General Physics II Laboratory
PHY-171 Spring 2021
Gustavus Adolphus College

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Course Objectives

- Explore physical laws applicable to electricity, magnetism, light, and modern physics
- Learn to formulate and test qualitative and quantitative hypotheses for physical systems
- Acquire experience and skills in making measurements and collecting data
- Acquire experience and skills in analyzing and reporting experimental data
- Learn to apply basic error analysis and error propagation techniques

Course Policies and Evaluation

Lab Materials:

- PHY-171 General Physics II Laboratory Manual (Experiments will be uploaded to Moodle or Emailed).
- **Two** laboratory notebooks (Roaring Spring #77227 or equivalent: 80 sheets, 5x5 quad ruled, 9.75 x 7.5 inches)
- A calculator
- A flat straight edge or ruler for making charts and tables (optional)

Pre-Lab Exercises: Most experiments in the lab manual are accompanied by a Pre-Lab exercise that will be in the form of a Moodle assignment. **Moodle assignments are due (must be completed and submitted) by 1 pm on Monday of that lab week.**

Lab notebooks and reporting:

A statement of the lab objective and any theory unique to the particular lab should be prepared in advance and recorded in your notebook (**pre-lab** content is due before the start of lab):

Lab objective and summary of physics principles

- A few sentences describing (in your own words) the principle of Physics you are investigating. What are you trying to measure? How are you attempting to make the measurement?

Summary of theory that is unique to this particular lab

- A few sentences of summary (in your own words) describing what theory and observation methods/equipment you plan to use in your investigation.

After these two introductory sections, your laboratory notebook will serve as a complete detailed journal of observations and data collection during the lab period (i.e. a chronological record of your work in the lab) followed by any post-lab analysis. The goal is for a future student to be able to reproduce your work and results using ONLY your laboratory notebook (and not the laboratory manual).

What data did you collect?

- Data that is collected by hand should be recorded by hand and sufficiently annotated to be understood.
  - Numbers need to have units and short descriptive phrases that act as labels.
  - Sets of data are organized into tables with columns labeled and with units.
  - In labs where we will propagate errors, uncertainty estimates should be given for all measurements.
- Data (charts and tables) that is collected via computer can be taped into the notebook. Again, descriptive information and units are important.
- Sometimes observations are not simply a number and need to be represented qualitatively by a short piece of descriptive prose.

How did you collect it? The idea here is not to reproduce in detail the procedure in manual but mainly to comment and explain to the extent that your report makes sense on its own (stand-alone).

- The goal is to have the report contain enough procedure so that the reader knows what you observed and how you observed it. This should be done in a near "stand-alone" level of detail.
- Procedural journaling should document what you did as you did it. There should be no writing to scratch paper for later entry into your lab notebook. Write directly in the lab notebook.
- Deviations should be discussed. For example, equipment malfunctions, mishaps, or procedural stumbles. Maybe you think of a way to improve upon the procedure in the manual (or do something extra); describe your idea and how you implemented it.
- The manual may call you to develop and optimize your own procedure for a measurement task. In a case like this you'll need to describe the approach you took and why. Sketches are very helpful in conveying procedural information!

The lab notebook also serves as a container for post-lab analysis, results, and answers to questions (as called out in the lab manual) that must be included in the report.

How did you analyze the data and calculate the results?

- Calculation methods need to be explained. Results should be annotated so the reader understands what is being presented.
- This material can be entered in hand written form or typed and taped in. Much of the analysis can and should be completed before leaving the lab. However, remember that the first priority of 'in lab time' is to observe the physical system and collect data.

Conclusions are an important part of hypotheses testing. Did your measurements agree with the theory (within the estimated uncertainty)? If not, what is behind the difference? Do you think there might be characteristics of the physical system that the theory is not accounting for? Are there systematic measurement errors or shifts causes by limitations of the measurement method? Depending on the lab, a question from the manual may ask you to make such a comparison; you can refer to your answer instead of repeating it in the conclusion. For a very prescriptive lab, a conclusion may not be appropriate. But generally, especially in labs where you are comparing measurements to theory, it's a spot where you can quantitatively and qualitatively summarize your observations and analysis.

