

THE UNIVERSITY OF ALABAMA
DEPARTMENT OF CHEMISTRY
PHYSICAL CHEMISTRY LABORATORIES
Syllabus for Chemistry 343,348

CH-343 (1 credit hour) Spring - 2004
CH-348 (2 credit hours)

General Information

1. Instructor: Dr. M. G. Bakker
Office: 335 Lloyd Hall
Laboratory 315 Lloyd Hall
Phone #: (205) 348-9116 e-mail: Bakker@bama.ua.edu
Office Hours: Monday, Thursday 3.00 - 4.30 PM
other times by appointment.
(if I am not in my office try the P. Chem. Lab.)

2. Teaching Assistants:
Monday & Wednesday : Mr. Vishal Warke
Tuesday and Thursday: Mr. William Adams
Office Hours To be announced

3. Course Objectives

The Laboratory Course serves three objectives; (1) mastering laboratory practice, (2) demonstrating by experiment fundamental concepts of physical chemistry and (3) learning to critically evaluate scientific information.

Any Chemistry Laboratory therefore requires students to master skills required by the chemical profession. In this laboratory course the emphasis is on the measurement of key physical parameters, on the evaluation of the accuracy and reliability of such measurements, and on the sources of error inherent in the measurement process. It is neither realistic, nor desirable to master each type of measurement that may possibly be needed. Instead experiments of a number of different types have been selected to illustrate the range of measurements carried out, and to develop awareness of how to select a technique or design an experiment to carry out a particular measurement.

Other skills that must also be mastered in the course include the ability to keep a well ordered and comprehensive notebook, and to write reports detailing the methods used, the measurements made, and the results of the experiment. This report must be sufficiently comprehensive for someone else to repeat the work and sufficiently clear for the non-specialist to determine the significance of the results.

4. Prerequisites: for CH348: CH 341

5. Texts:

Required: Shoemaker, Garland, and Nibler, *Experiments in Physical Chemistry*, 5th, 6th or 7th ed., (SGN).

Reference: Daniels, Williams, Bender, Alberty, Cornwell, and Harriman, *Experimental Physical Chemistry*, 7th ed., (DWBACH).

6. Grade Determination:

The grade given to each lab report will be based on the basic elements of the report (70%) and on the experimental observations recorded in the laboratory notebook (30%). The report should be legible and well written (as discussed below). If the reports are poorly written, or difficult to read or understand the grades will be lower, irrespective of the quality of the experimental results or understanding of the theory and technique displayed. The format of technical reports is typically similar to (10) below, and you should use this as a model for all your laboratory reports.

The lab reports are due and will be collected the week immediately following the experiment.

NOTE: the experiments are graded by the teaching assistants according to guidelines set by the instructor. It is the students responsibility to ensure that the appropriate teaching assistant receives the completed reports. The graded reports are due back the following week, if a report is not returned, please check that the T.A. received it, and notify the instructor if there is a problem.

Penalties for lab reports handed in late are as follows:

1 week - 25% deduction

2 weeks - 40% deduction

beyond 2 weeks 50% deduction

The final course grade will be evaluated (based on standard grading procedures) by the following criteria:

CH-343: Highest 10 reports (100 points each)	1000 points
final exam (700 points)	700 points
TOTAL	<u>1700 points</u>
CH-348: Highest 20 (100 points each)	2000 points
final exam (1400 points)	1400 points
TOTAL	<u>3400 points</u>

The laboratory final exam is scheduled for Saturday, April 24th 10 am to 1 pm.

CH 348 - W Designation

Because CH 348 is designated as a writing course "Writing proficiency is required for a passing grade in this course."

This means that a student who does not write with the skill normally required of an upper division student in chemistry will not be given a passing grade, irrespective of how well he/she performs otherwise in the course.

Writing skill will be assessed as follows; a faculty member will grade the experimental report for the experiments carried out on March 1st and 2nd against the standard that the report should be written as "coherent, logical, and carefully edited prose". The report will be returned with annotations to indicate where it falls short of the required standard. If performance is judged inadequate the student will be given the opportunity to rewrite the paper and have it re-graded. If the re-submitted paper is still judged inadequate, the student will be referred to the Writing Center of the English Department.

The experimental reports for the experiments carried out on the 24th and 25th of March will likewise be graded for writing performance. Again, in those cases where writing performance is inadequate the student may re-write, and resubmit his/her paper. If the revised report is still judged to be inadequate the student will be given a failing grade in the course.

