

Syllabus

CHEM 115 (Chemical Principles I) Fall Semester, 2018

Credits: 5 credits (course hours are met via the traditional Carnegie definition).

Course Designation and Attributes: *Breadth - Physical Sci. Counts toward the Natural Sci req; Level - Elementary; L&S Credit - Counts as Liberal Arts and Science credit in L&S; Honors - Accelerated Honors*

Meeting Time and Location: MWF 8:50-9:40 AM, Chemistry 2311

Instructional Mode: The course will be taught in-person, with additional course materials provide on line.

Chemistry 115 is the 5-credit, first course of a two-semester honors sequence focusing on fundamental chemical principles. It is designed for very well prepared and highly motivated students with a strong interest in science or engineering. The course is quite mathematical, and presumes a sound background in chemistry, physics, and calculus. We will explore a detailed atomic and molecular view of matter and its interactions. Topics include quantum theory, molecular structure and bonding, kinetic theory of gases, and descriptions of liquids, solids, and phase transitions. Chemistry 116, the second course of the sequence, treats thermodynamics, chemical and physical equilibrium, electrochemistry, acid-base chemistry, solubility, chemical kinetics, and spectroscopy.

Course Learning Outcomes:

- Apply a qualitative understanding of quantum mechanics to fundamental chemical concepts, including the structure of the atom and molecular bonding
- Solve elementary eigenvalue problems, including the “particle in a box” and “harmonic oscillator”
- Utilize the basic tenants of the kinetic theory of gases to describe the properties of gases
- Describe the structures of solids and liquids

Instructor: J.R. Schmidt, 8305d Chemistry, 262-2996, schmidt@chem.wisc.edu.

Lab Director: Dr. Pamela Doolittle, 535 SMI, 262-9679, pam@chem.wisc.edu.

Instructor Office Hour: Thursday afternoon, 12:30 – 1:30 pm, 8305d Chem. Or by appointment.

Teaching Assistant: Mr. Joseph Kim. EMAIL: jykim35@wisc.edu. Room 1201 Chemistry, desk #10.

TA Office Hour: 1-2 pm Wednesdays or by appointment.

Primary Text: D.W. Oxtoby, H.P. Gillis, and A. Campion, Principles of Modern Chemistry, 6th edition, Thomson Brooks/Cole, 2008. (This can be found online as a .pdf download.)

Other Required Materials: (1) Lab notebook (on sale in Chemistry 1375, first week of classes). (2) Industrial quality safety goggles for lab work (purchased at bookstore). (3) A scientific calculator. If you have a smartphone, there is likely an app!

Lectures: MWF 8:50-9:40 am, 2311 Chemistry. *The lectures and discussion sections are an integral part of the class.* Attendance is essential! You should take your own notes. To a first approximation, we will follow Chapters 1-10 and 21 in the text, but at a higher level.

Web Page: *Learn@UW* has a Chem 115 site where I will post problem sets, exam and problem set answer keys, reading assignments, etc. You can log in at: <https://learnuw.wisc.edu/>.

Problem Sets: Weekly, usually assigned Monday and due the following Monday before class. *Late papers will not be accepted!!!* Show your work! Solutions will be posted on *Learn@UW*. We encourage you to discuss the problems together, but you must hand in

and take responsibility for your own solutions. And you will take the exams alone!

Discussion Section: These are devoted to review of recent lecture material, the background for upcoming labs, and general problem solving. Your TA is in charge of content. Section 591 meets Tuesdays, 8:50-9:40 am, Room 2377 Chem. Section 592 meets Mondays, 3:30-4:20 pm, Room 2381 Chem.

Examinations: Three in-class exams during the semester. *Likely dates:* Friday, October 12, Monday, November 12, and Friday, December 7. *Final exam:* Friday, December 14, 7:45 am – 9:45 am. The exams will focus on the lecture material, but questions about the labs are possible. No make-up exams will be given. The final exam will be comprehensive.

