Laboratory Policies and Grades

Goals

Physics is an empirically-based science. The theories we discuss in lecture are not arbitrary opinions—they can be (and indeed are) checked and either confirmed or discarded. It is also important to appreciate that those theories have limitations and restricted ranges of validity.

One of our primary goals in these labs is to enhance your understanding of the phenomena and principles we discuss in the lectures. By actually performing measurements yourself instead of just reading about them, we hope to make physics seem less abstract and more relevant to the real world.

Our other primary goal is to introduce you to the *process* of doing physics—to help you become familiar with the patterns of thinking that are an integral part of physics. It would be remiss of us to simply present you with a "cookbook" set of instructions for each lab, and then grade you simply on whether or not you have followed those instructions to the letter. Following a cookbook often does little to enhance your understanding the underlying principles. During this lab experience you should begin to develop the ability to determine *for yourself* what techniques and procedures to follow, what questions to ask, what your data means, how reliable it is, and what to do when things don't work as expected.

Consequently we will keep our introductions brief and we will typically spell out for you only the essential background you need to understand the assignment at hand. No doubt you will sometimes be frustrated with this approach—we sympathize with your frustrations, but they come with the territory. Overcoming them is an essential part of learning how to function independently in any situation.

General Strategy

1. *Read and follow the instructions.* We have tried to anticipate the most common problems and questions, and address them right in the lab manual.

2. *Ask questions.* We certainly don't expect you to understand everything about the lab entirely on your own. One of the most important things to learn is how to recognize when you are missing something and how to find the information that you need.

3. *Don't give up easily.* Most experiments are designed to work successfully. If you find your results disagree significantly with what you expect, try to find the source of the disagreement and then correct it, if possible. Feel free to ask your instructor for help.

Lab Write-ups

Each lab write-up should include the following:

1. *The names of the members of your lab group.* This ensures you get proper credit for your work.

2. *The date and time.* This is occasionally important, for instance if weather conditions or equipment problems could affect the results. In a professional setting, the date can be crucial in establishing who was the first to make an important discovery.

3. *The division of labor among lab partners.* This can be very brief.

4. *The names of any collaborators.* Give credit where it is due! If you have consulted with other students in the laboratory, you should acknowledge their input. (You need not acknowledge your instructor.)

5. *Procedure notes.* If you followed the procedure as it is spelled out in the lab manual, it will suffice to identify the step in a few words and give a page reference. (E.g., "Measured heights of masses at equilibrium, p. 21 part a.") Often there will be additional details that were given to you in lecture or that you discovered for yourself. These *must* be included as well. If the detail refers to a specific data entry, or occurs while you are recording a particular set of data, it should be noted next to that entry or table.

6. *Raw data, with labels.*

   Be sure to record the *raw* data, before any adjustments are made. For example, if a meter is not zeroed, you should still record the raw data and make your zero-correction explicitly in your data table (or with a separate column in the computer worksheet). That way, if the correction itself needs to be adjusted (as has often happened) the raw data is readily available.

7. *All algebraic equations and formulae needed to analyze the data.* The whole point of keeping a laboratory log is that someone else should be able to reconstruct your thinking.

8. *Analysis.* It is not necessary to spell out every algebraic or arithmetic step of the calculations, but it should be very clear to anyone reading the lab report what calculations were intended, and that you fully understand the theory upon which the calculations are based.

9. *Succinct explicit statement of results.* Although it may seem redundant and obvious, be sure to state explicitly what your results are and whether they agree or disagree with what you expect. Be sure to make use of your uncertainties in these statements, if appropriate. Label this statement such that it can easily be found (e.g. in a section labeled "Results.") You should not expect your lab instructor to go hunting through your lab report to find your final results and compute whether or not they agree with the expected values. You should make the comparison clearly and explicitly yourself.

10. *Responses to questions in the lab manual.*

11. *Further evidence that you have fully understood the lab.* Some examples of this "further evidence" are:

    (a) Notes indicating clear insight into the physics of the experiment.

    (b) Good discussion of measurement uncertainty, especially estimates of the size and relative importance of different sources of uncertainty. **A long list of possible uncertainties and errors is usually not useful. Instead, try to focus on just those sources of uncertainty that you think were likely to have played a significant role in your experiment.** By "uncertainty" here, we mean unavoidable uncertainties inherent in the design of the experiment—*not* mistakes made by you as you record data or perform the analysis. Do not use the phrase "human error". If you think you made a mistake, go back and check your measurement or calculation. If you think there is error in the experiment due to the necessary inclusion of a human being in the apparatus—for example, human reaction time in recording the duration of an event on a stopwatch—be specific. In all cases, be as specific and quantitative as you can. Point to specific evidence or observations in your lab report that support your analysis.

    (c) Suggestions for how the apparatus and techniques could be altered to improve the experiment.

    (d) Suggestions for additional experiments that could be performed with the apparatus, or for alternative experiments that could be used to investigate the same ideas.

    (e) Suggestions for how the lab manual might be improved.

Grades

The grade for the laboratory portion of this course will be determined by your scores on the submitted lab reports. The schemes used for grading these reports will vary slightly from instructor to instructor. At the end of each semester, we will compare the scores assigned by each instructor in all of his or her sections, and make adjustments as needed.

Lab Etiquette

No talking on cellphones, texting, E-mailing, instant messaging, blogging, Pokemon-Go-playing, random internet surfing, etc. Focus on the lab!! You can, of course, use the internet to look up lab-related things, use your cellphone as a calculator for lab-related calculations, etc.

No earphones for listening to music. Lab is a social time between you, your partner, your instructors, etc. Don't isolate yourself.

Computer Use

The computers in the lab are shared among several different lab sections. Accordingly, it is important to leave them in the same state as they were when you started. **Do not load any software, change any settings, or make any customizations, however innocuous, unless instructed to do so by your instructor**. You may store your data on the computer, but be sure to pick unique filenames. Be sure to not overwrite any system files or `LoggerPro` experiment files. If you wish to take your data with you, you may email the files to yourself, bring a USB drive, or use your NetStorage account.

Attendance

You are responsible for completing all of the assigned experiments at the scheduled times. Any unexcused absences will result in a grade of zero for that lab. Make-up labs are not normally available for unexcused absences. If you can not make it to your scheduled lab, please try to come to one of the other sections for this course. Since the lab room may also be used for other courses, you can't count on the equipment being available outside of the scheduled times.

Course Tools

LoggerPro

`LoggerPro` is a data collection and analysis package that we will be using extensively this semester. Further details on the use of `LoggerPro` will be introduced as the semester progresses. A summary can be found in Appendix C of this laboratory manual.

Windows 10 Download

macOS 10.15, 10.14, 10.13 Download

Detailed Installation Instructions

For Windows and Mac computers that are no longer receiving updates, you will need an older version of Logger Pro. If your version is not listed below, please contact customer service at support@vernier.com.

Windows 7, 8.1 Download

Windows 8 Download Password: conservation

Windows XP and Vista Download Password: climate

Mac OS X 10.10, 10.11, 10.12 Download

Mac OS X 10.9 Download Password: experiment

Mac OS X 10.8 Download Password: exploration

Mac OS X 10.7 Download Password: experiment

Moodle

Each section of PHYS151-L has its own Moodle page. Each week, your laboratory instructor will enable a link to allow you to submit your completed laboratory report via the appropriate assignment module on your PHYS151-L Moodle page. It is imperative that you combine all documents – data, graphs, handwritten notes, etc. – together into a single .PDF file; otherwise, parts of your assignment might become lost, and grading becomes very unwieldy.