7. Make up Policy.

Students are allowed to miss 1 laboratory class if appropriate medical certificate or other written material validating their absence is presented to the instructor and teaching assistant. If there is no course conflict and the missed experiment is scheduled at another time, the student will be required to make up the missed experiment or experiments on another day or days.

Any student who is absent from the final examination with appropriate written validation, may be given an oral makeup examination.

8. Laboratory Hours:

The Physical Chemistry Laboratory is housed in Rooms 209 and 208 Lloyd Hall. The laboratory hours are 2:00 - 5:00 PM every weekday (**EXCEPT FRIDAY**). For liability reasons the Laboratory will not be opened before this time. Because many of the experiments run the full 3 hours you are required to have read all instructions for each experiment prior to the arriving in the laboratory.

9. Laboratory Notebook:

A (bound) laboratory notebook with tear-out carbon copies is required. No other substitute is acceptable. All information/experimental data that is collected/determined in this laboratory course are to be entered in **permanent ink** (not pencil) in the lab notebook. Each page must be numbered, and every entry must include the title of the experiment and date. Leave the first two pages blank, to use as INDEX for your notebook. At the end of each day get the T.A. to sign your note-book and initial any changes made. (Note that the T.A.'s have been instructed not to sign any notebooks until all waste chemicals have been properly disposed of, glassware is clean and the experimental area is tidy). (a notebook equivalent to the 43-649 Research Laboratory Notebook, is an example of an acceptable laboratory notebook, and can be found in the Campus Bookstore or Alabama Bookstore.) If you have sufficient space left in your organic laboratory notebook this may be used. **REMEMBER:** the notebook is an important element of your grade, as is discussed below.

10. Laboratory Reports:

The results of each experiment will be collected as a formal (but, brief) written report (not to exceed 5 pages). The report may be typewritten or done in ink (must be legible) on 8 $\frac{1}{2}$ x 11 paper. The suggested format of the report is as follows:

1. Title page - to include:

- Title of Experiment
- Name
- Date(s) Performed
- Date Reported
- Name(s) of Lab Partner(s)
- Name of Teaching Assistant present in the Lab.

2. Introduction - a brief theoretical description of the problem

3. Experimental - to include:

- Objective - statement of purpose
- Design - description of experimental configuration, i.e., a schematic or drawing of experiment
- Procedures - describe specifics and relevance

4. Results* - to include:
 - Raw Data - and standardization's
 - Observations - any and all relevant to data
 - Analysis - all calculations, in appropriate formats (i.e., tables, graphs, etc.)
4. (b) Discussion (where necessary)
5. Conclusions
6. References - cite all relevant references used to write the report
7. Appendix: The carbon copies out of notebook.

*NOTE: Any lab report that shows a discrepancy between the raw data entered in the laboratory notebook and that reported will not be graded, thus automatically resulting in a grade of zero. **Plagiarism of laboratory reports and/or falsification of experimental data will not be tolerated, and will be handled under the Academic Misconduct policy.** Although you will do your experimental work in groups your reports must be done **separately**.

11. Health and Safety, Laboratory Rules, Waste Chemical Disposal and Right to Know.

The first class meeting consists of a safety lecture covering hazards encountered in the Physical Chemistry Laboratory that have not previously been covered in Health and Safety Lectures. **Attendance at this session is mandatory.** For those students who have not previously attended the general chemistry safety lecture covering; right-to-know and Material Safety Data Sheets, chemical safety, policy on safety glasses (they are to be worn at all times), first aid, fire diamond, electrical, pressurized gas and other hazards (This lecture was given in any chemistry laboratory from the fall of 1994 onwards.). If numbers are sufficient the instructor will give a lecture covering these topics after which you will be given the opportunity to ask whatever questions are necessary for you to understand the material. You will then sign a statement that you have been given the presentation, understood it's contents and agree to abide by it.

12. Breakage

Because the equipment used in this laboratory is shared and expensive, no financial penalty will be assessed for minor glassware breakage (less than \$25). Above this level financial recompense based on the formula $(\text{cost})^{0.7}$ will be assessed in those cases where, in the opinion of the instructor, the student was careless or negligent. In the case of students working in groups the cost may be divided among the group.