Each lab report in the lab notebook should roughly follow this basic outline (sections 3 and 4 might be somewhat interspersed):

1. Title, date, student name, and lab partner name
2. Summary descriptions of the principles and methods (in your own words)
3. Data and observations (the journal)
4. Analysis and questions (the container)
5. Conclusions (Summary of findings. Is your hypothesis supported by observation? Why?)

The prior week's lab notebooks will be returned from the grader at the beginning of the lecture period before lab (either the day before lab or the day of lab). Your first step each week will be to prepare #1 and #2 above before the start of lab. The idea is to come ready to work!

Each student will prepare his/her/their/zir own lab report, even though the experiments were performed with a partner. **Reporting is an individual task and responsibility.** We encourage cooperative exchange, discussion, and sharing of ideas (and struggles) outside of lab. But we don't want to see duplicated reports. Reports should reflect your individual effort (wording, answers, analysis, and derivations).

Reports are due at the beginning of the next scheduled lab period. A penalty of 10% per day will be assessed each late lab report.

TA Grading: TAs are given the following guidelines for grading:

Heading	A lab title, date of lab, name, and partner's name are clearly present at the beginning of the lab report. **(0.5)**	A lab title, date of lab, name, and partner's name are missing from the lab report. **(0)**		
Purpose **Principles** **Roadmap**	The introduction includes ALL of the following: The objective is clearly stated and accurately reflects the purpose of the lab. AND The physics principles covered in the lab are briefly discussed and include equations. AND A brief description of what was done to accomplish the objective is stated. **(0.5)**	The introduction includes one of the following mistakes: An objective is stated, but it does not accurately reflect the purpose of the lab. OR The physics principles covered in the lab are incorrectly discussed. OR A brief description of what was done to accomplish the objective is stated, but unclear. **(0.4)**	The introduction includes two of the following mistakes: An objective is stated, but it does not accurately reflect the purpose of the lab. OR The physics principles covered in the lab are incorrectly discussed. OR A brief description of what was done to accomplish the objective is stated, but unclear. **(0.2)**	The objective, physics principles, and brief description on what was done are not included in the lab report. **(0)**
Procedure	A description of what was done to accomplish the objective is clear enough so that the experiment could be reproduced. **(3)**	A description of the experiment is included but is not clear enough so that the experiment could be reproduced. **(1.5)**	The description of what was done is missing from the report. **(0)**	
Data	Data is complete and is presented clearly in tables. All proper units, significant figures, and error are included. **(2)**	Data is complete but may not be presented in a neat manner or is missing some proper units, significant figures, and error. **(1.5)**	Data is incomplete (missing measurements, observations, or given information). **(0.5)**	Data is not present in the lab report. **(0)**
Calculations/ Results/ Analysis	A sample of all calculations is correctly presented in a neat, orderly fashion with the remaining results clearly presented. All formulas, units, and uncertainties are present. All analysis questions in manual are answered. **(2)**	A sample of all calculations is present but: includes minor errors, is not presented in a neat, orderly fashion, OR is missing formulas, units, or uncertainties, OR some analysis questions in manual are unanswered. **(1.5)**	Some sample calculations are missing from the lab report, OR there are some major errors in the calculations, AND analysis questions are unanswered. **(0.5)**	The calculations are incomplete error or are missing from the report. **(0)**
Conclusion/ Discussion	The conclusion includes a discussion of the results and cites specific evidence, discusses the validity of the experiment including experimental error, and suggests methods of improvement. **(1)**	The conclusion lacks one of the following: citing of specific evidence, OR discussion of validity/error, OR methods of improvements. **(0.7)**	The conclusion lacks two of the following: citing of specific evidence, OR discussion of validity/error, OR methods of improvements. **(0.3)**	The conclusion is grossly incomplete or is not present. **(0)**
Figures	Figures are correctly completed with title, labeled axes, units, fit, error bars, captions, etc. **(1)**	Figures are missing either a title, labeled axis, units, fit, error bars, or caption. **(0.7)**	Figures contain major errors. **(0.3)**	Figures are missing from the report. **(0)**

Lab Groups: Students will work in groups of 2 (maximum of 3). It is essential that all members of the group share in the different aspects of the lab and become completely familiar with operating the equipment and computer, taking the measurements, and analyzing the data. It is best if student roles are changed from week to week; this will insure that you are prepared for the lab final.

