CHEMISTRY 103

FALL 2004

LECTURE SECTION 1

Lectures:	MW 11:00 – 11:50 Room 1351 Chemistry
Lecturer:	Rodney Schreiner
Office:	9353 Chemistry
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E-mail:	schreiner@chem.wisc.edu
Office Hours:	M 2:30 – 3:30 pm & W 12:00 – 1:00 pm, or by appointment
	Stop by my office at any time without an appointment, and we will meet if I am free.
Web site:	http://genchem.chem.wisc.edu/lectures/course.asp?IDNUMBER=66

INTRODUCTION

Chemistry 103 is the first semester of a two-semester General Chemistry sequence that continues with Chemistry 104. Chemistry 103 and 104 together provide a general introduction to the fundamental facts and principles of chemistry. The 103-104 sequence serves as a prerequisite for advanced courses such as Organic Chemistry (341 or 343), Analytical Chemistry (221 or 223), and Inorganic Chemistry (311).

The formal prerequisites for this course are Math 101, concurrent enrolment in Math 112, or placement into a Math course above 112. Concurrent registration in Math 112 or above and one year of high school chemistry are recommended. However, no previous course in chemistry will be presumed. Students who have not taken high school chemistry can do well in this course, but they should expect to commit some extra effort, particularly in the early weeks of the semester.

The General Chemistry course explores chemical phenomena and principles, with an emphasis on developing an understanding of chemistry and an appreciation of what chemists do. You will learn to interpret chemical phenomena using chemical vocabulary and principles, and you will acquire skills in manipulating mathematical formulations that describe the chemical behavior of various substances. It is essential that you commit yourself to learning the basic vocabulary of chemistry. Although some topics, concepts, and terminology might be familiar from previous studies, there will be much that is new.

It is important that your instructors be informed about what is good, bad, and indifferent about what we do, and I hope that you will communicate to us what is especially clear, interesting, exciting, challenging, and exasperating as we go along.

TEXTBOOKS AND OTHER MATERIAL

1. *Chemistry and Chemical Reactivity*, Fifth Edition, John C. Kotz and Paul M. Treichel, Jr., Thomson-Brooks/Cole, 2003.
2. *Workbook for General Chemistry*, Third Edition, Bassam Z. Shakhashiri and Rodney Schreiner, Stipes Publishing, 2004.
3. *Chemistry 103/104 Laboratory Experiments, Fall 2004*, Department of Chemistry, University of Wisconsin-Madison.
4. Laboratory Research Notebook, 100-page carbonless notebook.
5. Safety goggles. Industrial quality eye protection is **required** in all chemistry laboratories. Safety goggles that fit over regular glasses can be purchased from local bookstores and drugstores.
6. A scientific calculator having capabilities for square roots, logarithms, and exponential notation operations. The calculator will be used on exams, quizzes, homework assignments and in the laboratory.

KEEP THIS SYLLABUS FOR FUTURE REFERENCE

COURSE FORMAT

Lectures. During lectures we will examine principles, outline goals, present illustrations, and observe demonstrations. Prior to coming to lecture, you should read the assigned sections from the textbook, study the Examples and work the Exercises found in the body of the text. (The answers to the Exercises are in Appendix N.) The assignments for each lecture are listed in the Course Outline that follows in this syllabus. During lecture, take your own thorough notes. After lecture you should review and study the appropriate pages in the textbook, making sure you understand the exercises in the text. Then, work the assigned Study Questions at the end of the chapter (the answers to questions with bold-face numbers are in Appendix O). The topics of the questions are indicated in the textbook, and you can choose to answer additional questions to help you understand the material. Assignments from the *Workbook for General Chemistry* are also listed in the Course Outline. The Workbook contains a series of succinct examples and exercises to help you master the skills necessary to appreciate our chemical world.

Discussion Section. A group of up to 22 students constitutes a discussion and laboratory section supervised by one teaching assistant (TA). Discussion sessions are for review and problem solving relevant to the recent lecture material. To get the most from discussion session, you need to be prepared when you come to class. It is your responsibility to communicate to your TA the concepts you do not understand and the skills you need to practice. You should ask specific questions of your TA and make sure you understand the questions and the answers given by your TA and by fellow students.

