

Student Course Information

CHEM*1050 - General Chemistry II

Fall 2006

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0. INTRODUCTION

This course outline describes CHEM*1050 in detail and identifies what is to be learned, and the administrative details of the course. It also provides you with a detailed schedule of events. Please read it carefully – it should answer the majority of your questions about the administration of CHEM*1050.

In this course, we will

- I. Study thermodynamics by considering enthalpy, entropy, free energy and the relationship of free energy to equilibrium.
- II. Determine oxidation states and examine oxidation-reduction reaction and electrochemistry.
- III. Consider the rates and mechanisms of chemical reactions.

It will be assumed that you understand the majority of concepts covered in CHEM*1040, or an equivalent course, based on the pre-requisites of this course.

1. REQUIRED MATERIALS

- (a) **Textbook:** *General Chemistry*, 8 ed., Darrell Ebbing and Steven Gammon, Houghton Mifflin Company, 2005 and *Student Solutions Manual*, David Bookin, Darrell Ebbing, and Steven Gammon, Houghton Mifflin Company, 2005. These two books are shrink-wrapped together with the study guide and may be purchased in the University Bookstore. The same text was used for CHEM*1040 in fall 2005 and winter 2006.
- (b) **Electronic calculator** with \ln , \exp or e^x , \log_{10} and 10^x functions is required. Calculators or notebook computers capable of storing text information are **NOT** allowed in examinations.
- (c) **Laboratory Manual** for CHEM*1050 can be purchased from the Chemistry Department. Bring your laboratory manual to your first laboratory meeting.
- (d) **Safety goggles** (not safety glasses) are required and can be purchased from the Chemistry Department as well as the University Bookstore.
- (e) **Lab coat** is required and can be purchased from the Chemistry and Biochemistry Club or the University Bookstore.

2. LABORATORY

Laboratories begin Monday, September 11 with mandatory safety training which is a pre-requisite for all subsequent laboratories. The laboratory is an integral part of the course where you will apply your chemistry knowledge in a laboratory setting.

- (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 1 then you may lose your place.

If you have a scheduling problem you may be able to resolve it through WebAdvisor – otherwise speak to Dr. Jones.

- (b) **Laboratory Authorisation**
As proof that you belong in a specific lab section, bring a recent computer print-out of “My Class Schedule” from WebAdvisor to your first lab.
- (c) **Laboratory Quizzes**
A brief quiz will be held at the beginning of most laboratory sessions. Refer to the Laboratory Schedule for details (page 6). These in-lab quizzes count towards your laboratory grade (roughly one fifth of your lab grade), and will usually be based on the experiment that you are about to perform.
- (d) **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.
- (e) **Laboratory Exemptions for Students Repeating CHEM*1050**
Students who obtained a laboratory grade of **at least 60%**, but who fail the course as a whole, may apply for a laboratory exemption. To apply, complete the WebCT quiz entitled “Laboratory Exemption Application” found under “Assessments”.

DEADLINE: TUESDAY, SEPTEMBER 12, 2006

Students repeating CHEM*1050 who are granted a lab exemption are strongly encouraged to attend one of the Problem Laboratories in Week 5 (refer to the lab schedule on page 6). You may attend any lab that week (check Webadvisor for times). The Problem Lab questions will be posted on the WebCT website under Course Resources.

3. WEB SITE

The web site is an integral part of the course and must be accessed daily. To access the web site go to the portal at www.courselink.uoguelph.ca. Your **User ID** 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.

Before you log in, move the cursor to the “Browser Check” link at the top of the Courselink@Guelph page to make sure your browser is configured properly for WebCT. Also on the Courselink@Guelph page, click the “Check here” link within the text of the page to make sure your computer is in prime condition to use the new version of WebCT. After you log in, the first page is “myWebCT: your name” which will list all your WebCT courses including CHEM*1050.

If you have any technical problems using WebCT, move the cursor to the “Help” 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 www.uoguelph.ca/ccs/accounts/index.html for more information.