Literature Research Topic and Oral Presentation: A research paper is due at the beginning of class on Monday, November 19. The paper should be 8-10 pages long (about 2500 words) and should describe a modern research topic related to the Chem 115 course material (broadly defined). Please include the relevant citations. You should begin looking for a topic that interests you. Your topic needs the professor's approval on or before Friday, October 26. You will also give a short oral Powerpoint presentation briefly summarizing your topic in the lab sections during the week of December 10.

Grading: Problems sets (100 points), Exam I (100), Exam II (100), Exam III (100), Final Exam (200), Research paper (100), oral presentation (100), Laboratory (200). Course grades based on the class distribution of total points; no absolute grading scale.

Math comment: All of you have had some calculus, but many of you have not seen multi-variable calculus. We will learn the math as we need it.

Questions: Please feel free to interrupt the lecture to ask questions. It helps me to sharpen my thinking and to better understand how things are going "out there".

Laboratory: Lab Section 891 meets Thursdays, 7:45-10:45 am, Room 5360 Medical Sciences Center. Lab Section 892 meets Wednesdays, 2:25-5:25 pm, Room 5360 Medical Sciences Center. See the schedule that follows. In all laboratory periods in which you work with chemicals you are required to wear safety goggles and shoes with closed toes (not sandals). Your TA will supervise the laboratories and direct your work. She will discuss related material, demonstrate unfamiliar techniques, and answer questions. The goal of the laboratory is to provide experience with a variety of techniques and to illustrate the principles we are discussing in lecture. We especially want you to learn to generate accurate and precise quantitative results and to interpret them critically. You must come to the laboratory prepared, having read and understood the procedure, and completed a statement of the objective of the experiment in your notebook. Your TA will give you more detailed instructions for the pre - laboratory assignments. You must keep a laboratory notebook providing a detailed record of your primary data, as described in the manual, and you must prepare a report for each laboratory. The style and detail of the laboratory reports will vary with the experiments. *You must complete the laboratory to pass the course.*

Chemistry 115 Laboratory Overview

Philosophy The laboratory time in Chemistry 115 is used for several activities: experimental work, numerical work using the MathCAD program, problem solving sessions, and oral presentations. The exact schedule for these activities is provided in your syllabus. This manual provides the details for the experimental work that is planned for this semester. Modifications, additions or deletions may be made during the semester and you will be notified of these changes.

The purpose of the experimental component of Chemistry 115 is to provide you with experience in designing and implementing experiments and exposure to common laboratory techniques and practices. Some experiments may be written with skeletal instructions. You will have to work with your classmates to devise and conduct appropriate and safe procedures that address the chemical system of interest. Some experiments are written with very detailed instructions. Do not just blindly follow these directions without the understanding of what you are doing. A good experimentalist is always thinking about how basic chemical principles govern their experimental observations, data, and results.

We view the laboratory experience as being an experiment itself, and we welcome your comments on any aspect of the laboratory.

Laboratory Notebook Good record keeping is important when doing experimental work, and you will be required to keep a laboratory notebook for your experimental work in Chemistry 115. You should use a notebook with carbon sheets so your TA can collect items directly from your notebook if necessary. Even though you will be working with a partner or in a small group, you will need to keep your own notebook. On days when experiments are scheduled, you are expected to come to laboratory having already read the background information on the experiment. From your background reading, you should be able to state the objective of each experiment. Include this objective in your notebook. Your notebook will serve as an experimental diary, so be sure to record what you are doing and thinking during the experiment. After each experiment, you should write a reflective summary to help you organize and interpret your findings. These reflective summaries should also be included in your notebook. Keep the following in mind as you prepare your notebook for Chemistry 115.

Basically, a lab notebook should:

- Say what you did
- Say what happened
- Be understandable to someone else

Specific elements of a good lab notebook:

- The notebook is a diary: a faithful record of what you were doing and thinking at the same time
- Notations are in ink and taken down as things happened—*not* re-copied!
- Mistakes are neatly crossed out with a single line—not obliterated or whited-out
- Each day's entry is dated

- Quantities and results of calculations are identified, carrying units and perhaps uncertainties
- The notebook is organized, neat, and legible—it needn't be a work of art!
- Graphs, spectra, etc. are affixed in the notebook

Elements of a good experimental account in a lab notebook :