Laboratory. In the laboratory, you have the opportunity to develop skills that are not easily learned or demonstrated in the lecture hall. These skills include designing experiments, using laboratory equipment properly, developing methods for sharing data, interpreting data, and communicating your ideas about the data with your classmates and laboratory instructor through discussions and in writing.

Before the Laboratory Period. In your laboratory manual, each experiment has a section titled "Techniques in this Experiment." Use the guidance it provides to help you prepare for the laboratory. View the web pages described in the section titled "On the Web" to learn about the equipment to be used in the laboratory. (Page vii of the laboratory manual explains how to view these web pages.) Read the relevant sections of the textbook and the manual, and think about how what you are reading is related to the scheduled experiment. Then follow the directions in the "In Your Notebook" section.

Safety in the Laboratory. Read the "For Your Safety" section in the lab manual before you come to lab. It describes safety information specific to that experiment. Safety goggles are required for every experiment. Failure to wear safety goggles in the laboratory is grounds for dismissal from laboratory, with no provision to make up the work you miss. In addition, shoes are the appropriate footwear; sandals are not permitted.

Laboratory Attendance. You must attend all laboratory sessions. There is no procedure to make up a laboratory that you miss. A grade of zero will be recorded for unexcused absences. If you have an excuse for missing lab, notify your teaching assistant as soon as possible, preferably before the lab period.

Reports. Reports are due at the end of the laboratory period. Reports that are turned in after the end of the laboratory period will receive a 5-point deduction.

Quizzes. There will be eleven take-home quizzes. They will be distributed every week, except exam weeks, at Monday lectures and collected at the start of the following Monday's lecture. The dates on which they are distributed are labeled with "Q" on the Course Schedule at the end of this syllabus. They will also be available on the Web in case you misplace your copy. They will not be accepted late. You may discuss the quiz with other students. You may elicit help from your instructors, although none of us will directly answer the quiz questions. However, the work you submit on the quiz must be your own.

Exams. There will be three mid-term exams of 75 minutes each and a two-hour final exam. Check the lecture outline for the examination dates and times. The location of each exam will be announced later. **No early or make-up exams will be given**. The 2-hour final exam will be comprehensive and will cover material from the entire course.

For each of the mid-term exams, you will be allowed to use a 4×6-inch card containing whatever notes you care to include. For the final exam, the size will be increased to an 8½×11-inch sheet. On all exams, at least 75% of the questions will be taken from the assignments in the text or workbook or from the quizzes, with an occasional number or substance changed to distinguish the knowledgeable. Copies of exams from previous years will also be available on the Web.

Course Grades. Your course grade will be based on 650 points divided as follows: 3 hour exams – 100 points each, final exam – 250 points, and quizzes – 100 points total (we will drop the lowest quiz score). Course letter grades will be assigned according to the following scale:

A	620 points and above
AB	590 to 619 points
B	550 to 589 points
BC	520 to 549 points
C	440 to 519 points
D	380 to 439 points

Laboratory Grading. The laboratory experiments will be graded on a scale described in the lab manual for each experiment. The total number of points this semester is 182. At the end of the semester, your lab scores will be added, and a lab letter grade will be assigned using a scale proportional to the one above. For example, to achieve a letter grade of B in lab, the number of points required is 182 × (550/650), which is 154. If the lab letter grade is higher than the course letter grade determined by your exam and quiz scores, your course grade will be raised by one level. Thus, if your course grade as determined by your exam and quiz scores is B, and your lab grade is A, then your course grade will be raised 1 level, to AB. If the lab grade is the same or less than the course letter grade, the course grade will be unchanged. However, in order to pass the course, you must receive a passing grade (D or better) in the lab.

LEARNING AIDS

Homework Exercises. Homework assignments are suggested. You are not required to turn in the assignment and consequently homework problems are not graded. You should complete the assigned problems, because they are typical of the kinds of problems you are expected to master and handle with ease. If you have questions about a homework assignment, you should seek help from your instructors, especially during discussion session.