4. HELP

- (a) **Office hours:** Dr. Jones will be available at certain times for consultation and help. Office hours will be announced at the first class meeting.
- (b) **Supported Learning Groups (SLGs)**
SLGs are regularly scheduled small group study sessions. Attendance is voluntary and open to all students enrolled in the course. These sessions have proven very helpful for students. The study groups are facilitated by successful senior undergraduates 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. 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 week of classes. For further information, please refer to the SLG website: www.learningcommons.uoguelph.ca/SLG/index.html
- (c) The web site contains a variety of activities to help you with the course. The “Course Content” page provides you with announcements, course resources, and quizzes (practice and for credit). Under the link entitled “Course Resources” you will find lecture outlines, a question of the week, course topic materials, and much more. The “Discussions” course tool gives students the opportunity to post questions about the course where others in the class can supply timely answers or suggestions.

Please note, all important announcements will be posted on the web site.

5. EXAMINATIONS AND GRADES

- (a) The course grade will be calculated as follows:
- | | |
|---------------------|-----|
| Online Quizzes | 10% |
| Laboratory | 20% |
| Midterm Examination | 30% |
| Final Examination | 40% |

(b) **Online Quizzes**

The quizzes are delivered on the WebCT 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** under examination conditions. The quizzes are 75 minutes in duration, can only be attempted once, and will be available on the dates listed below from 7:00 a.m. Tuesday until 11:55 p.m. Thursday. Answers to the 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. **If a quiz is not attempted, a grade of zero will be assigned**, except for extenuation circumstances. Please do not leave your quiz attempt until the last day!

Quiz #1 – Thermochemistry	Sept. 26 – Sept. 28
Quiz #2 – Entropy and Spontaneity	Oct. 10 – Oct. 12
Quiz #3 – Redox and Electrochemical Cells	Oct. 31 – Nov. 02
Quiz #4 – Electrochemistry	Nov. 14 – Nov. 16
Quiz #5 – Kinetics	Nov. 28 – Nov. 30

(c) **Midterm Examination Date: Sat., Oct. 14, 09:30 - 11:00 ROZH 101/103**
The midterm exam will consist of multiple choice questions, short answer questions, and problems similar to those in the problem assignments.

(d) **Midterm Examination Conflicts:** If you have a legitimate conflict you will be given the opportunity to write an alternate CHEM*1050 midterm exam on:

Thursday, October 12, 2006. 5:30 - 7:00 p.m.

You must provide Dr. Jones with a note including your name, ID number, and the reason for requesting the alternate midterm time by Friday, October 6, 2006. The location will be announced on WebCT.

(e) **Final Examination Date: Wednesday, December 13, 11:30 am – 1:30 pm**
The final exam will cover the entire course and will consist of multiple choice questions, short answer questions, and problems. (**Note:** Room assignments are made by the Registrar's office close to the final exam period – refer to www.uoguelph.ca/regweb/exam/exam_fall.html).

(f) All examinations will be closed book. 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.

7. POLICY ON MISSED WORK

A grade of zero will be assigned for any missed work except for valid medical, psychological or compassionate reasons and only if you follow the correct procedure.

a) Missed Midterm Examination: If you do not write the midterm examination, documentation must be given to Dr. Jones in 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. If a valid reason for missing the midterm is received, the grade on the missed midterm will be estimated from the student's performance on the final examination. **No make-up midterm will be given.**

b) Missed Laboratory: Follow the directions outlined on the "Purple Page for Lab Absences in First-Year Chemistry" posted under "Course Resources" on the course website.

c) Missed Final Examination: You need to contact your Program Counselor as soon as possible. Official documentation is required for a missed final examination. For further details, consult the on-line Undergraduate Calendar:

www.uoguelph.ca/undergrad_calendar/c08/c08-ac-ac.shtml

List of Program Counsellors: www.uoguelph.ca/uaic/students_counsellors.shtml

7. Lecture and Reading Schedule – FALL 2006

Please read the appropriate sections in the text **BEFORE** lectures.

