

# Student Course Information

## General Chemistry II

### CHEM\*1050

### Winter 2004

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**Course Coordinator:** Dr. R. J. Balahura, C&M 378

**Lecturers:**

Section	Professor	Time	Room
01	D. Thomas, MACN 120	12:30 - 1:20 pm, MWF	ROZH 104
02	M. Baker, MACN 122	2:30 - 3:20 pm, MWF	AXEL 200
03	R. DeLaat, C&M 202	4:30 - 5:20 pm, MWF	C&M 200
04	L. Jones, C&M 377	5:30 - 6:50 pm, MW	ROZH 104

**1. Required Materials**

- (a) "Chemistry", 3rd edition, John Olmsted III and Gregory M. Williams; "Student Solutions Manual", David Robichaud; Wiley, 2002. These two books are shrink-wrapped together and may be purchased in the University Bookstore.
- (b) Laboratory Manual for CHEM\*1050. You must have a laboratory manual before attending your first laboratory. Purchased in the Department.
- (c) Safety goggles and lab coat are required and are available in the University Bookstore.
- (d) Electronic calculator with  $\ln$ ,  $\exp$  or  $e^x$ ,  $\log_{10}$  and  $10^x$  functions. Calculators or notebook computers capable of storing text information are not allowed in examinations.

## 2. Laboratory

Labs begin in Week 2 on Monday, January 12. A Lab manual is required in Week 2. The laboratory is an integral part of the course.

- (a) **Laboratory Time and Location**  
You must take the labs in the time for which you have registered. If you do not attend your lab in Week 2 then you may lose your place.  
  
If you have a scheduling problem you may be able to resolve it through WebAdvisor.
- (b) **Quizzes**  
A brief quiz will be held at the beginning of some of the laboratory periods. See the Laboratory Schedule for details. These quizzes count towards your laboratory grade, and will usually be based on the experiment that you are about to perform.
- (c) **Laboratory Reports**  
Laboratory reports are due exactly one week after the lab. Submit the report to your demonstrator at the beginning of the next laboratory period.
- (d) **Laboratory Exemptions for students who are repeating CHEM\*1050.**  
Application for a laboratory exemption must be made before Tuesday, January 6 by filling in the application posted on the bulletin board, around the corner from MACN 125. A student who earns at least 12/20 in the laboratory, but who fails the course as a whole, may be granted a laboratory exemption. The laboratory work must have been completed during one of the three preceding semesters in which the course was offered.

## 3. Web Site

The web site can be accessed through the portal at <http://courselink.uoguelph.ca>. Your **username** is your Central Login Account ID (that part of your assigned University of Guelph e-mail address before the @ sign) and your **password** is your Central Login Account Password. The first page is “myWebCT: your name” which will list all your WebCT courses including CHEM\*1050. **The CHEM\*1050 web site is an integral part of the course and must be accessed daily.** If you have any technical problems using WebCT, move the cursor to the “Students” link at the top of the Courselink@Guelph page (Login page) and select the appropriate link from the menu. If you do not have a Central Login Account, visit the CCS help desk located in the library computer lab on the main floor. Go to <http://www.uoguelph.ca/ccs/accounts/index.html> for more information.

#### 4. Help

- (a) Your professor will be available at certain times for consultation and help. Office hours will be arranged at the first lecture.
- (b) Lecture Help in the Chemistry Help Room (MACN 106 in the MACN foyer)

The Lecture Help schedule is posted on the WebCT site under "Announcements."

Laboratory Help in the Chemistry Help Room (MACN 106 in the MACN foyer)

Tuesday, Wednesday and Thursday from 4:00 - 5:00 p.m.

