PHYSICS 231L – Introductory Physics I Laboratory

Dordt University, Summer 2021
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Student hours: By appointment.

Overview

Everything we predict and explain in physics using mathematics must be confirmed by experiment. By making simple measurements, we can learn a lot about the world around us. This term, we will explore different aspects of waves and oscillations, and how the theory we learn in class relates to what we observe in the lab.

Required Materials, Participation, Technology, **Academic Integrity,** and **Accommodations** will be as stated in the Physics 231 Course Syllabus.

Laboratory Objectives

Creational Structure

- Understand how physical theorems are reflected in experimental observations.
- Explain and self-evaluate the implementation of a physics experiment.
- Derive equations for and calculate the relevant sources of error in an experiment.
- Identify and explain other sources of error not accounted for in analysis.

Contemporary Response

- Design and maintain an organized and comprehensive lab notebook.

Grading and Laboratory Notebooks

Though virtual labs we will investigate together are simulation-based, keeping a lab notebook that reflects the (often error-laden) process of discovery is an important skill that you will rely on throughout future STEM courses.

Laboratory notebooks are to be kept in an organized Google Doc conforming to the guidelines that follow. Lab notebooks are to be shared with the instructor, who will comment on and grade the notebooks in Google Docs. The Title, Subtitle, and Heading options should be used to maintain an organized layout and Table of Contents. A lab book sample made in Google Docs can be found linked here (read-only).

Labs will be graded individually out of ten based on the following description of physics laboratory notebooks. Please read and review carefully.

A lab notebook is a record of what **you** did in the experiment. It is a detailed record of the choices you made in the procedure, and a resource for you to use to explain adherence or deviation to what you expected might happen. It should be detailed enough that if someone else looked at your lab notebook with no other context, they could perform your experiment exactly as you did and replicate your results. Given that it is both a personal record of what you did, and evidence for others who are interested in your results, your lab book should be **organized** and **neat**, but it need not be **perfect**. The following general organization should be followed:

- Your name should be on the front page.
- A Table of Contents should be maintained at the front of the document.
- Each page should be numbered sequentially.
- Each lab should state at the top of the first page the date it was performed and with whom you performed it.
- All data and information should be contained in your lab notebook. You should not write raw data, calculations, or anything else on scrap paper outside of your lab book.

Every lab should have the following structure and contents:

1. **Title:** As given in the lab handout
2. **Purpose(s)/Objective(s):** Concisely state the reason(s) why we are performing the experiment (there could be more than one!)
3. **Procedure:** Describe how you performed the experiment in your own words, making a note of what equipment was used and how you used it. Use diagrams, where appropriate. Do not copy down the lab handout; read the lab handout, follow the instructions, and write down what you did as each step is completed.
4. **Analysis:**
    a. *Calculations:* Any formulas and derivations necessary for your analysis (both your main analysis and your error analysis) should be included here. When you perform a calculation, you should:
        i. State the values that each variable will take on with units, *e.g.,* $r = 2.00\ \mathrm{m}$.
        ii. State the formula you will be using without any values plugged in, *e.g.,* $C = 2\pi r$.
        iii. State the formula with the values plugged in with units, *e.g.,* $C = 2\pi(2.00\ \mathrm{m})$.
        iv. Simplify analytically, if necessary, *e.g.,* $C = 4\pi$.
        v. Calculate and state your final answer, with units and the correct number of significant figures, e.g., $C = 12.6\ \mathrm{m}$.
    b. *Graphs:* Drawn graphs should be titled and axes clearly labeled (with units!), and a scale should be chosen such that the graph takes up at least half of the page. If there is more than one plot, you should label them as Figure 1, Figure 2, etc.
5. **Discussion:** Comment on your results, any thoughts you have, or if anything surprised you. You should also answer any questions posed in the lab handout here. When you answer any questions, you should answer it in such a way that what you write makes sense even without the original questions.
6. **Conclusion:** You should summarize your purpose(s)/objective(s), briefly summarize what you did, and summarize what you determined through your analysis and discussion, framed through your purpose/objective. Restate any important values you determined in your calculation(s).