Week	Date	Lecture	Material Covered in Lecture	Text Ref.	Problem Assignment
1	Sept. 11 to Sept. 15	1 2 3	Course Info., and thermodynamic def'ns Heat and Calorimetry Work and Enthalpy	6.1 6.2, 6.6 19.1, 6.3–6.5	1
2	Sept. 18 to Sept. 22	4 5 6	Hess's Law Standard Enthalpies Fuels	6.7 6.8 6.9	2
3	Sept. 25 to Sept. 29	7 8 9	Covalent Bond Energies Energetics of Ionic Compounds Entropy	9.11 9.1 19.2–19.3	3
4	Oct. 02 to Oct. 06	10 11 12	Spontaneity & Free Energy Thermodynamics and Equilibrium Bioenergetics	19.4–19.5 19.6–19.7	4
5	Oct. 09 to Oct. 13	No class! 13 14	Holiday (Thanksgiving) Review Class Review Class		5
	Oct. 14		Midterm Exam: 9:30 – 11:00 a.m.		
6	Oct. 16 to Oct. 20	15 16 17	Review Redox, Oxidation States Half Reactions, Balancing Redox Voltaic cells	20.1 20.2	6
7	Oct. 23 to Oct. 27	18 19 20	Cell notation Electromotive Force and Std. Potentials Free Energy and Electrochemistry	20.3 20.4–20.5 20.6	7
8	Oct. 30 to Nov. 03	21 22 23	Nernst equation Applications of Voltaic Cells Electrolytic Cells	20.7 20.8 20.9–20.10	8
9	Nov. 06 to Nov. 10	24 25 26	Electrolysis (40 th Class) Applications Reaction Rate, Instantaneous Rate	20.11 14.1–14.2	9
10	Nov. 13 to Nov. 17	27 28 29	Rate and Concentration Change of Concentration with Time Radioactive decay	14.3 14.4 21.4	10
11	Nov. 20 to Nov. 24	30 31 32	Rate and Temperature/Arrhenius Elementary Reactions Reaction Mechanisms	14.5–14.6 14.7 14.8	11
12	Nov. 27 to Dec. 01	33 34 35	Catalysis Review class Review class	14.9	12
	Dec. 13		Final Exam: 11:30 – 13:30		

Disclaimer: The precise sequence and timing of the above schedule is at the discretion of your Professor. The schedule above is the best zeroth-order approximation.

9. LABORATORY SCHEDULE – FALL 2006

Week 1 Sept. 11 – 15	Check-in Safety in the Laboratory (WHMIS)	No Quiz
Week 2 Sept. 18 – 22	Experiment 1 - Enthalpy of formation (Quiz on WHMIS and on Experiment 1)	Quiz
Week 3 Sept. 25 – Sept. 29	Experiment 2 - Measurement of an Equilibrium Constant	Quiz
Week 4 Oct. 02 – 06	Experiment 3 - Determination of ΔG° , ΔH° , ΔS°	Quiz
Week 5 Oct. 09* – 13	Problem Lab (Note: Those scheduled in a Monday lab will attend one of the other Problem Labs running this week – check WebAdvisor for times.)	No Quiz
Week 6 Oct. 16 – 20	Experiment 4 - Oxidation and Reduction (Part A)	No Quiz
Week 7 Oct. 23 – 27	Experiment 4 - Oxidation and Reduction (Part B)	Quiz
Week 8 Oct. 30 - Nov. 03	Experiment 5 - Galvanic Cells	Quiz
Week 9 Nov. 06 – 10	Experiment 6 – Electrolysis	Quiz
Week 10 Nov. 13 – 17	Experiment 7 - Chemical Kinetics	No Quiz
Week 11 Nov. 20 – 24	Clean-up	No Quiz
Week 12 Nov. 27 – Dec. 01	Check Final Lab Grades Problems Lab	No Quiz

*** October 09 is Thanksgiving – No Classes are Scheduled.**

10. WEEKLY PROBLEM ASSIGNMENTS

Problems are assigned to provide reinforcement of the principles covered in lectures, to allow you to develop problem solving techniques and to check your own knowledge before examinations. Work done on these problems is not graded, but mastering the problems provides you with an excellent way of finding out how well you really understand the chemistry presented in lectures. There is a good correlation between mastering the problems on a week-by-week basis and performance on examinations.