The Web. Our course has a series of Web pages at the address on the first page of the syllabus. These pages contain the course syllabus, lecture notes taken by the TAs, sample exams from previous years, course announcements, and a message board through which you can ask questions and help others.

Keeping in Touch with Your Instructors. You should take full advantage of the availability of your lecture professor and your TA outside the classroom for face-to-face meetings and e-mail contact. My e-mail address is on the first page of this syllabus. I usually check my e-mail once a day and attempt to answer my mail promptly. You will also get an e-mail address from your TA.

UNIVERSITY COUNSELING SERVICE

Performance Enhancement. At Counseling Services, a unit of University Health Services, students can find the emotional support they need. The experienced staff of the Counseling Sevices, located on the 4th floor at 905 University Ave., assist students in developing greater self-awareness, independence, and self-direction in such areas as adjusting to a large university, anxiety and stress management, concentration difficulties, and interpersonal relationships. For more information about these and other services, see their Web site at *http://www.uhs.wisc.edu/home.jsp?cat_id=36* or call them at 265-5600.

GREATER UNIVERSITY TUTORING SERVICE

GUTS. GUTS offers free tutorial assistance to all university students. It offers individual tutoring in weekly sessions that are offered during the semester, study groups led by an experienced tutor that meed weekly, and drop-in tutoring for immediate, short-term help offered on a first-come first-served basis. There are drop-in centers at various locations around campus, and they offer tutoring in several subjects. Sign up at the GUTS office, room 302A Union South, Monday through Thursday from 11:00 a.m. to 5:00 p.m. For more information, check their Web site at *http://guts.studentorg.wisc.edu/* or call the GUTS Tutoring Office at 263-5666.

UW CHEMISTRY ELECTRONIC COURSE RESOURCES

This course requires you to use a number of on-line and computer-based resources that supplement lectures, discussions, and labs. You may be required to produce and hand in (or email) assignments using a word processor, spreadsheet, or web browser.

What should I do first?

- Read this entire document. Then verify or set up your NetID and password at *http://my.wisc.edu/*.
- Login to Learn@UW at *http://uwmad.courses.wisconsin.edu/*. Click the link to your chemistry class to browse course resources or complete on-line assignments.

What hardware is needed?

- A computer with CD reader, access to the Internet, and a printer. You can use the Chemistry Department computer lab in room 1375 or one of the on-campus computer Infolab locations (see below).
- For access from off-campus, at least a 56K modem, DSL, or cable modem.

What software and proficiencies are required?

- A word-processor program (such as Microsoft Word) and spreadsheet program (preferably Excel).
- An e-mail program (such as Eudora) and web browsers Netscape Navigator 4.7 or newer and Internet Explorer 6.0. Both may be needed to use all resources. A number of plugins for both these browsers are also required. For details and related links go to *http://genchem.chem.wisc.edu/setup/index.asp*.
- Software is either free or at reduced student pricing via at the DoIT Techstore. See the links to DoIT below for help in obtaining software and becoming proficient in these programs.

What resources are used, and how do I access them?

- *http://genchem.chem.wisc.edu/*.

  These resources are intended primarily for students in general chemistry, though most are also available to the public. Examples are course homepages, syllabi, lecture notes and lab resources. Some lab resources are only available to users who access the Internet via UW-Madison.

- *http://uwmad.courses.wisconsin.edu/*.

  This is the login site for access to resources that are restricted to students registered for specific courses. On-line quizzes, on-line homework, on-line grades, etc., may be used in your course. Learn@UW is used by many departments across campus. Only one login is used to access all your courses. Use your NetID and password to login.

- CD-ROM.

  Some courses will use resources found on a CD included with the lab manual for the course.

