

Course Overview: Experiments in this course are meant to illustrate concepts being discussed concurrently in Chemistry 347 and to familiarize you with many of the tools used by physical chemists. The tools you will learn to apply include the chemical literature; written and oral communication; mathematical functions; error analysis; and mechanical and electronic equipment such as vacuum pumps and computers.

Required Text: None, but reading assignments will be provided prior to each experiment.

Required Equipment: bound duplicating laboratory notebook, water insoluble pen (Pentel Hybrid model available at the bookstore is acceptable) and goggles, which must be worn during lab.

Lab: 1:50-5:10 THURSDAY (HS 428)

Office Hours: Dr. Gutow (HS-412): MWF 8:30-9:30, T 9-10. Dr. Matsuno (HS-409): MW 2-3, Th 8-9, F 12-1. Or by appointment.

Exams: There will be a 90 minute final exam based on work done in lab. You will be able to refer to your textbooks, lab reports, and lab notebooks on the exam. The 90 minutes allotted for the exam will not be enough to figure out what you did from your text and your lab reports. You will only have enough time to use them as references to get constants, formulae and relationships correct. You will need to review your laboratory reports and correct any mistakes you made in order to do well on this exam. You will also be responsible for material from the prelabs and assigned reading. Two non-graded problem sets will be distributed during the semester to assist your preparation for the exam.

Laboratory Notebooks: Notebooks should be records of everything a scientist does. They are used as legal evidence that an experiment was performed in patent claims and are often referred to by other scientists working on related experiments. Entries should be made in permanent ink. *Notes from pre-lab lectures should not be recorded in your notebook*, but all calculations and data analysis should be. Guidelines for note taking appear in Chapter I of Shoemaker. Pages should be numbered consecutively and a table of contents included. Date each page as it is used and start a new page on each day; do not tear out pages, simply draw a line through errors. Copies of your entries will be collected at the end of each lab period for grading.

Pre-lab preparation: Read the description of the experiment and any additional assignment. The experiments are not described as a list of steps to be followed, so careful reading and reflection before lab will be required to develop a plan for the project.

In your notebook record a brief outline of the procedure you expect to follow and construct two tables of information: 1) reagents; 2) equipment. In the reagents table write the chemical name, chemical formula, a drawing of the structure, the state in which it will be found (solid, liquid, gas, or in solution), and hazard information from the Material Safety Data Sheet(s), which are available online or in the stockroom. If solutions are to be prepared, calculate the amounts needed. Each row in the equipment table should contain the property to be measured, the equipment used for the measurement, and the sample(s) that will be measured.

During lab: Procedures actually followed should be described in your laboratory notebook. Do not rely on a summary written before the lab. List lab partners. Include all experimental observations, data and calculations; you may staple or tape in computer printouts and spectra. If data is stored in computer files accurately record the data file names. Goggles and appropriate clothing (no sandals or shorts) must be worn at all times. Failure to wear safety goggles may result in ejection from lab and an F in the course.

Lab Reports: Because scientists use many formats for communicating information, we will practice a variety of report styles this semester.

- 1) Formal laboratory reports: Your reports should be written as if for publication in *The Journal of Physical Chemistry*. Assume that your readers have studied physical chemistry but are not familiar with your handouts. A sample lab report will be handed out and is available on the class web site. Additional recommendations on word choice, grammar, reference format, notation and nomenclature may be found in *The ACS Style Guide*, J. S. Dodd, Ed. (QD8.5.A25) which is on reserve in the Halsey Resource Center.
- 2) Feature article for a newsmagazine: This is aimed at the general public so should connect the experiment to more common experiences. The length should be two to three typewritten pages plus one or two figures or graphs. Sample calculations and error analysis are not to be part of the article but should be attached for grading.
- 3) Poster presentation: This is the way most scientific work is communicated at meetings. Posters must be eye-catching and informative. Keep text to a minimum. You must have: a title, author's name, an introduction, a body (consisting mostly of tables and figures with appropriate captions), a conclusion and references.
- 4) Oral report: Over the course of the semester groups of students will work to prepare a 10 minute presentation on one laboratory. The instructor will assign a topic and a date for the oral presentation for each group. Each group member will present a part of the report

(Introduction, Experimental, Results/Discussion) The time limit means it will be a summary of the material in a formal report. Overhead transparencies or PowerPoint™ should be used as visual aids.