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. If you have difficulties, seek help as soon as possible.

Solutions to problems

The detailed solutions to the problems from the text are contained in the "Student Solutions Manual" which is included with the text. Answers and solutions to the problems below which are not from the text will be posted on the website. If you are having difficulty with the material, please see your professor.

PROBLEMS

ASSIGNMENT 1:

- 1-1: Text: 6.61, 6.63, 6.45, 6.49, 6.55, 19.25.
- 1-2: A 100.0 mL sample of 0.200 M aqueous hydrochloric acid was added to 100.0 mL of 0.200 M aqueous ammonia in a coffee cup calorimeter. The temperature increased from 22.17°C to 23.50°C. In a separate experiment the heat capacity of the calorimeter plus the final solution was found to be 784 JK⁻¹. Calculate ΔH for the reaction: $\text{NH}_3(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{NH}_4\text{Cl}(\text{aq})$
- 1-3: 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.
- 1-4: If a piston expands into a vacuum, against zero pressure, how much work is done? Explain.

Note: ΔE and ΔU (used in the current text) are both used to represent the change in internal energy of a system. (In question 6.63, because volume is constant $q_V = \Delta U$ and $\therefore \Delta H = \Delta U + \Delta PV = -1.37 \times 10^3 \text{ kJ/mol.}$)

ASSIGNMENT 2:

- 2-1: Text: 6.29, 6.33, 6.65, 6.69, 6.73, 6.75, 6.87, 6.89, 6.97, 6.103, 6.111, 6.121.
- 2-2: One mole of He(g) enclosed in a cylinder with a moveable piston absorbs 1.00 kJ of heat while expanding against a constant external pressure of 1.00 atmosphere. Calculate ΔH and ΔU for this process. C_p for He(g) = 20.8 JK⁻¹mol⁻¹.

ASSIGNMENT 3:

- 3-1: Text: 9.79, 9.101, 9.103, 9.113, 19.17, 19.19, 19.21, 19.23, 19.29, 19.33, 19.37, 19.67.
- 3-2: Given the following data:
- | | <u>Bond Enthalpies, kJ.mol⁻¹</u> | <u>Enthalpies of Formation, kJ.mol⁻¹</u> |
|-----|---|---|
| O-H | 463 | OH ⁻ (aq) -229.9 |
| H-H | 436 | H ₂ O (l) -285.8 |
| | | H ₂ O (g) -241.8 |

a) Calculate ΔH for each of the following reactions.

- i. $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$
- ii. $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g})$
- iii. $2\text{H}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{g})$
- iv. $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$
- v. $2\text{H}(\text{g}) \rightarrow \text{H}_2(\text{g})$
- vi. $2\text{H}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$

3-3: Calculate the average H–S bond energy in $\text{H}_2\text{S}(\text{g})$ given the data below.

Compound	ΔH_f° , $\text{kJ}\cdot\text{mol}^{-1}$
$\text{H}_2\text{S}(\text{g})$	–20.1
$\text{H}(\text{g})$	217.9
$\text{S}(\text{g})$	222.8

3-4: 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 $\text{Cl}(\text{g})$: $-349 \text{ kJ}\cdot\text{mol}^{-1}$
- enthalpy of formation of $\text{MgCl}_2(\text{s})$: $-641 \text{ kJ}\cdot\text{mol}^{-1}$

ASSIGNMENT 4:

4-1: Text: 19.41, 19.45, 19.55, 19.59, 19.63, 19.69, 19.77, 19.79, 19.83, 19.91, 19.95, 19.103

4-2: Given the following possibilities for $\Delta G^\circ_{\text{rxn}}$, what can you say about the magnitude of K_{eq} for the reaction in each case?

