

CHEM 302L: Physical Chemistry Lab

Instructor <i>TA</i>	Day	Email	Office	Office Hours
Nathan Kidwell <i>Hannah Naldrett</i>	Monday	nmkidwell@wm.edu	ISC 1287	Mondays 11:30–12:30 pm
Jeff Molloy <i>Huw Richards</i>	Tuesday	jcmolloy@wm.edu	ISC 2031	By appointment
Kristin Wustholz <i>Lydia Dolvin</i>	Wednesday	kwustholz@wm.edu	ISC 2041	Thursdays 3:30–4:30 pm
Tyler Meldrum* <i>Hao Qian</i>	Thursday	tkmeldrum@wm.edu	ISC 1060	Wednesdays 11:00–12:20 pm

Other office hours by appointment with the instructor.

**Prof. Meldrum is responsible for course administration, including schedule changes and gradekeeping.*

Course Description

By measuring physical properties and processes, thoughtfully interpreting data, and developing laboratory and communication skills, you will put the concepts of physical chemistry into practice. The course is organized around three main units: *Data*, *Theory*, and *Synthesis*. In *Data*, you will explore and analyze data, considering sources of error and the limitations of your conclusions. In *Theory*, you will explore the behavior of matter from the microscopic (quantum) to the macroscopic (thermodynamic) realm. In *Synthesis*, you will put it all together, exploring uncertainty in speed of sound and calorimetric measurements, as well as measuring fluorescence intensity as a protein is denatured.

During our weekly meetings, we will collect and analyze data, evaluate models, create compelling figures, and practice scientific writing.

Learning Objectives

At the end of this course, as active participants in the learning and communicating process, you will be able to:

- Understand and apply fundamental concepts in physical chemistry.
- Examine a chemical problem and develop an approach to address it.
- Identify sources of error and limitations of data.
- Evaluate uncertainty in order to draw reasonable conclusions.
- Design effective plots and figures in order to illustrate experimental findings.
- Compose written reports that effectively describe and evaluate experimental findings.
- Create a coherent product that accurately and responsibly communicates your conclusions.

Grading

Your grade in CHEM 302L comprises the following components:

Formal submissions (45% total):

You will submit five (5) lab reports (or parts of lab reports) during the semester. Each of these reports will be slightly different and specific requirements are detailed in the corresponding entries in the lab manual. These are associated with:

- (5%) *Working with Data* (due approximately February 3–6)
- (10%) *Quantifying Barriers to Hindered Rotation* (due approximately February 24–27)
- (10%) *Electronic, Vibrational, and Rotational Coupling* (due approximately March 23–26)
- (5%) *DSC and Speed of Sound* (due approximately March 30–April 2)
- (15%) *FRET in cytochrome-c* (due approximately April 20–23)

Your formal submissions will be uploaded to Blackboard. Please note that because there are only five formal submissions, *you must submit and receive a grade for all five formal submissions in order to pass the course.*

Peer-review (5%):

Two lab reports will be peer-reviewed by class members. Your participation in reviewing others' work will contribute 5% to your final course grade. The grade you receive on the final lab report is separate from the peer-review score.

Lab citizenship (10%):

A lab citizenship score will be assigned by the course instructors. Good lab citizenship includes coming to lab prepared with the appropriate materials in hard copy, your computer, personal protective equipment as needed, and working appropriately with your lab partner.

In-class exercises and worksheets (30% total):

Most weeks there will be in-class activities in your lab manual. These will be completed by you, often together with your lab partner, and will be checked by the instructor or the TA during class. Each exercise will be graded pass/fail. For an example activity, see page 5 in Unit 1.

Lab notebooks (10%):

Your lab notebooks will be checked by an instructor/TA each week before you leave. Not only is this a check that you're using a lab notebook appropriately and that you'll have sufficient data to write up your reports but is an essential habit for research scientists. Confirmation of research is essential in the scientific process, and the lab notebook is the record that allows an experiment to be repeated. Record important things that happen in lab, including unexpected events, filenames for saved data, important observations, and other information as needed to thoroughly record your experience during the experiment. Your lab notebook is also where you will include sample calculations for your experiments. You will receive a weekly pass/fail grade.