- 5) Peer Review: All articles published in the literature are reviewed by anonymous reviewers. They are only published after the reviewers are satisfied that they are accurate, well written and a new contribution to the scientific body of knowledge. Most articles are rewritten at least once in response to reviewers' comments. Often additional experiments are also done. You will review two of your peers' formal lab reports for each formal report that is due and rewrite your reports based on the reviews returned to you.

Students may discuss the write-up and calculations with each other but every student must turn in an individual report. Reports must be typed or computer word processed. Use of computers for data plotting and analysis is encouraged as is reference to the chemical literature for accepted values.

Reports will be graded as follows: 10 points on writing, 10 points on calculations including error analysis, 2 points for literature search/comparison with the literature. A copy of the grading cover sheet for formal reports is attached to this syllabus. The criteria are:

- 1) Does the report contain all the sections (abstract, introduction, experimental method, results, discussion)? Is the information logically distributed among the sections?
- 2) *Is sufficient information given in experimental methods for another physical chemistry student to repeat the experiment without referring to your handouts?*
- 3) Have all the discussion questions been answered?
- 4) Are the spelling and grammar correct? Is verb tense consistent (present or past)? In general past is preferred. Is the voice correct? Most scientific articles are in the passive voice. For example: instead of, "we did the experiment three times," write, "the experiment was done three times." Note that the implied "by _____" is left out.
- 5) Are the equations used in calculations included? Are there any errors in the calculations? Are the significant figures carried correctly? Are the error estimates reasonable?
- 6) Was a literature search performed? Is a copy of the title/author/abstract found in the search attached. You may use the references supplied in handouts or the text for actual comparison, but you must perform a literature search using STN/CAS and provide an abstract found this way for an appropriate reference.

The reviews will be due the lab day after the reports were originally due. You may rewrite reports based on the reviews. If you turn in the rewritten report within one week of getting the reviews, the grade will be recalculated as the mean average of the original and rewritten reports. A

copy of one of your reports, the best, will be kept for your student portfolio. Thus you should rewrite at least one report. Turn in **three** copies of the initial version of your formal reports and **two** copies of rewritten reports **with the original graded version attached.** Reviews of classmates' reports are worth 2 points each.

Reports are due in class the week following completion of the project. Late reports will be marked down 10%/day. Incomplete reports will be returned and the late penalty assessed.

Grading:		10	library worksheet
	6 x 5 =	30	pre-laboratory preparation
	6 x 5 =	30	laboratory notes
	6 x 2 =	12	reviews of reports
	6 x 22 =	132	laboratory reports (one is a poster)
	1 x 10	10	oral report
		76	final exam
		<hr/>	
		300	points total

The total points necessary to receive a particular grade are listed below. The instructor reserves the right to change the point total downward.

A: 273 AB: 258 B: 243 BC: 227 C: 211 CD: 196 D: 181 F: <181

Assessment of Learning: As part of the department's assessment of its majors program, evidence will be added to your portfolios to demonstrate your ability to:

- 1) read and follow experimental protocols;
- 2) properly set up and safely manipulate laboratory equipment;
- 3) plan and execute experiments, including the use of the chemical literature;
- 4) maintain accurate records of experimental work;
- 5) analyze data statistically and assess reliability of results;
- 6) prepare effective written scientific reports;
- 7) use mathematical representations of physical phenomena;
- 8) use and understand modern instrumentation;
- 9) use computers for chemical applications;
- 10) retrieve specific information from the chemical literature;
- 11) work cooperatively in problem solving situations.

