

KWANTLEN UNIVERSITY COLLEGE

CHEMISTRY 2310: PHYSICAL CHEMISTRY SPRING 2008

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Prerequisites: CHEM 1210 and MATH 1220 or MATH 1230

Transfer status: SFU, UBC, UNBC, and UVic (See Calendar for transfer status)

Instruction format: Lecture 4 hours/week & laboratory 3 hours/week.

Textbook: K.J. Laidler & J.H. Meiser, **Physical Chemistry**, 4th edition, Houghton Mifflin Co. (2003)

Laboratory Manual: Available at my web site
(<http://www.kwantlen.ca/science/chemistry/faculty/classigne>).

LABORATORY REQUIREMENTS:

Each student **MUST** have:

- a) a copy of the experiments
- b) lab notebook, and
- c) safety glasses, or goggles, or side shields (to be worn with glasses),
- d) lab coat

N.B. Contact lenses are **NOT ALLOWED** in the lab at any time!!!

OFFICIAL FINAL DATE OF WITHDRAWAL

Students withdrawing on or before **March 1** will receive a "W" on their transcripts.
Failure to officially withdraw by that date will result in a grade of "F".

TEXT AND REFERENCE MATERIALS

TEXT: K.J. Laidler & J.H. Meiser, **Physical Chemistry**, 4th edition, Houghton Mifflin Co. (2003)

REFERENCES:

G.W. Castellan, **Physical Chemistry**, 3rd edition, Addison Wesley (1983).

J. P. Bromberg, **Physical Chemistry**, 2nd edition, Allyn & Bacon, 1984.

A.W. Adamson, **A Textbook for Physical Chemistry**, 2nd ed, Academic Press, 1979.

R.A. Alberty and F. Daniels, **Physical Chemistry**, Wiley, 1980.

D.R. Metz, **Schaum's Outline for Physical Chemistry**, McGraw-Hill, 1976.

A.M. Lesk, **Introductory Physical Chemistry**, Prentice Hall, 1982.

A.R. Knight, **Introductory Physical Chemistry**, Prentice-Hall, 1970.

P.W. Atkins, **Physical Chemistry**, 2nd edition, Freeman Press, 1982.

J.H. Noggle, **Physical Chemistry**, Little, Brown & Co., 1985.

SCHEDULE OF TOPICS AND EXAMS

<u>Week</u>	<u>Topic</u>	<u>Lectures</u>
1-4	Chemical Kinetics (February 7, Exam #1 Chemical Kinetics)	1-7
5-7	Spectroscopy (February 28, Exam #2 Spectroscopy)	8-13
8-14	Thermodynamics (March 27, Exam #3 Thermodynamics)	14-31

COURSE CONTENT

1. **CHEMICAL KINETICS** (Chapters 9 & 10)
Rate of reactions, order and molecularity, rate equations, determination of reaction order, half-life, complex reactions, steady state approximation, temperature dependence of the rate constant, Collision State theory, Transition State theory, enzyme catalysis and acid-base catalysis.
2. **SPECTROSCOPY FOR STRUCTURE DETERMINATION** (parts of Chapters 13 & 14)
Atomic spectroscopy, IR spectroscopy, NMR spectroscopy, UV/visible spectroscopy.
3. **PROPERTIES OF GASES & KINETIC THEORY OF GASES** (Chapter 1)
Review of ideal gases, absolute temperature scale, Dalton's Law of partial pressures, kinetic theory of gases, mean speed, root mean square speed, most probable speed, mean free path, collision frequency, equipartition principle of energy and heat capacity of gases, deviations from ideal gas behaviour, real gas isotherms, compressibility factor, van der Waals' equation, other equations of state, critical phenomena, Boyle temperature, continuity of states.
4. **FIRST LAW OF THERMODYNAMICS & APPLICATIONS** (Chapter 2)
Definitions, PV work, expansion of an ideal gas, heat, heat capacity, path dependent functions, statements of the first law, constant volume processes, enthalpy, C_v, C_p , reversible processes, adiabatic and isothermal processes, standard states, Hess' Law, ΔH_f° , combustion reactions, temperature dependence of ΔH , use and calculation of bond energies, Born-Haber cycle.
5. **SECOND AND THIRD LAWS OF THERMODYNAMICS & EQUILIBRIUM** (Chapters 3 & 4)
Carnot cycle, efficiency of heat engines, entropy, calculation of ΔS for various processes, temperature and volume dependence of S, molecular interpretation of S, the Third Law of Thermodynamics and its use in the calculation of absolute entropies, Gibbs and Helmholtz free energies, interpretation of ΔG and ΔA , calculation of ΔG , temperature and pressure dependence of ΔG , chemical potential, non-ideal systems, fugacity. Spontaneity, calculation of ΔG from ΔG_f° 's, thermodynamic equilibrium constant, K_c, K_p , calculation involving equilibrium in homogeneous and heterogeneous systems, degree of dissociation, temperature dependence of K.
6. **PHASES, PHASE EQUILIBRIA AND SOLUTIONS** (Chapters 5 & 6)
The phase rule, phases, components and degrees of freedom, Clapeyron equation, liquid-vapor, solid-vapor, and solid-liquid equilibria, phase diagrams of one-component systems, effects of pressure and temperature on freezing point, boiling point and sublimation point of a pure substance.