Attendance and Late Policy

You are required to attend lab every week. You need to have a “checkmark” for each week’s activities to pass the course. In addition, you should not abandon your lab partner(s) in their time of need. If you know you will miss lab for a legitimate reason, please let your instructor know well ahead of time so we can make arrangements. If you are sick, please notify your instructor as soon as possible.

Each formal submission must be successfully uploaded to Blackboard by 1 pm on the specified due date. (Due dates match the day of the week when you have lab.) Each late day (or portion thereof) that your formal submissions are received will result in a 10% penalty. If there are extenuating circumstances that will affect your ability to submit your work on time, we are able to work with you; however, you will need to communicate with both your instructor and the Dean of Students so we can make appropriate arrangements.

Computers

Modern physical chemistry requires computers and skill in using them. Please bring your laptop to lab every week, and make sure that the relevant software (usually MS Office, but possibly other programs that you may wish to use for analysis) are up-to-date.

Guidelines for Lab Partners

Team skills are an essential part of chemistry. The American Chemical Society (ACS) recommends learning how to interact effectively with a diverse group of peers to solve scientific problems. These team skills are as important as the chemistry content, laboratory techniques, and safety skills that you will be learning in the lab this semester. Lab partners, classmates, teaching assistants, faculty, and staff are expected to create an environment of mutual respect and cooperation. Everyone is expected to practice these team skills, conduct lab procedures safely, and maintain respect for the abilities of others.

SAS Statement

William & Mary accommodates students with disabilities in accordance with federal laws and university policy. Any student who feels they may need an accommodation based on the impact of a learning, psychiatric, physical, or chronic health diagnosis should contact Student Accessibility Services staff at 757-221-2512 or at sas@wm.edu to determine if accommodations are warranted and to obtain an official letter of accommodation. For more information, please see www.wm.edu/sas.

Writing Resources Center

The Writing Resources Center, located on the first floor of Swem Library, is a free service provided to W&M students. Trained consultants offer individual assistance with writing, presentation, and other communication assignments across disciplines and at any stage, from generating ideas to polishing a final product. To make an appointment, visit www.wm.edu/wrc.

Tentative Schedule (as of 22 January 2020 and subject to change)

Dates	Unit	Week	Topic <i>Experiment (if applicable)</i>	Things due
1/23			Kick-off meeting 6 pm, ISC 1127	
1/27–1/30	I. DATA	1	Working with data	
2/3–2/6		2	Visualizing data, making figures <i>Quantifying barriers to hindered rotation</i>	Figure and short write-up: <i>Working with data</i>
2/10–2/13		3	Uncertainty and error propagation	
2/17–2/20		4	Writing lab reports, peer-review	
2/24–2/27	II. THEORY	5	Electronic spectroscopy <i>N₂ emission spectra</i>	Final lab report: <i>Quantifying barriers to hindered rotation</i>
3/2–3/5		6	HCl-DCI <i>Vibrational and rotational spectroscopy</i>	
3/9–3/12			SPRING BREAK	
3/16–3/19		7	Peer review	[ungraded] Draft lab report: <i>Coupling (electronic, vibrational, rotational)</i>
3/23–3/26		8	No lab meeting	Final lab report: <i>Coupling (electronic, vibrational, rotational)</i>
3/30–4/2	III. SYNTHESIS	9	Energy level populations, calorimetry <i>Speed of sound, DSC</i>	
4/6–4/9		10	Biophysical method: fluorescence <i>FRET in cytochrome-c</i>	Data workup: <i>Speed of Sound, DSC</i>
4/13–4/16		11	[cont.] Biophysical method: fluorescence	
4/20–4/23		12	Course evaluations, summary	[ungraded] Draft lab report: <i>FRET in cytochrome-c</i>
4/27–4/30		13	No lab meeting	Final, peer-reviewed lab report: <i>FRET in cytochrome-c</i>