Lab Schedule:

Date	Project	Written	Review	Rewrite	Oral
2/3	Library Assignment	2/3 (Data Sheet)	-	-	-
2/10	Real and Ideal Gases	-	-	-	-
2/17	Real and Ideal Gases (continued)	2/24 (formal)	3/3	3/10	3/4

2/24 - 3/24 Rotate through 2 labs (Heat of combustion; Solution Calorimetry)

2/24	Calorimetry lab A	-	-	-	-
3/3	finish lab A	3/10 (formal)	3/24	3/31	3/24
3/10	Calorimetry lab B	-	-	-	-
3/17	<i>Spring Break</i>				
3/24	finish lab B	3/31 (article)	-	-	4/8

3/31 - 4/21 Rotate through 2 labs (Partial Molar Volume, Refractometry and Viscometry)

3/31	lab C	-	-	-	-
4/7	finish lab C	4/14 (formal)	4/21	4/28	-
4/14	lab D	-	-	-	-
4/21	finish lab D	4/28 (poster)	-	-	5/11
4/28	Electrochemistry	-	-	-	-
5/5	Electrochemistry (continued)	5/12 (formal)	-	-	-
5/12	Exam				

Oral presentation dates (during CHEM 347 lecture/review sessions and a lab period). Please come promptly.

3/4: 10:20 AM HS367, Real and Ideal Gasses

3/24 1:50 PM HS428, Calorimetry (lab A)

4/8: 10:20 AM HS367, Calorimetry (lab B)

5/11:10:20 AM HS367, lab D

Additional Resources:

WEB RESOURCES: This syllabus, copies of homework assignments and answer keys will be available at the course web site. The course web site may be accessed by starting at the instructor's home page: http://www.uwosh.edu/faculty_staff/gutow/. Problem sets and answer keys will be password protected. The username for login into the protected web site is: pchems05. The password will be supplied the first day of class.

TEXTS: The following book is on reserve in the Halsey Resource Center (HS-289).

The ACS Style Guide, J. S. Dodd, Ed. QD8.5.A25. This book explains the standard format used in ACS journals.

ASSESSMENT GOAL #2
Laboratory Report Cover Sheet

Student: _____

Course: _____

Semester/Year: _____

Skill Level Indicators

N Novice: requires explicit guidance of instructor

I Intermediate: performs with minimal guidance

A Advanced: exhibits independence; may modify protocols to new conditions, instruct others

ne No Expectation in this area

number in parentheses indicates maximum deduction if in error.

Performance of experiment N I A

___ Follow experimental protocols (N needs list of steps to follow; I plans steps from a general description; A uses the literature to develop procedure)

Laboratory Notebooks N I A ___ / 5

___ Record data accurately (I numbers recorded; A additional observations)

___ Record procedures followed (N none; I minimal; A work could be reproduced from notes)

Laboratory Report N I A ___ / 10

___ Spelling/grammar (some -1, many -2, unreadable -3); vocabulary (-1/2); tense consistency (-1/2); voice passive (-1/2)

___ Organize material into standard sections (minor problems -1/2, major problems -1)

___ Abstract: system studied; method used; important results (-1 if absent, no other deductions)

___ Introduction: what experiment will tell us (-1); balanced equations for chemical reactions (-1)

___ Experimental: reagents (-1/2); equipment specifications/name (-1/2); procedures followed (only refers to text -2, N)

___ Results: data is complete; displayed as table or graph when appropriate (up to -1)

___ Discussion: significance of experiment (-1); comparison to literature; answers to text questions (-1); discussion of error sources (-1/2)

___ Equations: complete description including definition of variables (some missing -1/2, many missing -1, most -1.5)

___ References: complete; correct format

Data Analysis and Interpretation N I A ___ / 6

___ Performs algebraic calculations: includes equations; units (-1/2); sample calculations (-1); accuracy (up to -4)

___ Graphs data (N simple graph, I regression/curve fitting) (up to -2 if missing)

___ Uses computer simulations/molecular modeling

Assess reliability of results N I A ___ / 4

___ Estimates error in measurements (N gives sources of error (-2), I propagates errors-- includes equations, sample calculations (-2))

___ Significant digits (-1/2)

Literature Search N I A ___ / 2

___ Finds appropriate references (provide abstract) (-1)

___ Compares literature results with own (-1)