- (c) Supported Learning Groups (SLGs)

SLGs are regularly scheduled small group study sessions. Attendance is voluntary and open to all students enrolled in the course. The study groups are facilitated by successful senior students who have recently taken the course. SLG leaders attend all lectures, take notes and work with faculty and staff to create study activities that integrate course content with effective approaches to learning. Students who attend SLG sessions have an opportunity to apply and demonstrate their understanding of course concepts in a safe practice environment. The group study format exposes students to various approaches to learning, problem-solving, and exam preparation. The session times and locations will be announced during the first lecture. These sessions have proven very helpful for students.

- (d) The web site contains a variety of activities to help you with the course. There are practice quizzes and examinations, an animation on electrochemical cells, many examples with full solutions, a question of the week, and much more. Please note, all important announcements for the course will be made on the web site.

#### 5. Examinations and Grades

- (a) The course grade will be calculated as follows:

Midterm	30%
Final Examination	40%
Laboratory	20%
Online Quizzes	10%

(b) Quiz and Midterm Examination Dates

Quizzes

The quizzes are delivered on the web site. You may use the text and any notes when attempting the quizzes. The maximum benefit from the quizzes will be obtained if you do them on your own and under examination conditions. The quizzes are 75 minutes in duration and will be available on the dates listed below from 1:00 a.m. Tuesday until 11:55 p.m. Thursday. Answers and help for questions on your quiz may be accessed on the Friday, Saturday and Sunday of the quiz week. Each quiz can only be accessed at these times. **No reason for missing a quiz will be accepted. If a quiz is not attempted, a grade of zero will be assigned.**

Please do not leave your quiz attempt until the last day!

Quiz #1 - Thermochemistry, Entropy and Spontaneity	Jan. 27-Jan. 29
Quiz #2 - Redox and Electrochemical Cells.	Mar. 02-Mar. 04
Quiz #3 - Electrochemistry.	Mar. 16-Mar. 18
Quiz #4 - Kinetics.	Mar. 30-Apr. 01

Midterm Examination

**Saturday, February 7, 9:30 - 11:00 a.m.** Room assignments will be posted in the C&M and MACN buildings and on the web site under “Announcements”.

**Midterm Conflict:** Apply in writing to the course coordinator during the week of Jan. 26 - Jan. 30 to write the **Alternate Midterm on Thursday Feb. 5, 5:30 - 7:00 p.m.** Include your name, ID, and reason for conflict and leave the application in the folder on the door of C&M 378. If you are not contacted the week of the examination, your application to write the alternate midterm has been approved. The room for the alternate midterm will be posted on the WebCT site under “Announcements.”

- (c) All examinations will be closed book, with no written or printed materials of any kind permitted. Electronic calculators can be used but no electrical outlets are available in exam rooms. Computers or calculators capable of storing text information or formulas are not allowed in examinations.

**6. Policy on Missed Examinations**

A grade of zero will be assigned for any missed examination except for valid medical or compassionate reasons. For a missed examination, documentation must be given to your professor in person. We are not responsible for documentation lost because it was not sent to the right person. There is no need to consult a doctor to obtain a note. However, if you have consulted a medical practitioner because of illness or injury, the doctor's note is acceptable documentation. In the case of a missed midterm, if a valid reason for missing the midterm is received, the percent value of the midterm will be added to the final examination. **No make-up midterm will be given.**

## 7. Lecture Schedule

Lecturers will cover the same material but may do so in a different order. Thus it is important that you attend your assigned lecture section throughout the semester. Please read the appropriate sections in the text before lectures.