Objective

- Concise statement of the experimental objectives

Method

- Recounted in sufficient detail to repeat experiments

Running Account

- Raw data (tabular form if possible/appropriate,)
- Observations

Calculations (and error analysis if appropriate)

- Clearly stated equations used (assumptions and theories, if appropriate)
- Perform calculations needed to transform raw data into final results—use units!
- Uncertainties for raw data based on reproducibility and/or accuracy
- Uncertainties correctly propagated to final results
- Explicitly state major contributions to experimental uncertainty

Reflective Summary (needn't be long)

- Comparison of results to previous literature values (if appropriate)
- Examination of data for trends, systematic error
- Suggestions for improvements and future experiments
- Summarize important findings and their interpretations

Safety Laboratory safety rules must be followed when anyone is doing experimental work in the laboratory. This includes wearing industrial-quality eye protection. Safety goggles can be purchased from local bookstores and drugstores. You must also wear close-toed shoes in the lab. Although contact lenses are not strictly prohibited, it is recommended that you do not wear contacts in the laboratory. Please let your TA know if you will be wearing contact lenses.

Laboratory Reports For each experiment, you will have to hand in a laboratory report. Each report will be graded and will contribute to your overall laboratory score. The format of each report will depend on the particular experiment. In general, keep the following in mind as you prepare your report:

General Content:

- Write in the third person
- Use headers to organize and guide the reader through the report
- Date and write your name on every page
- Include your lab partner's name on *at least* the first page
- Mistakes crossed out with a single line; for large errors include an initialed explanation of why is was crossed out (not necessary for spelling errors etc.)

Objective:

- Sentence/command format
- State the lab objective (e.g., what is being done—the actual technique/process)
- State the learning objective (e.g., why it is being done and what you are going to learn)

Intended Procedure/Method:

- use future passive voice
- number the steps

Experimental/Running Account/Data and Observations:

- present data in tables
- tables must include units, be neat, and include error if appropriate
- include experimental observations such as gas evolution, color, texture, changes of state etc.

Calculations:

- Units are still important—include them!
- Be neat
- It's helpful to those reading your report if you draw a box around final answers or important conclusions

Conclusions:

- Write in sentence form
- Include final answer/results (including error if appropriate)
- Discuss ways to improve experiment and list sources of error
- Fix your carbonless copies from your notebook to a typed report.

University of Wisconsin
 Chemistry 115 – Chemical Principles I (Schmidt)
 Fall Semester 2018
 Laboratory Schedule

	Scheduled Experiment
Week 1 (9/3)	Check-in/Series of Reactions
Week 2 (9/10)	Synthesis of Cu-Ammine Compounds
Week 3 (9/17)	Synthesis of Cu-Ammine Compounds— Day 2
Week 4 (9/24)	<i>Literature Searches—(Ariel Andrea)</i>
Week 5 (10/1)	Propagation of Error
Week 6 (10/8)	Crystal Violet*
Week 7 (10/15)	<i>Computer Activity: Potential Wells and the Hydrogen Atom</i>
Week 8 (10/22)	Atomic Emission*
Week 9 (10/29)	<i>Computer Activity: Molecular Orbitals</i>
Week 10 (11/5)	Spectrophotometric Determination of Fe/Measuring Fe in Cereal
Week 11 (11/12)	Nine Solutions
Week 12 (11/19) (meeting M&T)	Window on the Solid State (online activity) Neutron Activation Energy of Silver ⁺
Week 13 (11/26)	Dumas Method and GC-MS
Week 14 (12/3)	Solid State Structures and Properties Optical Diffraction <i>Check Out</i>
Week 15 (12/11)	<i>Presentations**</i>

Lab is scheduled for Thursday from 7:45 AM to 10:45 AM in MSC room 5360 for section 891 and Wednesday from 2:25 PM – 5:25 PM in MSC room 5360 for section 892.

*Laboratory report should be submitted as a formal paper.

+Labs this week will be on Monday afternoon and Tuesday morning. Contact your TA if you have a conflict. Some of this lab can be done online.

**A schedule for presentations will be announced prior to week 15.

Entries in italics do not require lab attire for performing experimental work.