Preparation for Laboratory: Advance preparation is essential for the efficient use of the limited lab time. Students are expected to be thoroughly familiar with the purpose and general procedures of the experiment before coming to lab; theory and procedure summaries should be prepared in advance and recorded in the lab notebook. The primary purpose of the Pre-Lab Moodle exercise is to encourage and reward preparation for lab (both in grade and ease of carrying out the experiment). Each student must bring his/her/their/zir lab manual to lab.

Attendance: **Students must arrange in advance to attend a lab at other than their scheduled time.** It is the responsibility of the student to consult with the instructor during the first week of the semester regarding any anticipated absences due to field trips, athletic events, musical performances, or other activities. Because of equipment conflicts and other logistical reasons, it may NOT be possible to make up a lab outside of a scheduled lab session. Lab equipment is dismantled and next week's lab is set up typically on Friday afternoon.

Honesty: Students are expected to follow the Gustavus honor code: *On my honor, I pledge that I have not given, received, or tolerated others' use of unauthorized aid in completing this work.* Please ask if you have any questions about the appropriate use of another student's work.

Evaluation: Pre-Lab Exercises 20%, Written Lab Reports 80%.

Incompletes: A grade of incomplete will only be given for work not completed due to circumstances beyond the control of the student. [College policy.]

Final Grades: Final course grades will be assigned using the following scale as a guide only:

A	94-100	A-	90-94	B+	86-90
B	82-86	B-	78-82	C+	74-78
C	70-74	C-	66-70	D+	62-66
D	58-62				

Students need to record and keep track of their own assignment/test grades if they wish to know their current grade in the course as the semester progresses. Final grades may also take into account the instructor's evaluation of the student's attendance, participation, effort, and evidence of improvement or regression.

Office Hours: Darsa can usually be found in their office (10:00 am-6:00 pm) or the physics labs during the scheduled times (posted outside 204). See Paul or Tom during their office hours or other times by arrangement.

Disability Services: Gustavus Adolphus College is committed to ensuring equitable and inclusive learning environments for all students. If you have a disability and anticipate or experience barriers to equal access, please speak with the accessibility resources staff about your needs. A disability may include mental health, attentional, learning, chronic health, sensory, physical, and/or short-term conditions. When appropriate, staff will guide students and professors in making accommodations to ensure equal access. Accommodations cannot be made retroactively; therefore, to maximize your academic success at Gustavus, please contact them as early as possible. Accessibility resources staff are located in the Center for Academic Resources and Enhancement (https://gustavus.edu/care/accessibility/) (x7227). Accessibility Resources Coordinator, Katy Clay, (clayk@gustavus.edu), can provide further information.

COVID PASS/FAIL OPTION

Due to the extraordinary stresses, hardships, and exacerbation of inequities imposed by the COVID-19 pandemic, Gustavus faculty have decided to continue to offer students the option of pass/fail grading for the vast majority of courses through Spring 2021. An important exception is courses, including prerequisites, for Nursing and Athletic training, both of which have external accreditation requirements that conflict with current pass/fail policy. Students must request pass/fail grades by 4:00 pm on the final day of classes (Thursday, May 6, for Spring 2021). This decision is ultimately up to each student. Additionally, students should not be asked by their professors whether or not they have requested a pass/fail grade for any given course.

Here's what **you** should do:

- Check with your academic advisor and/or the directors of Nursing or Athletic Training if you are enrolled in or considering those programs for guidance on whether to request pass/fail grades for any particular course. It may also be useful to consult with department chairs or program directors in your major for their input on the implications of pass/fail grades in their areas.
- Read the Pass/Fail Grading Student FAQ document carefully to better understand the important reasons for and against requesting pass/fail grades.

Pass/Fail Request Form (Please note that the link is the same for J-Term and for Spring 2021, so requests for Spring 2021 need to be made after J-Term has ended.)