Week / Date	Lectures	Topics	Text Reference
Weeks 1-5 Jan. 5 to Feb. 6	1-15	Thermodynamic definitions, energy changes, calorimetry, enthalpy, covalent compounds and bond energies Energetics of ionic compounds Entropy and Free Energy Thermodynamics and equilibrium Bioenergetics Review class	Ch 12, 12.1-12.5 Ch 9, 9.2  Ch 7, 7.5 Ch 13, 13.1-13.4 Ch 15, 15.3 Ch 13, 13.6
<b>Feb. 7, 9:30 - 11:00 a.m.</b>	<b>Midterm Exam</b>	<b>Lectures 1-15 and corresponding problem assignments.</b>	
Week 6 Feb. 9-13	16-18	Redox processes, half-reactions, balancing redox reactions	Ch 18, 18.1, 18.2
Feb. 16-20		<b>WINTER BREAK</b>	
Weeks 7-9 Feb. 23 to Mar. 12	19-27	Galvanic cells, Cell notation Cell potentials, standard cell potential Cell potentials, Free energy, equilibrium constants, the Nernst equation Practical cells, corrosion Electrolysis (electrochemical stoichiometry)	Ch 18, 18.3 Ch 18, 18.4 Ch 18, 18.5  Ch 18, 18.6 Ch 18, 18.7
Weeks 10-12 Mar. 15 to Apr. 2	28-36	Chemical Kinetics Radioactive decay Review class	Ch 14, 14.1-14.7 Ch 21, 21.7 (Dating...)

Midterm Examination, Saturday, Feb 07, 9:30 - 11:00 a.m.

The midterm exam will consist of multiple choice questions, short answer questions, and problems similar to those in the problem assignments.

**The Final Examination covers the entire course and is scheduled for  
Wednesday, April 7, 11:30 am - 1:30 pm**

## 8. Laboratory Schedule

Week 1 Jan. 5-9	Students who have a TBA lab must switch into a scheduled lab section on WebAdvisor this week. All students <b>must</b> bring a printout of “My Class Schedule” to their lab in Week 2.	
Week 2 Jan. 12-16	Check-in, Safety in the Laboratory (WHMIS)	No Quiz
Week 3 Jan. 19-23	Experiment 1 - Enthalpy of formation Quiz on WHMIS and on Experiment 1.	Quiz
Week 4 Jan. 26-30	Experiment 2 - Measurement of an Equilibrium Constant <b>MACN 306, MACN 307</b> Experiment 3 - Determination of $\Delta G^\circ$ , $\Delta H^\circ$ , $\Delta S^\circ$ <b>MACN 128, MACN 130, C&amp;M 152</b>	Quiz Quiz
Week 5 Feb. 2-6	Experiment 3 - Determination of $\Delta G^\circ$ , $\Delta H^\circ$ , $\Delta S^\circ$ <b>MACN 306, MACN 307</b> Experiment 2 - Measurement of an Equilibrium Constant <b>MACN 128, MACN 130, C&amp;M 152</b>	Quiz Quiz
Week 6 Feb. 9-13	Experiment 4 - Begin Oxidation and Reduction <b>Part A MACN 306, MACN 307</b> <b>Part B MACN 128, MACN 130, C&amp;M 152</b>	No Quiz
Feb. 16-20	<b>WINTER BREAK</b>	
Week 7 Feb. 23-27	Experiment 4 - Finish Oxidation and Reduction <b>Part B MACN 306, MACN 307</b> <b>Part A MACN 128, MACN 130, C&amp;M 152</b>	Quiz
Week 8 Mar.1-5	Experiment 5 - Galvanic Cells	Quiz
Week 9 Mar. 8-12	Experiment 6 – Electrolysis	Quiz
Week 10 Mar. 15-19	Experiment 7 - Chemical Kinetics	No Quiz
Week 11 Mar. 22-26	Clean-up	No Quiz
Week 12 Mar 29-Apr.2	Check Final Lab Grades.	

## 9. Problems

Problems are assigned to provide reinforcement of the principles covered in lectures, to allow you to practice problem solving techniques and to check your own knowledge before examinations. Work done on these problems is not graded, but there is a good correlation between mastering the problems on a week-by-week basis and performance in the course as a whole.

**Work the problems in the week that the material is covered in lectures.** A common reason why students fail first year Chemistry is that they fall so far behind with the material that they never catch up. Lectures become harder to comprehend without the reinforcement effect of constant practice.

