

Physics with Calculus: PHY22X

Lab Report Guidelines

Prof. Leif Eccles

1. Motivation

- A lab report is a piece of scientific writing that can serve different purposes, such as to support or invalidate a hypothesis based on scientific data and its interpretation, to allow others to reproduce the experiment described, or to provide a record of results for future reference.
- As future scientists or engineers, it is important for students to be able to produce professional, clear, and accurate lab reports. There are several reasons why acquiring practice in writing lab reports is important: (1) to improve technical writing skills, (2) to become familiar with the rules and conventions of scientific writing, and (3) to reinforce concepts, learn how to interpret data, and draw scientific conclusions from experimental observations.

2. General Information

- **Please see your course syllabus to know which lab(s) require a full lab report.** For labs that are just a fill-in packet, no additional lab report is required.
- Lab submissions should be handed in during class or submitted via Blackboard by midnight the day it is due.
- Email questions to me! [Prof. Leif Eccles](#)
- For electronic submissions:
 - It is your responsibility to verify that your report was uploaded without error.
 - Must be in PDF format in a single file:
 - [CutePDF](#) and [PrimoPDF](#) are freeware pdf creator programs.
 - [PDF Split and Merge Basic](#) is a freeware program to combine several files into a single pdf.
 - Document Name: PHY22[X]-[Section #]_Lab [x]_[Last Name].pdf
 - Ex. PHY221-01P_Lab 1_Smith.pdf
- Each student must create lab reports independently from lab partners – your data will be the same but how you summarize everything should be your own words.
- **Copied/plagiarized work will not be graded.**
- Total points possible per lab report: 30 pts (pre-weighted)
 - Grading based on completeness, professionalism of report, clarity of thoughts and ideas, demonstration of knowledge, and in-class behavior.
 - Lab Report Grading Rubric posted on course website

3. Sections of a Lab Report

Each lab is composed of one to four experiments that have some common theme (ex. Various systems that demonstrate conservation of energy). The abstract and conclusion of your report will tie together the experiments by discussing how each experiment related to the common theme. Specifics below:

- **Abstract:** summary of *all experiments* and how they relate to the overall theme in 1-3 paragraphs. At a minimum, describe the objectives, expected outcomes, data collection methods, and results (including actual numbers measured) for each experiment clearly and distinctly. This is a summary of the entire report and not an introduction; therefore, it should be in the past tense. An abstract is brief: do not include tables or figures. It is best to write this after finishing the entire report. It is similar but not identical to your conclusion.
- **Introduction & Data Collection:** *each experiment will have this section.*
 - Introduction: Introduce the experiment in your own words. Summarize the key concepts, show relevant equations (if any), show relevant figures (if any), answer preliminary questions from lab.
 - Hypothesis: summarize your hypothesis (predictions) in words and/or graphically.
 - Methods: describe the experimental methods in your own words, and list special equipment used. This is a good place to mention each team member's contribution.
 - Results: Introduce your data and include the relevant results in tables and/or graphs. Be sure to include where applicable meaningful titles, axis labels, even and appropriate axis scaling, and units. Graphs should include only the relevant data. **Do not include a raw data table if it is also plotted.** Summarize how error bars and/or uncertainty in measurements were determined and use appropriate significant figures. If calculations were a major part of the data analysis, show your work. Use the equation editor that comes with word processing software and put each equation on its own line much like you see in your textbook. If you aren't sure how to do this, ask your instructor.
- **Analysis:** *each experiment will have this section.* Describe the key features of your results that either prove or contradict your hypothesis. Describe how the data demonstrates the principles being studied. Answer any analysis questions from the lab in your own words. What potential sources of error may have affected your results? What did you learn? If you had any difficulties with this experiment, explain briefly. Show the accuracy of a key result with either percent error or percent difference:

$$\%Error = \left[\frac{v_{\text{exp}} - v_{\text{theo}}}{v_{\text{theo}}} \right] \times 100\%$$

$$\%Diff = \left| \frac{x_1 - x_2}{(x_1 + x_2) / 2} \right| \times 100\%$$

Percent error is useful when you have found an experimental value for a known constant (such as gravity). In that equation, v_{exp} is the experimental value you found and v_{theo} is the theoretical value you expected to find. Percent difference is useful if you are comparing two experimental values (Ex. two experimental methods used to solve for the spring constant). (Source: http://en.wikipedia.org/wiki/Percent_difference)

- **Conclusion:** Briefly summarize *entire lab including all experiments*. First, summarize the objectives, methods, and key results of each experiment distinctly. Then, summarize your discussions from the analysis section(s) (sources of error, difficulties, etc). You may wish to also answer these questions: Did any of your results deviate from your expectations? What was most challenging about the lab? What would you do to improve this lab? Do not include data tables or graphs in this section and do not introduce relevant results or analysis of data that has not already been stated in previous sections.

