

How to Write a Lab Report

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One may think that the work of a scientist is done after the experiment is completed, and its results are analyzed. This is not true! Any research finding have to be communicated to the scientific community and make its contribution to the common knowledge “database”. Therefore, learning how to communicate the results of your experiments to others is a very important skill.

In science the most common way to inform the world about your work is to write a paper in a scientific journal. A good paper introduce the readers the original research goal and its significance, describes the experimental methods used, presents the results and analyze how they fit into the known physical picture, and draw conclusions. All important information must be included in the paper: ideally, any person knowledgeable in the field should be able reproduce the experiment and obtain similar results.

A lab report serves similar purpose, but for more limited audience (you course instructors and possible your classmates). It is important that you learn how to communicate your findings. In you report you have to clearly and concisely communicate the purpose, the methods and the results of your experiments.

The format for a lab report you need to follow is similar to a scientific paper in a journal. Your lab report must include the following parts.

- **Title of the experiment.**
- **Authors list.** The person writing the report must be listed first; the name of all people participating in the experiments are listed afterwards. This is a traditional practice in a research publications.
- **Abstract.** Abstract is a very short summary of your report. The challenge is to describe what experiment you were doing and what are the important conclusions in less than 100 words.
- **Theory and significant equations.** Give a brief summary of theoretical background and the list of equations you will need for the data analysis. In a regular scientific publications this is usually a significant part of the paper, and usually includes a review of the relevant publications. However, for a lab report it is ok to keep it very brief.
- **Error analysis.** In this section please list the equations and methods for figuring out the uncertainties for different measured and calculated experimental values. Also list any found and suspected systematic errors.
- **Experimental setup and procedures.** Sketch the experimental apparatus. Don't forget to label all the used equipment! Briefly describe the important steps taken to produce the data, and explain what variables are being measured. In this section you may also give values of experimental parameters which do not change in the course of the experiment (such as room temperature or laser wavelength).
- **Data and the data analysis.** Provide the results of your measurements and data analysis in a form of a table(tables) and graphs. Carry out explicit “sample” calculation (including calculations of an uncertainty) to show how the results are obtained from the measured data points. Also, if anything strange or unexpected happened during the experiment you should mentioned it.
- **Conclusions.** Give a brief summary of main experimental results and draw conclusions. If your results disagree with theoretical predictions or accepted value, explain possible sources of disagreement.
- **References.** This section is optional. But if you have used any external sources during lab preparation or the data analysis, you should add a reference to them.

This sectioning is only approximate. Sections can be merged, dropped or broken into subsection depending on the particular experiment, as long as all the points mentioned above are addressed.

You should turn in a **hard** copy of your lab report, but you are strongly encouraged to prepare your report electronically. While journal publisher expand the range of acceptable formats for paper submissions, most physicists (and other scientists who type a lot of equations) prefer LaTeX. A report template in Latex is available on the course web-site. *Warning:* your first couple experiences with LaTeX may not be very satisfactory - in fact, you may be very frustrated! But once you get familiar with the system, you will find it quite pleasant to work with. Also, try to find an editor you are comfortable with - for example, WinEdt(<http://www.winedt.com/>) is very easy to use. This is a shareware program and comes with 30 day free trial.

Similarly, all the graphs should be done electronically. The default data analysis software for this course is Igor Pro from Wavemetrics. Additional instructions will be available from the instructor. However, if you would like to use a different software (Matlab, for example, or xmgrace for Linux), you can do so *after you receive instructor's permission*. Before you ask, however, make sure that this software can:

1. produce a readable graph with normal axes, axes labels and legend (if needed);
2. plot data points with error bars;
3. fit the plotted data and returns fit parameters with experimental uncertainties.

Please don't forged: while you are encouraged to do the experimental preparation, the data taking and the data analysis as a team, the lab report is an individual task. Copying any part of someone else's report is considered plagiarism. This also violates the Honor code, and will be reported to the Honor council.

Grade points assignment

- *Abstract:* 10 pt - Concise; describes purpose, method and main results in 3-5 sentences.
- *Theory/Significant equations:* 5 pt - Brief history, theory behind method and analysis of experiment, major equations.
- *Error Analysis* 10 pt - describes what errors were introduced, how they were treated, how you will determine the error on your calculated values (include only the equations you will use in terms of the variables particular for each experiment).
- *Set-up/Procedure:* 10 pt - describe set-up and procedure, include a diagram and/or pictures of the set-up.
- *Data and Analysis:* 20 pts - include data, your manipulation of the data, describe the data and why you manipulated it a certain way, include the major values you found (in text) and analyze what it all means.
- *Conclusion:* 15 pts - restate purpose, results, meaning, remark about errors, anything else of interest. Concise but thorough.
- *Format:* 10 pt - equations are formatted correctly, pages are in order, ordering of information is logical, numbers in text have correct units.
- *Graphs/Tables:* 10 pt - graphs/tables/diagrams are labeled, graphs are correct, all have correct units, all are readable.
- *Lab Journal:* 10 pt - Lab journal pages are attached, all the experimental records are readable, all relevant data are included.