- (a) $\Delta G^\circ_{\text{rxn}} > 0$ (b) $\Delta G^\circ_{\text{rxn}} < 0$ (c) $\Delta G^\circ_{\text{rxn}} = 0$

4-3: At the normal boiling point of ethyl ether, 34.5°C , ΔH° 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 , ΔU , ΔS , and ΔG for the reversible vaporization of 1 mole of ethyl ether at a constant pressure of 1 atm.

ASSIGNMENT 5:

5-1: At what temperature will the vapour pressure of water equal 600 Torr? Assume the enthalpy and entropy change to be independent of temperature.

5-2: 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.

5-3: For the reaction: $\text{Li}_2\text{SO}_4\cdot\text{H}_2\text{O}(\text{s}) \leftrightarrow \text{Li}_2\text{SO}_4(\text{s}) + \text{H}_2\text{O}(\text{g})$
 $\Delta G^\circ = 15.2 \text{ kJ mol}^{-1}$ at 298 K. Calculate the pressure of $\text{H}_2\text{O}(\text{g})$ in torr, in equilibrium with $\text{Li}_2\text{SO}_4\cdot\text{H}_2\text{O}(\text{s})$ and $\text{Li}_2\text{SO}_4(\text{s})$ at 298 K. (Pressure unit conversion: 1 atm = 1 torr)

5-4: For each of the reaction listed below:

- a) Use tabulated data to calculate ΔG° at 298 K
- b) Use tabulated data to calculate ΔH° and ΔS° at 298 K and verify that $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
- c) Will the reaction occur spontaneously at 298 K with all reactants and products in their standard states? If so, which factor (enthalpy or entropy) provides the principle driving force?
- d) Where the reaction will not occur spontaneously at 298 K, determine whether it would become

spontaneous at some higher or lower temperature. For each reaction determine the range of temperatures, if any, over which it will be spontaneous.

- i. $4\text{HCl(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O(g)} + 2\text{Cl}_2\text{(g)}$
- ii. $\text{H}_2\text{(g)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{HCl(g)}$
- iii. $\text{C(graphite)} \rightarrow \text{C(diamond)}$

ASSIGNMENT 6:

6-1: Text: 20.33, 20.35, 20.95

6-2: Balance each of the following equations, identifying the oxidizing agent and the reducing agent in each case. All ions are in aqueous solution.

- a) $\text{Cr}_2\text{O}_7^{2-} + \text{C}_2\text{H}_4\text{O} \rightarrow \text{C}_2\text{H}_4\text{O}_2 + \text{Cr}^{3+}$ (acidic solution)
- b) $\text{PbO}_2\text{(s)} + \text{Cl}^- \rightarrow \text{ClO}^- + \text{Pb(OH)}_3^-$ (basic solution)
- c) $\text{H}_2\text{S}_2\text{O}_3 \rightarrow \text{S}_8\text{(s)} + \text{HSO}_4^-$ (acidic solution)
- d) $\text{HO}_2^- + \text{Cr(OH)}_3^- \rightarrow \text{CrO}_4^{2-}$ (basic solution)

ASSIGNMENT 7:

7-1: Text: 20.19, 20.27, 20.37, 20.39, 20.41, 20.45, 20.47, 20.49, 20.53, 20.55, 20.57, 20.61, 20.65, 20.99

7-2: For each of the following reactions,

- a) Write the oxidation and reduction half-reactions;
- b) Determine the number of electrons transferred in the equation as written;
- c) Use standard reduction potentials to calculate E° ;
- d) Tell whether the reaction is spontaneous as written under standard conditions
 - a) $\text{Fe}^{2+}\text{(aq)} + \text{Ag}^+\text{(aq)} \rightarrow \text{Fe}^{3+}\text{(aq)} + \text{Ag(s)}$
 - b) $\text{Cu(s)} + \text{AgCl(s)} \rightarrow \text{Cu}^{2+}\text{(aq)} + 2\text{Ag(s)} + 2\text{Cl}^-\text{(aq)}$

ASSIGNMENT 8:

