SPH **Writing a Formal Lab Report**

The goal of a lab report (in whatever format) is to document your findings and communicate their significance. When reporting experimental results in physics, your formal lab report should say exactly what you did, exactly how you did it, and exactly what you found. The report should be easy to read, accurate, and most importantly, should answer the question asked *with good evidence*.

A good lab report does more than present data; it demonstrates the writer's comprehension of the concepts behind the data. Merely recording the expected and observed results is not sufficient; you should also identify how and why differences occurred, explain how they affected your experiment, and show your understanding of the principles the experiment was designed to examine. Bear in mind that a format, however helpful, cannot replace clear thinking and organized writing. You still need to organize your ideas carefully and express them coherently.

There are several major sections to a formal written lab report (* means required).

Title page (you will put a copy of the title page in your lab book)

***Title**: The title states clearly what the experiment is about in no more than 10 words. No cute titles. If indicated, it should state clearly both the independent and dependent variables, without stating what the effect actually is.

***Abstract:** In a few sentences, summarize the experiment, including a statement of the problem, the procedure, the main results – including numbers and error – and the conclusions. See *Writing an Abstract*.

***Names and dates**: In the lower right-hand corner, list the date of the experiment, the date the report is submitted, the names of the experimenters (both first and last names, with yours first and the rest of your partners in descending alphabetical order), the name of the course, and the name of the teacher.

Statement of the Problem

***Purpose:** Briefly outline the problem to be solved or the question to be answered. Occasionally, more background is called for. If so, summarize it and cite relevant literature if appropriate.

Hypothesis: The hypothesis predicts the influence of the independent variable(s) on the dependent variable(s). If the purpose of the experiment is to discover a value, omit the hypothesis.

Experimental Design

***Materials and setup:** List all the equipment you used to carry out the experiment and how it was arranged. A diagram or picture is usually required in this section.

***Method:** Outline what steps you took to gather data. Write in the past tense – you are telling the reader what you already did. The steps should be clear and detailed enough for another person to duplicate your method and get the same results. If you are following a textbook procedure, don't copy it word for word; instead, refer to it: "The method followed was the same as in Investigation 10.3, pp. 297-298 in [3]." Note any deviations from the reference method.

NOTE: You are *not* writing a list of instructions or a recipe. Do not give orders.

BAD: "1. Place a 20 g mass on the spring and record the force. 2. Continue adding masses in 20-g increments and measure the force each time."

GOOD: "We placed masses on the spring in 20-g increments, measuring the force after each increase."

Data Collection, Display, and Analysis

***Data:** Make a distinction between the raw data you collect and any calculations you do. Keep them separate. All your labeled data tables and graphs should be placed first.

***Analysis:** Use your experimental results to arrive at a final answer. This is where you do any necessary calculations, including numerical error analysis. If there are multiple sets of calculations to be done, do one sample calculation clearly, and omit the rest for brevity. Tell the reader what you are doing and explain why you are doing it: "The wavelength of the light was calculated using the formula $\lambda = \frac{\Delta y d}{x}$. A complete calculation is shown for trial 1." The analysis section should be a blend of math, tables, graphs, and English.

Conclusion(s) and Discussion

***Conclusion(s):** Clearly answer the question(s) asked in the purpose with the results of your analysis, including error. E.g.: "The acceleration due to gravity was found to be 9.76 ± 0.3 m/s^2. Our result was within 0.4% "

***Discussion:** You should evaluate your hypothesis clearly, if appropriate. Justify extrapolations from your data and any assumptions or simplifications you made. Talk about interesting things that you found, likely sources of error in your method, and possible improvements that could be made to the experiment. You should make connections to other studies or experiments if appropriate and make recommendations for further study. If your results seem to contradict accepted theory, now's your chance to discuss why.

NOTE: See *Writing Informal Lab Reports* for a discussion of analysis and error.

References: List *all* of the resources you used to write your report (a textbook should only be listed as a reference if you are using one of its experiments). APA style is preferred. List the resources alphabetically by author and number them in square brackets. For example:

[1] Hewitt, Paul G (1989) Conceptual Physics, 6th Ed., HarperCollins.

When citing a reference in the discussion, write its number in square brackets: "This is similar to the Heisenburg uncertainty principle [5]." See the method section for another example.

Formal reports will be submitted online using Google Docs. Graphs will be done using graphing software. Use equation typesetting to show your calculations. Your report should look polished and professional, not like something that was thrown together five minutes before class.

I will deduct marks for improper grammar, incorrect spelling, and punctuation mistakes. Do not rely entirely on spell-check; it doesn't distinguish between *their* and *there* or *it's* and *its*. Make sure all sentences make sense. I cannot and will not guess what a jumbled heap of words actually means.

Students will usually work in groups to collect data. However, each student will hand in their own report. While I don't object to students working through the analysis together, each student must do their own work and not copy from another member of the group. The purpose of writing a lab report is to learn how to analyse and discuss experiments. If you copy someone else's analysis, you are denying yourself that education. If you copy someone else's work, trust me, I'll know. This is plagiarism and it's serious business. Plagiarized work will result in a mark of zero for *everyone* involved.

Formal lab reports are due the week after the lab was performed. For example, if a lab was done on Tuesday, the report is due the following Tuesday.