**Work the problems independently.** Working from the solutions is not useful for learning.

### Solutions to problems

The detailed solutions to the problems are contained in the "Student Solutions Manual" which is included with the text. If you are having difficulty with the material, see your professor or go to the Chemistry Help Room.

## PROBLEMS

### I Energetics of Ionic Compounds, Thermodynamic Definitions, Bond Enthalpies, Entropy and Free Energy, Thermodynamics and Equilibrium

Text: 12.1, 12.3, 12.7, 12.11, 12.15, 12.19, 12.21, 12.23, 12.25, 12.27, 12.29, 12.31, 12.33, 12.35, 12.45, 12.49, 12.51, 12.55, 12.57, 12.59, 12.61, 12.65, 12.67, 12.69, 12.71, 12.79, 12.81, 12.83, 12.85, 9.11, 9.13, 9.59, 7.37, 7.39, 7.41, 7.45, 13.3, 13.5, 13.7, 13.9, 13.11, 13.13, 13.15, 13.17, 13.21, 13.23, 13.27, 13.29, 13.31, 13.35, 13.43, 13.45, 13.47, 13.49, 13.53, 13.57, 13.63, 13.73, 13.75, 13.79, 13.81, 13.87, 15.19, 15.21, 15.59, 15.71.

Note:  $\Delta E$  (used in the current text) and  $\Delta U$  are both used to represent the change in internal energy of a system at constant volume.

### II Electrochemistry

Text: 18.1, 18.3, 18.5, 18.7, 18.9, 18.13, 18.15, 18.19, 18.21, 18.25, 18.27, 18.31, 18.35, 18.37, 18.41, 18.43, 18.45, 18.49, 18.53, 18.55, 18.57, 18.59, 18.63, 18.67, 18.69, 18.73, 18.77, 18.81, 18.85, 18.87, 18.91.

### III Chemical Kinetics

Text: 14.3, 14.7, 14.9, 14.15, 14.17, 14.19, 14.21, 14.23, 14.25, 14.27, 14.29, 14.31, 14.35, 14.37, 14.41, 14.45, 14.49, 14.51, 14.55, 14.57, 14.59, 14.61, 14.63, 14.65, 14.67, 14.81, 14.83, 14.85, 14.89.

## Conceptual and Integrated Problems

No solutions for the following problems will be available. To check an answer or for help with any of these problems, please see your professor or go to the Help Room.

1. Given the data:	Bond Enthalpies, $\text{kJ}\cdot\text{mol}^{-1}$	Enthalpies of Formation, $\text{kJ}\cdot\text{mol}^{-1}$
	O–H 463	$\text{OH}^{-}(\text{aq})$ -229.9
	H–H 436	$\text{H}_2\text{O}(\text{l})$ -285.8
		$\text{H}_2\text{O}(\text{g})$ -241.8

calculate  $\Delta H$  for each of the following reactions.

- $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$
- $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g})$
- $2\text{H}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g})$
- $\text{H}^{+}(\text{aq}) + \text{OH}^{-}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- $2\text{H}(\text{g}) \rightarrow \text{H}_2(\text{g})$
- $2\text{H}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$

2. Calculate the average H–S bond energy in  $\text{H}_2\text{S}(\text{g})$  given the data below.

Compound	$\Delta H_f^{\circ}$ , $\text{kJ}\cdot\text{mol}^{-1}$
$\text{H}_2\text{S}(\text{g})$	-20.1
$\text{H}(\text{g})$	217.9
$\text{S}(\text{g})$	222.8

3. Calculate the work needed to make room for products in the combustion of 1 mole of methane gas to carbon dioxide and water vapour at STP.