Computing-related links and resources for students

- UW NetID accounts: *http://my.wisc.edu/*; 264-4357; 1210 W. Dayton St.
- DoIT (Division of Information Technology) site for students: *https://www.doit.wisc.edu/students/index.htm*
- DoIT Help Desk: *http://helpdesk.doit.wisc.edu/*; 264-4357; 1210 W. Dayton St.
- Campus computer labs: *http://www.wisc.edu/computerlabs/*
- General Chemistry: *http://genchem.chem.wisc.edu/*; 1328 Chemistry; 263-2424
- Learn@UW: http://uwmad.courses.wisconsin.edu/

COURSE OUTLINE

TEXT = Chemistry & Chemical Reactivity, WKBK = Workbook for General Chemistry

PROPERTIES OF MATTER – Sept 8 (W)

- Macroscopic Properties
- Atoms and Molecules
- Classifying matter
- Mixtures and pure substances
- Elements and compounds
- Quantitative properties
- Significant figures

READINGS
- TEXT 1.1–1.8

STUDY QUESTIONS
- TEXT Ch.1: 3,7,12,14,20,28,32,42,44,56, 58,62,74

ATOMS AND ELEMENTS – Sept 13 (M)

- Atomic structure
- Isotopes
- Atomic mass
- The mole
- Molar mass
- The periodic table

READINGS
- TEXT 2.1 – 2.8

STUDY QUESTIONS
- TEXT Ch.2: 6,10,14,20,22,24,30,36,38,42, 46,48,52,54,56
- WKBK: pp 1–9

CHEMICAL COMPOUNDS – Sept 15 (W)

- Chemical formulas
- Ionic compounds
- Naming ionic compounds
- Properties of ionic compounds
- Molecular compounds
- Naming molecular compounds
- Properties of molecular compounds

READINGS
- TEXT 3.1–3.4

STUDY QUESTIONS
- TEXT Ch. 3: 3,12,18,20,22,24,30,32,34,36,40, 42,90

COMPOUNDS AND MOLES – Sept 20 (M)

- Molar mass of a compound
- Percent composition
- Empirical formulas
- Molecular formulas

READINGS
- TEXT 3.5–3.7

STUDY QUESTIONS
- TEXT Ch. 3: 1,7,44,48,52,54,60,64,68,74,78,86
- WKBK: pp 9–17

CHEMICAL EQUATIONS – Sept 22 (W)

- Chemical reactions and equations
- Balancing chemical equations
- Mass relationships in chemical reactions
- Stoichiometry

READINGS
- TEXT 4.1–4.3

STUDY QUESTIONS
- TEXT Ch. 4: 2,8,10,12,14,18,44,46
- WKBK: Lessons 2 & 3

CHEMICAL ANALYSIS – Sept 27 (M)

- Limiting reactant
- Percent yield
- Determining the formula of a compound

READINGS
- TEXT 4.4–4.6

STUDY QUESTIONS
- TEXT Ch. 4: 6,20,22,24,26,28,36,40,56
- WKBK: Lesson 4

Exam 1 — Wednesday, September 29 — 5:45 – 7:00 p.m.

REACTION TYPES 1 – Oct 4 (M)

Electrolytes
Solubility of ionic compounds
Precipitation reactions
Net ionic equations
Acid-base reactions

READINGS
TEXT 5.1–5.6
STUDY QUESTIONS
TEXT Ch. 5: 3,5,7,22,24,26,28,30,40,42,44,46
WKBK: Lesson 5

REACTION TYPES 2 – Oct 6 (W)

Oxidation-reduction reactions
Molarity
Preparing solutions
pH
Solution stoichiometry

READINGS
TEXT 5.7–5.10
STUDY QUESTIONS
TEXT Ch. 5: 9,13,52,54,56,58,62,64,68,72,74, 78,84,94,96,100,118
WKBK: Lesson 6, pp 145–151

HEAT AND ENERGY – Oct 11 (M)

Temperature
Energy
Heat capacity
Heat transfer
Heat energy
Enthalpy

READINGS
TEXT 6.1–6.5
STUDY QUESTIONS
TEXT Ch. 6: 2,16,18,22,26,34,36,70
WKBK: pp 79–83

HEAT AND REACTIONS – Oct 13 (W)

Calorimetry
Enthalpy of reaction
Hess's law
Enthalpy of formation

READINGS
TEXT 6.6–6.10
STUDY QUESTIONS
TEXT Ch. 6: 38,50,52,56,58,78,82
WKBK: pp 84–96

THE BOHR MODEL OF THE ATOM – Oct 18 (M)

Wave properties
Electromagnetic radiation
Atomic emission
Bohr's model of the atom

