

How to Write Physics Lab Reports

There are three questions to keep in mind when writing lab reports.

1. Could your friend (or your boss) read the report and understand exactly what you did?
2. Could you read the report a month later and repeat the experiment and get the same results?
3. Could another scientist read the abstract and immediately decide whether to take the time to read the full report? Every scientific article published has an abstract immediately under the title and author on the first page!

A full lab report consists of six essential parts as discussed below:

- 1. Title Page/Abstract**
- 2. Purpose and Theory**
- 3. Procedure and Apparatus**
- 4. Raw Data & Graphs**
- 5. Calculations & Error Analysis**
- 6. Results & Conclusions**

You may vary the exact number of parts or title of each part. It may be appropriate to combine some parts together. However, the information in the parts must be included in your lab!

I. Title Page/Abstract: The first and front page includes your name, lab partner name, date, title and number of lab, your section # and the abstract. The abstract is a concise, one-paragraph (100-200 words) summary of the purpose, methods, and significant results of the experiment. It is a "lab report in miniature" and appears at the top of the first page. The abstract contains three things:

What you did means what you measured, including a very brief description of the apparatus. How you did it, means the experimental procedures used, including the type of equipment. Results mean the final numerical results including units and errors. **Write the abstract only after the rest of the report is written.**

2. Purpose & Theory: The purpose is what you're trying to do. The theory is a brief statement of the important equations and what you have to measure. It may include deriving your theoretical result from your experimental set up. If so, include a diagram that is labeled with the same variables you use in your equations and derivations. Be sure to label all diagrams and figures and refer to them in your report (e.g. 'figure 2', etc)

3. Procedure and Apparatus: The procedure spells out the experimental steps you do in the lab. Do not copy the instructions verbatim. The procedure is a record of what you actually did. Some of these steps may not be in the write up! The apparatus states the actual equipment you used including the type and model number of the equipment. A block diagram of all the equipment is essential. You may copy and paste images from the lab write-up into your lab report.

4. Data: Raw Data and Graphs "Raw" data means the data taken in the lab, not something you calculated later. The raw data is critical because it allows the curious reader to calculate the results independently. You want to make sure that the data you took during the experiment is neat and readable, so you, or someone else, can make sense of it later. Data must be taken in tables with all the columns labeled, units given, and estimated errors. **Be sure to include a column with your error for each measurement!** Each graph must be titled, dated, and the axes labeled. You may share your raw data and graphs with your lab partners. All other parts of the lab must be your own.

5. Calculations & Error Analysis: The calculations take you from the data to the final result. It is important that you calculate your result before leaving lab in order to make sure your data is good. The lab instructor must sign off on your data and calculation sheet before you leave lab. For your lab report, if many similar calculations are involved, just include one sample calculation in detail but put all your calculations in a table, along with the error. If your final result is an average value, say so. Express your final results in standard form with units and error in absolute or fractional form. Box your final results.

$$A = 210 \text{ cm}^2 \pm 4 \text{ cm}^2$$

If you are calculating a result that is to be compared with a theoretical or given value, you must calculate the percent error between your experimental (calculated) value and the theoretical (accepted) value:

Percent error = [(accepted value - your value) ÷ accepted value] x 100%

VI. Results & Conclusions: Here is where you discuss your results in terms of discrepancy, error and percent error. Is the acceptable value within your experimental uncertainty? Here is where you also analyze the factors that influenced your results and how you might improve them.

Here are some things to avoid - things that will definitely "cost you" in terms of your grade: You will lose points if your conclusions do not follow logically from your results. Do not say something just because that is what the textbook says.

- You will lose points if you do not remark about remarkable results, and attempt to analyze their cause. For instance, if your lab record says "We measured the free-fall acceleration, g , in the classroom to be 468 m/s^2 ." without any further comment, you are "toast".
- You will lose points if you use the word "prove" or "disprove" in any of its forms. Proof is a mathematical notion, and you haven't done it. There is no absolute truth in science. Your results may "support" or "not support", some hypothesis, theory, or law, but you did not "prove" it. The words "verify" and "confirm" seem a little strong to me, but they are OK.
- You will lose points if you merely speculate about sources of experimental error. Statements like "Friction may have caused a discrepancy in the results" need to be supported with data, or at least some plausible theoretical mechanism.
- You will SO lose points if you use the words "human error". Your instructor will read this phrase as "I don't care enough about this experiment to actually think about what is going on in it, so please butcher my lab grade."
- You will SO lose points if you say something like "there may have been a calculation error". Your instructor will read this phrase as "I really don't care enough about this experiment to go back and check my work, so please butcher my lab grade."