

Physics 8 Lab Report Guidelines

Who is the audience?

Write for a (fictitious) fellow Physics 8 student who has not done this lab or read the lab handout. You may assume knowledge of the material that has been studied in or prior to Physics 8 (*i.e.*, you don't need to explain what a capacitor is) **except** that in the theory section you do need to explicitly derive the key theoretical results to which you are going to compare your data, even if those same results have already been derived in class. For example, if you are writing about the standard *RLC* lab, you should derive the current in the driven *RLC* as a function of frequency, the expression for the FWHM of the resonance curve, and the phase as a function of frequency in your report; for the freely oscillating circuit, you should derive the form of the voltage across the capacitor as a function of time. If you are doing a different set of measurements on a different circuit, you should derive the theoretical results to which you will compare your measured data.

General good practices for scientific writing

1. Follow AIP guidelines for "Before beginning to write".
2. To avoid unintentional plagiarism, keep your references (lab handout, Purcell, etc.) closed while you write, and provide proper references in your report. You are welcome and encouraged to discuss the ideas of the lab report with your lab partners or other members of the class, but each of you should write your own lab report independently.
3. Use the active voice rather than the passive voice whenever possible.
4. Use consistent verb tenses throughout.
5. Be as specific as possible. For example, "the work done" is not very specific (unless context supplies what is missing); "the work done by the bow on the cart" is specific
6. Be concise. Shorter is almost always better except if it comes at the cost of clarity or specificity. Use diagrams whenever it is difficult to accurately describe something with words only.
7. All graphs and tables, and all numerical values reported in the body of the text, must have units.
8. Avoid repetition as much as possible while remaining clear. The abstract and conclusion should each summarize the rest of the report, but otherwise, there should be little repetition within the report.

Sections of the lab report:

1. *Abstract*: The abstract should be a very concise, one- or two- paragraph summary of the key ideas and results. It should focus on the purpose of the measurement, how it was accomplished, and what it found. It should not recount every detail of the experiment.
2. *Introduction*: The introduction provides context for the theory and experimental methods sections that come later. For example, if you were writing about the Thevenin's theorem lab, you would say something about how analyzing complicated networks of resistors and voltage sources is made simpler with Thevenin's theorem. The introduction should also provide a broad-brush summary of the experimental method being used, which will be elaborated on in the Experimental Methods section. The introduction is usually pretty short, and is likely to repeat some of the information that is in the abstract. It is nice to motivate why the experiment you are writing about is interesting, but don't stretch too far for this (don't try to make this sound like a cure for cancer or the next technological breakthrough).
3. *Theory*: In this section, derive the key theoretical results that will be compared to your measurements. Derivations should be at a level of detail similar to what's in textbooks; you don't need to show every step of algebra, but you should motivate how you get from one step to another. Mathematics should be interspersed with prose commentary in the same manner as in the lab handout and the textbook; explain the steps you take in the derivations and interpret the results.

Equations should be numbered and symbols used in them should be defined explicitly when introduced. If a diagram will help make your derivation clearer, as is almost always the case, include it. It is fine to hand-draw diagrams as long as they are clear and neat.

4. *Experimental methods*: Give a detailed description of the method you used to measure your data. This section **must** include a diagram of the experimental apparatus unless it is identical to a diagram you used in the theory section, in which case you can refer back to it. If you refer back to a diagram in the theory section, you must indicate what equipment was used for idealized things (i.e. “A function generator served as the ac voltage source”). You should describe what you actually did: “We measured the voltage across the capacitor on channel 1 of an oscilloscope and simultaneously measured the voltage across the function generator with channel 2. To find the amplitudes of these voltages, we used the “Measure” function of the oscilloscope. We then used the “Math” menu on the oscilloscope to calculate the voltage across the resistor as the difference between channel 2 and channel 1, and used the cursors to determine the amplitude of the voltage across the resistor.” (You could use symbols for these voltages, i.e. V_C and V_R , if you previously defined them in the theory section.) Your methods section and results section together should convince your reader that you have used sound scientific methods, and you have guarded against inadvertent sources of error.
5. *Results*: Here you provide your measured data as graphs or tables and narrate the results in the main text (“Figure 5 shows the force on the cart (measured with the force probe) vs. the acceleration of the cart (measured with the motion detector. These data represent the average of many (25 – 75) data points measured while the cart was undergoing steady acceleration; the error bars represent the standard error of each average.”). This section will most likely be a sequence of descriptions of tables and figures, held together by text explaining how and/or why you went from one measurement to the next. Again, look at the textbook or the lab handout for examples. Provide captions for all graphs and tables; captions are somewhat redundant with the labels and the main text. The conventional distinction between “Results” and “Discussion” is that data are presented in the “Results” section and analyzed in the “Discussion” section. That said, you can use some judgment for exactly where to draw the line between “data” and “analysis.” Is the resonance frequency identified as the peak of the graph of current amplitude vs frequency “data” or “analysis”? Hard to say. If you have identified the resonance frequency by means of a curve fit, is that “data” or “analysis”? It’s easier to identify that as analysis. Conventionally, least count-type uncertainties and error bars in the data belong here; uncertainties coming from curve fits belong in the next section. It is less important that particular elements of your report are presented in a particular section than that the report has coherence and logic to its overall presentation, and that it is complete. Feel free to ask if you’re unsure where something goes.
6. *Discussion*: Here you analyze your data, compare your results to the theory, and comment on agreement or lack thereof within the bounds of your uncertainties. When there is disagreement, you should comment on possible sources of the discrepancy. If you felt that the method used to find the data was inadequate to obtain good results, it is great to suggest an improved way to obtain the data, but it should be clear in your report why this alternate method is likely to solve the problems.
7. *Conclusion*: This will almost certainly repeat a lot of what is in your abstract (often it’s good practice to write the conclusion next-to-last and the abstract last, when writing your report). Be quantitative and concise. This section should focus on the core result and not on minor issues.
8. *References*: Provide references for everything you consulted in writing the lab report. Probably this will just be your lab handout, your textbook and one or two books you consulted.

For further guidance, consult American Institute of Physics (AIP) Style Manual. The entire manual or sections may be downloaded from <http://www.aip.org/pubservs/style/4thed/toc.html>