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REQUIRED READING: Chapters 1 and 2 in Garland, Nibler, and Shoemaker (SGN) should be reviewed prior to the first experiment. page numbers are for 7th edition [6th edition in square brackets], (5th edition in brackets)

EXPERIMENTS

1. Determination of Molecular volume / error analysis, handout
2. Vapor Pressure of Pure Liquid - SGN (exp.#13) p.199-207 [199-207],(219-229), handout
3. Elevation of the Boiling Point - handout, DWBACH p.83-87
4. Viscosity of Gases - SGN (exp.#4) p.126-134 [126-134],(130-141)
5. Heat of Combustion: Adiabatic Bomb Calorimetry - handout, SGN (exp.#6) p.145-158, [145-158] (153-169)
6. Quantum Chemistry:
Majors Q. C. I (Vibrational Analysis of Ammonia and Water)
Minors Q. C. II (Conformation of Acetylcholine)
7. Phase Diagram, handout - SGN (exp. #15) p. 215-222, [215-221]
8. Adsorption from Solution - handout
9. Chemical Kinetics: Acid-Catalyzed Hydrolysis of Sucrose - handout, SGN (exp.#22) p.264-274, [264-276], (297-311)
10. Electrochemistry - handout
11. Conductance of Solutions - handout, SGN (exp.#17) p.228-238, [228-238], (253-267)
12. Distribution of Solute between Immiscible Solvents - handout, DWBACH p.117-122
13. Acid Dissociation Constant of an Indicating Dye - handout
14. Intrinsic Viscosity of polymers- SGN (exp.#28) p. 318-327, [317-326], (370-380)
15. EPR - handout, SGN (exp.#41) p.441-453,[508-521]
16. Rotation-Vibration Spectrum of HCl - handout, SGN (exp.#37) p.403-411, [461-468], DWBACH p.247-256
17. Absorption Spectrum of a Conjugated Dye - SGN (exp.#34) p.380-385, [378-383] (440-446) handout
18. Surface Tension - handout, SGN (exp.#25) p. 292-301, [291-301] (339-350)
19. Quantum Efficiency of a Photochemical Reaction - handout, DWBACH p. 376-379
20. Solution Calorimetry, SGN (exp 8), p.167-171, handout
21. NMR (60MHz) Determination of Keto-enol Equilibrium Constant - SGN (exp.#42) p. 453-461, [446-454] (522-531)
22. Fluorescence of Dyes in Cyclodextrins, Handout
23. Magnetic Susceptibility SGN (exp.#32) p.361-370, [359-369] (418-429), handout

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SCHEDULE

NOTE: The laboratory will be split into groups of two or three students. Each group will perform all of the experiments listed above. The numbers for the experiments correspond to this list, not to the numbers given in SGN! The groups and their schedule for experiments are listed below. Note that the schedule of experiments (below) are what is planned. Due to equipment breakdown or damage deviations may be necessary.

CHEMISTRY - 348: GROUPS

Week Starting	811	812	813	814	821	822	823
19-Jan							
	1	1	1	1	1	1	1
26-Jan	19	13	6	7	2	10	7
	18	2	10	19	18	13	19
2-Feb	7	19	5	20	19	5	9
	9	17	18	21	17	19	12
9-Feb	6	11	13	12	8	20	4
	8	6	4	11	6	21	10
16-Feb	11	20	12	10	9	12	13
	2	21	3	4	14	7	11
23-Feb	14	7	11	5	13	18	3
	10	5	21	13	11	8	14
1-Mar	15	15	15	15	15	15	15
	12	18	20	9	4	2	5
8-Mar	20	10	14	2	12	16	2
	21	3	9	6	7	9	16
15-Mar	17	9	7	8	20	3	17
	16	12	2	17	21	14	18
22-Mar	13	16	19	3	5	17	20
	3	14	17	16	3	11	21
29-Mar	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.
	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.
5-Apr	4	8	16	14	10	6	8
	5	4	8	18	16	4	6

Experimental Schedule - CH 343

Week Starting/Group	311	312	313	314	315	321	322	323	324
19-Jan	1	1	1	1	1	1	1	1	1
26-Jan	11	9	8	5	10	10	8	6	5
2-Feb	10	11	5	2	16	11	3	2	9
9-Feb	3	5	2	16	7	9	2	3	7
16-Feb	6	8	16	9	11	5	10	8	3
23-Feb	8	6	3	11	9	6	9	5	16
1-Mar	5	2	7	3	8	8	7	16	11
8-Mar	16	7	10	8	2	3	5	11	8
15-Mar	7	3	9	6	5	16	6	7	2
22-Mar	9	10	11	7	6	7	16	10	6
29-Mar	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.	S.B.
5-Apr	2	16	6	10	3	2	11	9	10