Concentration units, partial molar quantities, ideal solutions and Raoult's Law, Henry's Law, P-X and T-X diagrams, fractional distillation, deviations from Raoult's Law, colligative properties in electrolyte and non-electrolyte solutions, two-component liquid systems, immiscible liquids and steam distillation, two-component solid-liquid systems, formation of a eutectic mixture.

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LAB SCHEDULE FOR SPRING 2008

<u>Date</u>	<u>EXPERIMENT</u>
Jan. 9	Kinetics of the Fading of Phenolphthalein
Jan. 16	Iodination of Acetone (P)
Jan. 23	Benzoic Acid Distribution in H ₂ O/Toluene and Dimerization in Toluene(P)
Jan. 30	Thermochemistry (P)
Feb. 6	Bomb Calorimetry (P)
Feb. 13	Vapor Pressure of a Pure Liquid (P) & Atomic Absorption (P)
Feb. 20	Liquid-Vapor Equilibrium in Binary Systems (P)

CHEMISTRY 2310 COURSE EVALUATION

The student's grade in the course will be determined by her/his performance in three areas: written examinations, assignments and laboratory work. The approximate percentage of the final mark is indicated below:

Assignments (10%)

These will consist of problems which the student will hand in to be marked. The solutions will be posted or discussed in class.

Examinations (70%)

Exam #1 (**February 7**) on Chemical Kinetics (**15%**)

Exam #2 (**February 28**) on Spectroscopy (**10%**)

Exam #3 (**March 27**) on Thermodynamics (**15%**)

Final Exam (**April 17; 800-1100 in D132**) on Thermodynamics (**30%**)

Laboratory (20%)

The student will perform **eight** experiments during the semester. The reports must be submitted on the due date otherwise marks will be DEDUCTED. Laboratory data should be written in a standard laboratory notebook.

NOTE: Under no circumstances can your lab mark raise your final grade in the course by one letter grade (e.g. you cannot have a **B** grade in class work and have your lab work raise your overall mark to an **A** grade for the course, however it is possible that your lab work can raise your overall mark to a **B+** for the course.)

<u>OFFICE HOURS:</u>	Tuesday	1300-1400 (in TLC)
	Wednesday	Weeks 1-7 (in E110 Lab) 1400-1600
	Thursday	900-1000

MAKE UP POLICY:

Assignments will not be accepted past due date.

Lab experiments can only be made up with Doctor's note.

Exams can only be made up with Doctor's note.

Lab reports will be deducted 1/2 mark per day late.

CHEMISTRY GRADE GUIDELINES

The following are the grade guidelines which are used to determine a grade in this Chemistry course. Satisfactory completion of the laboratory part of this course is a requirement.

<u>GRADE</u>	<u>PERCENT</u>	<u>LECTURE REQUIREMENTS</u>
A+	90-100	A Minimum of 75% average must be obtained for the four exams.
A	85-89	
A-	80-84	
B+	76-79	A minimum of 65% average must be obtained for the four exams.
B	72-75	
B-	68-71	
C+	64-67	A minimum of 55% average must be obtained for the four exams.
C	60-63	
C-	56-59	A minimum of 45% average must be obtained for the four exams.
D	50-55	
F	<50	