Quantum Idea: | 17.1-4 | Jan. 20 |
| 2 | | The Quantum Idea: | 17.5-7 | |
| 3 | Particle in a Box (PIB) Formalisms Harmonic Oscillator | Models: 1 | 17.8-10 | Jan 25 |
| 4 | | Quantum Mechanics | 17.11 | |
| 5 | | Quantum Models: 2 | 17.12 | |
| 6 | HO Model (Cont) | Models | 17.12 | Feb. 1 |
| 7 | Fundamentals & Empirical Selection Rules | Spectroscopy | 21.1-2 | |
| 8 | Vibration of a Diatomic Molecule | Spec Application | 21.3 | |
| 9 | Vibration of a Diatomic Molecule | Spec Application | 21.4 | Feb. 8 |
| 10 | Particle on a Ring (POR) and . . . Sphere | Models 3&4 | 17.13-14 | |
| 11 | Rotation of a Diatomic Molecules | Spec Application | 21.3,4 | |
| 12 | Electronic Structure of Atomic Hydrogen | Model(?) 5 | 19.1-3 | Feb. 15 |
| 13 | Electronic Structure of Atomic Hydrogen | Model(?) 5 | 19.1-3 | |
| 14 | Electron Spin & periodic table | New Quantum Idea | 19.4 | Feb. 17 |
| 15 | Approximation Methods | Practical Mechanics | 18.15 | |
| 16 | Helium and Electronic Angular Momentum | Application | 19.5 | |
| 17 | Hartree-Fock Atomic Electronic w. f. | Application | 19.6-7 | Feb. 25 |
| 18 | Born-Oppenheimer Approximation | Molecular Electronic Motion | 20.1,2 | |
| 19 | Hydrogen Molecule Cation H_2^+ | Electronic Structure | 20.3 | |
| 20 | Diatomic Molecules | E.S. | 20.4 | Mar. 10 |
| 21 | Diatomic Molecules | E.S. | 20.4;5 | |
| 22 | Polyatomic Molecules | E.S. | 20.6,7 | |
| 23 | Advanced Calculations | E.S. | 20.8-13 | Mar. 17 |
| 24 | Molecular Spectroscopy | | 21.5-7 | |
| 25 | Vibrations, overtones, selection rules | | 21.8,9 | |
| 26 | Electronic Spectroscopy | | 21.11 | Mar. 24 |
| 27 | Other Spectroscopys | | 21.12-16 | |
| 28 | Lasers | | Handout | |
| 29 | Lasers (Cont) | | | Mar 31 |
| 30 | The Canonical Ensemble | Intro to Stat. Mech | 22.1 | |
| 31 | Derivation of Boltzmann Distribution | | 22.2 | |
| 32 | Entropy S & Helmholtz A | | 22.2 | Apr. 7 |
| 33 | Empirical correction for a minor error | | 22.3 | |
| 34 | Applications to Ideal Gases | | 22.4,5 | |
| 35 | IG, Cont | | 22.6 | Apr. 14 |
| 36 | IG, Properties through C_v | 22.6,7 | | |
| 37 | Chemical Reactions and Equilibria | | 22.8-10 | |
| 38 | | | | Apr. 21 |
| 39 | (MLK Day) one anticipates 3 exams | | | |

Problem Assignments: Spring, 2010

The following problems from the text should be considered to be homework assignments. These problems are to be attempted by each student, and worked on until solved. The instructor is happy to answer questions about assigned problems during office hours, problem sessions, and in a more limited format in class. Working with a friend or friends, judicious use of a study guide, and asking questions are all laudatory approaches. Solution of problems is critically important to success in the course.

By the way, these assignments are by chapter, but the problems are identified by section; I leave it to you to make the appropriate correlation to the syllabus.

Spring 2010 Problem Assignments

| Chap | Problems |
|------|---|
| 17 | 1, 2, 4-7, 9, 12, 19, 22, 23, 25, 27, 33, 37, 41, 42, 45, 46, 47, 48, 51, 56, 57, 58 |
| 18 | 2, 4, 8-12, 15-16, 20, 22, 24, 25, 29, 30, 32, 33, 37, 41, 43, 46, 48, 49, 65, 69 |
| 19 | 1, 3, 11, 23, 27, 30, 33, 36, 41, 43 |
| 20 | 2, 4, 6, 7, 8, 9, 10, 13, 14, 20, 22, 23, 24, 26, 27, 30, 35, 45, 48, 50, 55 |
| 21 | 2, 3, 4, 8, 14, 17, 18, 20, 25, 26, 27, 28, 36, 40, 42, 43, 44, 46, 50, 54, 60, 66, 72 |
