

CHEMISTRY 101
GENERAL CHEMISTRY I
FALL 2008

- INSTRUCTOR:** Maria A. Gomez (G22C Carr; magomez@mtholyoke.edu)
Office hours: Tu 1-2 PM, W 2-3 PM, Th 3-5 PM or by appointment.
- TUTORS:** *PLUMS Team:* Sara Martin, Amanda Strickland, Caroline Hickok, Ahri Lee, Mikaela Smith, Tenaya Vallery (emails on ella under Resources/PLUMS)
- SAW Mentor: Vidya Raghavan
Hours: By email appointment (ragha20v@mtholyoke.edu).
- HOURS:** Tu, Th 11:00 AM – 12:15 PM
W 3:15-4:05 PM
- TEXT:** Brown, LeMay, and Bursten, *Chemistry: The Central Science*, 10th Edition
(Available in Odyssey Bookstore)
- WEB:** <http://www.mtholyoke.edu/courses/magomez/chem101>
For internal class resources, log onto ella.
- LABORATORY:** See laboratory syllabus for details

COURSE DESCRIPTION

Chemistry is the study of matter and its transformations. This course aims to introduce the central concepts of chemistry to students new to the discipline while simultaneously preparing students for further study within chemistry or the chemistry-related sciences.

The course is divided into three units, each of which addresses a core concept of chemistry:

Unit #1: *Introduction to chemistry: languages and representations*

Unit #2: *The microscopic world: Atomic and molecular structure*

Unit #3: *From microscopic to macroscopic descriptions of matter*

ASSIGNMENTS

Problem Sets: Problem sets are due in class on the dates specified in the schedule. You need to show all work to receive full credit. Late assignments will not be accepted. The solution manual is on reserve at the library. This should give you ample opportunity to check your answers before handing your HW in.

Guided Problem Solving: Assignments will be started individually and in groups during class on the dates specified in the schedule; these assignments will be guided inquiries on the week's topics.

Scientific Essay: The scientific essay can either be on proton conduction in solid state fuel cells or dissolution of beryllium oxide and its links to Chronic Beryllium Disease. These topics will be discussed in class on 9/17 and 9/24. Additional references will be suggested on these days. The essay should be two pages in length plus references and is due on 12/2/08. 10% of your essay grade will be based on your

having met with Vidya Raghavan, our SAW mentor, to go over a draft of your essay. You need to meet with Vidya prior to 11/20/08. Appointments must be made two weeks in advance. A limited number of appointments will be possible each week so you need to start early.

Exams: Each unit will conclude with an exam focusing primarily on material covered in that unit. However, the nature of the material in this course is cumulative, and topics may draw heavily from material presented previously in the course. There will be a review before each exam. In addition, there will also be a comprehensive final exam. The last day of class will review for this exam.

GRADING POLICY

Problem sets:	10%
Guided problem solving:	10%
Scientific Essay	10%
Exams (lowest grade dropped):	30%
Comprehensive final exam	20%
Laboratory:	20% (see lab syllabus)

All laboratory experiments must be completed, and all lab reports must be handed in to receive a passing grade in the course (see lab syllabus for more details).

Unit 1: Introduction to the Language, Representations, and Concepts of Chemistry

Chemistry is a very broad field of study, but it is unified by a common set of terms, concepts, and techniques. In this unit, we will introduce and review many of these: the atom, the molecule, electrons, the periodic table, reactions and stoichiometry, acids and bases, and oxidation and reduction. All of these concepts will help form the vocabulary you will need both in this course and in later chemistry courses.

(a) Chemistry and measurement

<i>Topic</i>	DATE	<i>Reading</i>
Why study chemistry? Logistics	9/4	BLB 1.1-1.3
Measurement guided problem solving	9/5	BLB 1.4-1.6
Discovery of atomic structure	9/9	BLB 2.1-2.5
Atomic symbols and formulas guided problem solving	9/10	BLB 2.6-2.9

Problem Set 1 (due 9/16): Chapter 1 Exercises 29, 34, 55
Chapter 2 Visualizing Concepts 1, 6; Exercises 12, 14, 24, 34, 48,
54

(b) Stoichiometry

<i>Topic</i>	DATE	<i>Reading</i>
Stoichiometry: Chemical formulas	9/11	BLB 3.1-3.5
Stoichiometry: Chemical equations	9/16	BLB 3.6-3.7

Reactions in a solid fuel cell guided problem solving	9/17	
-------------------------------------------------------	------	--

Problem Set 2 (due 9/23): Chapter 3 Visualizing Concepts 5, 8; Exercises 15, 20, 40, 49 (c), 54, 63, 74, and 76

(c) Aqueous reactions and solution stoichiometry

<i>Topic</i>	DATE	<i>Reading</i>
Aqueous reactions	9/18	BLB 4.1-4.3
Oxidation-reduction reactions; Solution stoichiometry	9/23	BLB 4.4-4.6
Dissolution of BeO and Chronic Beryllium Disease guided problem solving	9/24	

Problem Set 3 (due 9/30): Chapter 4 Visualizing Concepts 6, 9; Exercises 18, 24, 40, 56, 62, 81, and 84

Other deadlines and dates

Unit 1 Review: THURSDAY SEPTEMBER 25TH

Unit 1 Exam: THURSDAY OCTOBER 2ND

UNIT 2: The Microscopic World: Atomic and Molecular Structure

A modern understanding of chemical phenomena is based on knowledge of the structure of atoms and molecules. In chemistry (as in many fields of biology), "structure determines function": in order to understand and predict the physical and chemical properties of materials, we need to be able to describe their structures on the molecular level. In this unit, we will explore the basic principles of quantum chemistry and the electronic structures of atoms and molecules, as well as begin to relate these ideas to chemical properties.