4. Areas on which you will be graded:

- **Professionalism:** A professional report is well organized and easy to follow, all sections are in order and clearly identifiable. There are no spelling or grammatical errors, language is scientific, and thoughts are clear. Formatting is consistent throughout the document and you have made effective use of tables and graphs.
- **Content:** All required sections of the lab are included. The abstract summarizes the objectives, methods, and key results in a clear and concise way. The Introduction and Data Collection sections are well-developed and include: an introduction to each experiment, clearly stated objectives, an equipment list or description of the setup, a summary of the experimental methods, and answers to any preliminary questions from the lab packet written in paragraph form.
- **Results:** Results are complete and match team members' results. Excellent use of figures, charts, and/or tables. All figures, charts, and tables are properly labeled and formatted, easy to read and interpret, with meaningful titles and captions. Raw data used for graphs is not shown. In some instances, results offer additional information above that required.
- **Analysis & Conclusion:** Each analysis section completely summarizes results including any relevant calculations, thoroughly discuss of sources of error and includes error calculations. Answers to analysis questions from the lab packet are written in paragraph form. The conclusion summarizes the entire report including the objectives, methods, and key results of each experiment clearly and distinctly. It also discusses disagreements between theoretical predictions and experimental results clearly. Concluding remarks demonstrate a solid understanding of the lab.

- **Lab Behavior:** During lab, group showed effective teamwork and all members had an equal level of participation (if you worked in a group). All equipment was put away in its proper place and your lab station was cleaned. In your lab report team members' names are listed on the front or top of the report (first and last, spelled correctly) and the roles of each team member is clearly described somewhere in your report (typically the methods section(s)).

5. Tips

- Make use of peer review! Oregon Tech has a service through the Peer Consulting Center called the Online Writing Lab (OWL) found at this link: <http://www.dropitto.me/peerconsulting>. The password to log in is: OWL. Please allow 36 hours turn-around time to get feedback on your paper.
- During lab: take good notes of your methods, calculations, issues with data collection, results, discussion points with your team, team member names (first and last) and their contributions. Also, be sure that all equipment has been put away in its proper place and your lab station is clean. Be sure to save all necessary data.
- Proofread your report for spelling, grammatical errors, and poor sentence structure. RUN SPELL-CHECK!
- Use scientific/professional language – avoid slang or colloquialisms.
- Avoid using subjective measures to evaluate results (e.g. “These results agree very well with our prediction”). Provide objective measures instead (e.g. “The maximum percent error between the experimental results and the theoretical predictions was 0.5%”).
- Lab reports do not need to be long – be concise (this is a skill that takes practice!)
- Tables and graphs should be easy to read, accurate, and well labeled. Only the relevant data should be included – do not include raw data of what is plotted. If you performed the same data collection 3 times, only include 1 representative graph. Introduce your data before presenting it.
- If you need help editing graphs in LoggerPro or plotting in Excel, let your instructor know early!
- The Lab Report Grading Rubric will include my comments – please read these to avoid repeat mistakes.

6. Lab Report Outline

The following is an outline of how your report might look. For a lab with two experiments, this shows exactly how many sections you need to have, how to title each section, and what should be in each section. You may wish to have more content/sections than what is shown, but at a minimum, you need to have these. I do not require IEEE format as long as the required sections and content described in this document are included.

Name (First & Last)

OIT ID#

Team Members' Names (First & Last)

Lab # and Name

Lab Title

Abstract:

Summary of the overall theme of the lab, summary of the objectives of each experiment, brief description of methods, expected outcomes, and brief summary of key results.

Experiment 1: (experiment name)

Introduction and Data Collection:

- Introduction
- Hypothesis
- Methods
- Results

Analysis:

- Answer Analysis questions from lab
- Compare results to hypothesis and, if applicable, show relevant calculations, graphs showing further analysis of data, % error, or % difference.
- Discussion: challenges performing experiment, sources of error, etc.

Experiment 2: (experiment name)

Introduction and Data Collection:

- Introduction
- Hypothesis
- Methods
- Results

Analysis:

- Answer Analysis questions from lab
- Compare results to hypothesis and, if applicable, show relevant calculations, graphs showing further analysis of data, % error, or % difference.
- Discussion: challenges performing experiment, sources of error, etc.

Conclusion:

Summary of the overall theme of the lab, summary of the objectives of each experiment, brief description of methods, expected outcomes, brief summary of key results, sources of error, challenges encountered, lessons learned, ways to

improve experiment, etc. This is very similar to your abstract but should not be identical.