4. Calculate the lattice enthalpy of magnesium chloride from the following data.

- enthalpy of formation of  $\text{Mg}(\text{g})$ :  $148 \text{ kJ}\cdot\text{mol}^{-1}$
- first ionization energy of  $\text{Mg}(\text{g})$ :  $736 \text{ kJ}\cdot\text{mol}^{-1}$
- second ionization energy of  $\text{Mg}(\text{g})$ :  $1450 \text{ kJ}\cdot\text{mol}^{-1}$
- enthalpy of formation of  $\text{Cl}(\text{g})$ :  $122 \text{ kJ}\cdot\text{mol}^{-1}$
- electron-gain enthalpy of  $\text{Cl}(\text{g})$ :  $-349 \text{ kJ}\cdot\text{mol}^{-1}$  (EA in the text)
- enthalpy of formation of  $\text{MgCl}_2(\text{s})$ :  $-641 \text{ kJ}\cdot\text{mol}^{-1}$  ( $\Delta E$  in the text)

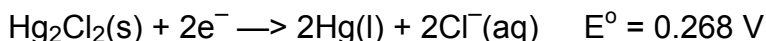
5. At the normal boiling point of ethyl ether,  $34.5^{\circ}\text{C}$ ,  $\Delta H^{\circ}$  of vaporization is  $26.0 \text{ kJ}\cdot\text{mol}^{-1}$ . Assuming that the volume of 1 mole of liquid ethyl ether is negligible and that ethyl ether vapor behaves as an ideal gas, calculate  $q$ ,  $w$ ,  $\Delta U$ ,  $\Delta S$ , and  $\Delta G$  for the reversible vaporization of 1 mole of ethyl ether at a constant pressure of 1 atm.

6. The standard free energy of formation of benzene is positive. Benzene is a common, stable organic solvent. Is there a conflict between these facts? If so, explain why the two statements can still be simultaneously true.

7. At what temperature will the vapour pressure of water equal 600 Torr? Assume the enthalpy and entropy change to be independent of temperature.

8. If a piston expands into a vacuum, against zero pressure, how much work is done? Explain.

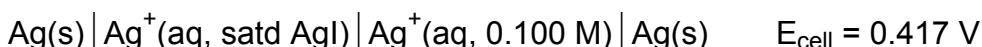
9. A hydrogen electrode having a  $\text{H}_2(\text{g})$  pressure of 1.00 atm is combined with a standard calomel electrode, whose half-reaction is



(a) If the cell potential is 0.800 V, find the pH of the solution surrounding the hydrogen electrode.

(b) Calculate the cell potential when the hydrogen electrode is immersed in a neutral solution.

10. Calculate the  $K_{\text{sp}}$  of AgI given the concentration cell below.



11. How long will it take to produce a solution of pH 2.00 by electrolysis of 500.0 mL of 0.100 M  $\text{AgNO}_3(\text{aq})$  by using a constant current of 0.240 Amperes?

12. The time-concentration data below were collected for the following reaction.

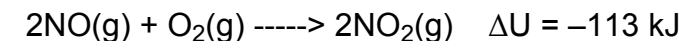
**A -----> Products**

Determine the order of the reaction graphically and calculate the rate constant.

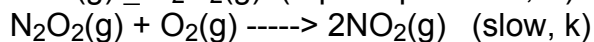
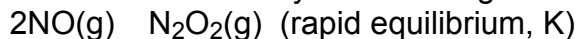
time, s	0	1	2	3	4
[A], M	1.00	0.430	0.270	0.200	0.160

13. A charcoal sample from Stonehenge, an ancient megalithic site near Salisbury in Southern England, is analyzed by carbon-14 dating. A 1.00-g sample gave 9.65 disintegrations per minute. A 1.00-g sample of carbon from a modern source gave 18,400 disintegrations in 20.0 hours. How old is the charcoal from Stonehenge?

14. The reaction



is believed to occur by the following mechanism:



(a) Derive the rate law predicted by this mechanism.

(b) Draw the energy profile (plot of energy versus reaction coordinate) for the reaction, clearly labelling all intermediates.