(a) Electronic structure of atoms

<i>Topic</i>	<i>DATE</i>	<i>Reading</i>
Wave nature of light; Spectroscopy guided problem solving	9/30	BLB 6.1-6.2
Wave-particle duality	10/1	BLB 6.3-6.4
Atomic Orbitals and many electron atoms	10/7	BLB 6.5-6.9
No class (use the time to work on your HW)	10/8	

Problem Set 4 (due 10/9): Chapter 6 Visualizing concepts 2, 5; Exercises 20, 30, 34, 44, 46, 48, 54, 64, 73, and 74

(b) Periodic Properties of Elements

<i>Topic</i>	<i>DATE</i>	<i>Reading</i>
Effective charge and radii; Ionization energy and electron affinity	10/9	BLB 7.1-7.5
Metals, semi-conductors, and insulators guided problem solving	10/15	

Problem Set 5 (*due 10/21*): Chapter 7 Exercises 14, 16, 32, 50, 51; Go through Gaussian tutorial (<http://www.mtholyoke.edu/acad/chem/mmlab/index.html>) and turn in results.

(c) Chemical Bonding

<i>Topic</i>	<i>DATE</i>	<i>Reading</i>
Bonding and Lewis dot structures	10/16	BLB 8.1-8.7
Lewis dot structures guided problem solving	10/21	

Problem Set 6 (*due 10/28*): Chapter 8 Exercises 4, 22, 40, 47, 54, 56, 60, and 62

(d) Molecular geometry and bonding theories

<i>Topic</i>	<i>DATE</i>	<i>Reading</i>
VSEPR	10/22	BLB 9.1-9.3
Hybridization	10/23	BLB 9.4-9.6
Molecular geometry guided problem solving	10/28	
Molecular Orbitals	10/29, 10/30	BLB 9.7-9.8
Covalent insulators and semi-conductors guided problem solving	11/4	

Problem Set 7 (*due 11/4*): Chapter 9 Exercises 13, 22, 26, 36, 38, 44, 48, 49, 56, 60, and 72

Other deadlines and dates

Unit 2 Review: THURSDAY NOVEMBER 5^h

Unit 2 Exam: THURSDAY NOVEMBER 13th

Unit 3: From microscopic to macroscopic descriptions of matter

Many principles that we apply to chemistry were developed before the discovery of the atom. These principles were based on macroscopic phenomena. In this unit we cover some of these basic principles of thermodynamics, apply them to chemistry, and build a bridge from the microscopic world of atoms and molecules to the properties of macroscopic materials we encounter every day. In order to accomplish this, we will first derive the properties of gases and then consider the forces by which atoms and molecules interact with one another.

(a) Thermochemistry

<i>Topic</i>	<i>DATE</i>	<i>Reading</i>
Energy and the first law of thermodynamics	11/6	BLB 5.1-5.2
Enthalpy, Hess' law, and bond strength	11/11	BLB 5.3-5.7, 8.8
Hybrid car guided problem solving	11/12, 11/18	

Problem Set 8: (due 11/18) Chapter 5 Visualizing Concepts 3, 7; Exercises 27, 42, 46, 48, 58, 60, 76, 115; Chapter 8 Exercise 70

(b) Gases

<i>Topic</i>	<i>DATE</i>	<i>Reading</i>
Ideal gas	11/19	BLB 10.1-10.6
Molecular basis for ideal behavior and deviations from ideal behavior t	11/20	BLB 10.7-10.9
Hydrogen storage issues guided problem solving	11/25	

Problem Set 9 (due 12/2): Chapter 10 Exercises 34, 42, 46, 56, 57, 68, 70, 82, 108, 110

(c) Intermolecular forces, liquids, solids and solutions

<i>Topic</i>	<i>DATE</i>	<i>Reading</i>
Intermolecular forces	12/2	BLB 11.1-11.5
Solution process and colligative properties	12/3	BLB 13.1-13.5
Dyeing yarn guided problem solving	12/10	

Problem Set 10 (due 12/10): Chapter 11 Exercises 14, 22, 26; Chapter 13 Visualizing Concepts 6, 8, Exercises 38, 54, 56, 68, 76

Other Deadlines

Unit 3 Review: THURSDAY DECEMBER 4th
 Unit 3 Exam: TUESDAY DECEMBER 9th (Material up to 12/2)
 Review for Final: THURSDAY DECEMBER 11th