READINGS
TEXT 7.1–7.3
STUDY QUESTIONS
TEXT Ch. 7: 20,22,24,28,34,36,38,68,70

MODERN ATOMIC THEORY – Oct 20 (W)

Schrödinger wave equation
Orbitals
Electron spin
Magnetism
Electron configuration

READINGS
TEXT 7.4–8.5
STUDY QUESTIONS
TEXT Ch. 7: 44,56,74
Ch.8: 3,8,10,14,20,22,24
WKBK: Lesson 10

PERIODIC PROPERTIES – Oct 25 (M)

Atomic size
Ionization energies
Electron affinities
Ion sizes

READINGS
TEXT 8.6–8.7
STUDY QUESTIONS
TEXT Ch. 8: 34,36,38,40,52,54,58,60,70,76
WKBK: Lesson 11

Exam 2 — Wednesday, October 27 — 5:45–7:00 p.m.

BONDING & LEWIS STRUCTURES – Nov 1 (M)

Valence electrons
Lewis structures
Ionic bonding
Covalent bonding
Octet rule
Resonance
Exceptions to octet rule

READINGS
TEXT 9.1–9.6
STUDY QUESTIONS
TEXT Ch. 9: 4,10,28,30,36,38,42,86,90
WKBK: Lesson 12

BOND PROPERTIES – Nov 3 (W)

Formal charge
Bond polarity
Bond length
Bond energy

READINGS
TEXT 9.7–9.8
STUDY QUESTIONS
TEXT Ch. 9: 18,46,50,54,56,62,64,66,68, 70,96,106
WKBK: pp 152–155

SHAPES OF MOLECULES – Nov 8 (M)

Describing molecular shapes
VSEPR
Molecular polarity

READINGS
TEXT 9.9–9.11
STUDY QUESTIONS
TEXT Ch. 9: 24,72,74,78,82,84,88,98,108
WKBK: Lesson 14

VALENCE BOND THEORY – Nov 10 (W)

Overlap of atomic orbitals
Hybrid atomic orbitals
Sigma and pi bonds

READINGS
TEXT 10.1–10.2
STUDY QUESTIONS
TEXT Ch. 10: 2,4,12,18,20,22,24,26,32,42,52,74
WKBK: Lesson 15

MOLECULAR ORBITAL THEORY – Nov 15 (M)

Molecular orbitals
Combinations of atomic orbitals
Diatomic molecules
Band theory
Semiconductors

READINGS
TEXT 10.3–10.4
STUDY QUESTIONS
TEXT Ch. 10: 16,34,36,38,40,60,64,68,70

MOLECULAR SPECTROSCOPY 1 – Nov 17 (W)

Absorption of electromagnetic radiation
Beer's law
UV-visible spectroscopy
IR spectroscopy

READINGS
Handout
STUDY QUESTIONS
Handout

MOLECULAR SPECTROSCOPY 2 – Nov 22 (M)

NMR Spectroscopy
Determining molecular structure

READINGS
Handout
STUDY QUESTIONS
Handout

Exam 3 — Tuesday, November 23 — 5:45–7:00 p.m.

IDEAL GAS LAW – Nov 29 (M)

Pressure
Boyle's law
Charles's law
Avogadro's law
Dalton's law
Ideal gas
Molar mass determination

READINGS
TEXT 12.1–12.5
STUDY QUESTIONS
TEXT Ch. 12: 10,12,14,18,22,26,28,30,36,46,74
WKBK: Lesson 9

KINETIC MOLECULAR THEORY – Dec 1 (W)

Postulates
Molecular speed and kinetic energy
Diffusion and effusion
Deviations from ideal gas behavior

READINGS
TEXT 12.6–12.9
STUDY QUESTIONS
TEXT Ch. 12: 50,52,54,58,66,90

INTERMOLECULAR FORCES – Dec 6 (M)

Dipole interactions
Polar molecules
Non-polar molecules
Hydrogen bonding

READINGS
TEXT 13.1–13.5
STUDY QUESTIONS
TEXT Ch. 13: 16,18,20,22,30,32,50,54,56,58,68

SOLIDS – Dec 8 (W)