8-1: Text: 20.69, 20.73, 20.77, 20.79, 20.81, 20.105, 20.111, 20.125

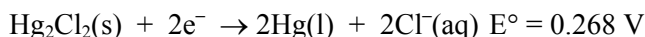
8-2: Use tabulated data to calculate ΔG° and K_{eq} for each of the following reactions:

- a) $2\text{Ag(s)} + \text{F}_2\text{(g)} \rightarrow 2\text{Ag}^+\text{(aq)} + 2\text{F}^-\text{(aq)}$
- b) $\frac{1}{2}\text{H}_2\text{(g)} + \text{Fe}^{3+}\text{(aq)} \rightarrow \text{Fe}^{2+}\text{(aq)} + \text{H}^+\text{(aq)}$

8-3: Calculate E for the half-reactions:

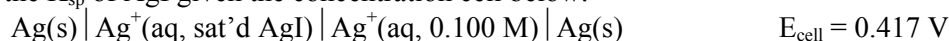
- a) $\text{H}^+\text{(aq, } 1.00 \times 10^{-7} \text{ M)} + \text{e}^- \rightarrow \frac{1}{2}\text{H}_2\text{(g, 1 atm)}$
- b) $\text{H}^+\text{(aq, } 1.00 \times 10^{-14} \text{ M)} + \text{e}^- \rightarrow \frac{1}{2}\text{H}_2\text{(g, 1 atm)}$

8-4: 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.

8-5: Calculate the K_{sp} of AgI given the concentration cell below.



ASSIGNMENT 9:

9-1: Text: 20.85, 20.87, 20.89, 20.107, 20.113, 20.117.

9-2: Calculate the minimum decomposition voltage in the electrolysis of 0.200 M $\text{CuBr}_2(\text{aq})$.

9-3: Sodium metal is produced commercially by the electrolysis of molten sodium chloride. Calculate the mass of sodium and the volume of chlorine gas measured at 1 atm and 25°C produced by a current of 20.0 amperes in 1.00 hour.

9-4: 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?

ASSIGNMENT 10:

10-1: Text: 14.25, 14.27, 14.35, 14.39, 14.43, 14.47, 14.49, 14.51, 14.53, 14.57, 14.63, 14.65, 14.93, 14.95, 14.99, 14.101; 21.23, 21.57, 21.59, 21.65, 21.71.

10-2: The reaction: $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$ is found experimentally to be first-order in O_2 and second-order in NO . Beginning with $1.88 \times 10^{-3} \text{ mol L}^{-1}$ of $\text{O}_2(\text{g})$ and $2.00 \times 10^{-1} \text{ mol L}^{-1}$ of $\text{NO}(\text{g})$, to what fraction of the initial rate has the rate decreased when

- (a) half of the initial $\text{O}_2(\text{g})$ has been consumed?
 (b) half of the initial $\text{NO}(\text{g})$ has been consumed?

10-3: Sulphuryl chloride, SO_2Cl_2 , decomposes on heating according to the equation:



A study of the reaction at 329°C led to the following results:

Time (min.)	$[\text{SO}_2\text{Cl}_2], \text{M}$	Time (minutes)	$[\text{SO}_2\text{Cl}_2], \text{M}$
0	2.02×10^{-3}	315	8.45×10^{-4}
76	1.64×10^{-3}	410	6.70×10^{-4}
200	1.17×10^{-3}	560	4.31×10^{-4}

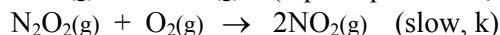
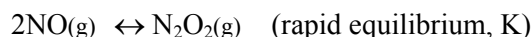
Use a graphical method to determine the rate law and the rate constant at 329°C .

10-4: 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?

ASSIGNMENT 11:

11-1: Text: 14.69, 14.73, 14.75, 14.79, 14.111, 14.113.

11-2: The reaction: $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$; $\Delta U = -113 \text{ kJ}$ 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.

ASSIGNMENT 12:

12-1: Text: 14.87, 14.119, 14.125.