Amorphous solids
Crystalline solids
Unit Cells
Metals
Ionic crystals
Molecular solids
Network solids

READINGS
TEXT 13.6–13.9
STUDY QUESTIONS
TEXT Ch.13: 36,38,40,64,66

LIQUIDS AND SOLUTIONS – Dec 13 (M)

Properties of liquids
Solution formation
Liquid-liquid solutions
Solid-liquid solutions
Gas-liquid solutions
Colloids

READINGS
TEXT 14.2–14.3, 14.5
STUDY QUESTIONS
TEXT Ch. 14: 28,32,34,72,96

SUMMARY AND REVIEW – Dec 15 (W)

Final Exam — Monday, December 20 — 12:25 – 2:25 p.m.

CHEMISTRY 103 — LECTURE SECTION 1

LECTURE, LABORATORY, AND QUIZ SCHEDULE

Fall 2004

DATE		LECTURE TOPIC	WEEKLY EXPERIMENT
Sept 3 (F)	Q	Introduction	No experiment
Sept 8 (W)		Properties of Matter	Solutions, Density, and Graphing (In lab)
Sept 13 (M)	Q	Atoms and Elements	Lake Study (Outside)
Sept 15 (W)		Chemical Compounds	
Sept 20 (M)	Q	Compounds and Moles	Reaction of Zinc and Iodine; Check-in (In lab)
Sept 22 (W)		Chemical Equations	
Sept 27 (M)		Chemical Analysis	No experiment
Sept 29 (W)		Q&A — **EXAM 1** — 5:45 – 7:00 p.m.	
Oct 4 (M)	Q	Reaction Types 1	Synthesis of an Alum (In lab)
Oct 6 (W)		Reaction Types 2	
Oct 11 (M)	Q	Heat and Energy	Reaction Types and Chemical Logic (Outside)
Oct 13 (W)		Heat and Reactions	
Oct 18 (M)	Q	The Bohr Model of the Atom	Solution Calorimetry (In lab)
Oct 20 (W)		Modern Atomic Theory	
Oct 25 (M)		Periodic Properties	No experiment
Oct 27 (W)		Q&A — **EXAM 2** — 5:45 – 7:00 p.m.	
Nov 1 (M)	Q	Bonding and Lewis Structures	Determination of the Alcohol Content in Wine (In lab)
Nov 3 (W)		Bond Properties	
Nov 8 (M)	Q	Shapes of Molecules	No experiment
Nov 10 (W)		Valence Bond Theory	
Nov 15 (M)	Q	Molecular Orbital Theory	Project Lab 1 (In lab)
Nov 17 (W)		Molecular Spectroscopy 1	
Nov 22 (M)		Molecular Spectroscopy 2	No experiment
Nov 23 (T)		Q&A — **EXAM 3** — 5:45 – 7:00 p.m.	
Nov 29 (M)	Q	Ideal Gas Law	Project Lab 2 (In lab)
Dec 1 (W)		Kinetic Molecular Theory	
Dec 6 (M)	Q	Intermolecular Forces	Window on the Solid State (Outside)
Dec 8 (W)		Solids	
Dec 13 (M)		Liquids and Solutions	No experiment
Dec 15 (W)		Course Summary	
Dec 20 (M)		**FINAL EXAM** — 12:25 – 2:25 p.m.	

RETURN to your TA by Friday, September 10

CHEMISTRY 103 — Lecture 1 — Fall 2004
Dr. Rodney Schreiner

STUDENT INFORMATION SHEET
Please PRINT

Name _____ , _____
(last) (first)

Lab Section Number _____

TA _____

Telephone (Madison) _____

E-mail _____

Class (e.g., Soph, Special) _____

Major _____

Please
Attach Photo
Here

Name and location of your high school: _____

In what year did you graduate from high school? _____

How many years of chemistry courses have you completed? _____

In what year did you complete your last chemistry course? _____

If you are currently enrolled in a Math course, indicate its number: _____

How many credits are you taking this semester? _____

If you are working at a job this semester, how many hours per week do you work? _____

Do you plan to take another chemistry course beyond this? Yes No Undecided

Tell me a couple of interesting things about yourself.

THANK YOU!