Semester-End Tech Report

The technical report, in written format, is quite different from the lab summaries you prepare for other experiments. Your tech report should be in the style of a scientific research publication: a self-contained exposition of the question, the approach you took to answering it, and the results you obtained. The report should be understandable and convincing to an incoming Harvey Mudd freshman, without reference to the Physics 22 lab manual or to your lab notebook. The tech report is both a scientific investigation *and* a piece of writing; you will be required to submit at least one draft and go through at least one cycle of revision before turning in the final report.

Suggestions for writing the report:

→ Remember your audience, and make sure your paper is clear and compelling to a reader who is not familiar with the Physics 22 experiments. You might ask a friend who isn't in Physics 22 to read your draft and tell you what they think they learned from it.

→ The heart of a physics paper is the graph (or graphs) that summarize your principal results. Everything that appears in your paper before this figure leads up to the figure, and everything that appears after it discusses its significance. To lead up to your central figure, you must motivate your investigation (answer the "so what?" question), explain the approach you took in your investigation, and explain your setup and procedure in enough detail to clearly define all the data shown in the figure. To discuss the significance of your central figure, you must explain the logical or theoretical basis for your interpretation of the figure, interpret the figure (including uncertainties!) fairly, and suggest possible extensions and applications of your work.

→ Refer to the specific content guidelines on the next page.

→ Examine the sample scientific publications included in the handout, noting the particular features pointed out in side notes.

→ Reports should be submitted in typed, double-spaced format. A typical report is 4-6 pages long, plus figures, but content is more important than length.

→ *The tech report is expected to be self-contained, so that it does not refer to material that is only contained in the lab notebook.*

Specific content guidelines:
Except for the title and abstract, these are merely guidelines for the information your report should contain, NOT requirements for section headings within your report. Organize the main body of your report in any way that tells the story of your investigation clearly and logically.

*Title: Your report should begin with a *title* (one line, bold-face, centered).

*Abstract: Next comes a 3-6 sentence *abstract* saying what you set out to measure/investigate, what method you used, *and* what results you found. This is something like the thumbnail version of the rest of your report. After the abstract, start the text of the report itself; the main body should *not* refer back to the abstract.

*Intro/Motivation:

What question are you investigating for your tech report? Do not assume the reader is familiar with Physics 22 experiments already, so be sure you give sufficient context.

Why is this investigation interesting? (for example, a relationship to a technology? Discrepancies that many Ph22 students have seen and that you can explain? Other?)

What if any expectations and/or hypotheses did you have as you started the data-taking? Why?

*Theory and Methods:

Write this for a reader who *does not know* what you did in lab or what equipment you had available to you. This should be a logical exposition of what you did to obtain the final result, and *why* each step was important or relevant. Attention to detail is important.

Make sure all symbols are defined before you use them.

Carefully labeled drawings are very helpful. These can be integrated into text or included at the end and referred to by Figure #.

Present theoretical background for your investigation. You need not show each step of a derivation, but the starting points (including approximations and assumptions) should be clearly set up, and the final result should be prominently reported.

*Results/Discussion:

Make sure quantities are well defined. Units and errors are also important.

It is not necessary (or desirable!) to include all your raw data in the paper, but it should be clear how the raw data was processed to obtain the graphs shown. For example, how many trials contributed to each data point and error bar? How were important quantities measured?

Explain the source of any quoted uncertainty estimates (statistical variation, ruler precision, etc.)

Data should be analyzed (plotted, fitted, compared with theory, etc.) logically and understandably. Graphs should include titles, axis labels, units, and error bars. Fit formulas should correspond to appropriate theory. Data should be properly combined to give final answers that address the original question as far as possible. Uncertainties should be reasonably treated.

Clearly state comparisons to theory or to "known" values, and include source citations or derivations if necessary for the theory or known values. Statistical significance (or lack thereof) of result should be discussed.

*Conclusions:

What light do your data and analysis shed on the original question/hypothesis?

If there is a firm theoretical prediction, does the experiment agree with the theory? If so, with what precision can you confirm theory? If not, by how much is it off (relative to uncertainty)?

If the experiment was designed to measure an unknown quantity or effect, what is your result? How precise can you claim it is?

What are the major sources of systematic and random error in your experiment? What extensions/improvements suggest themselves if you had 1 or 2 more lab sessions?

Relevance of your work to future Physics 22 labs or to some other circumstance may be pointed out if appropriate.

*Cite references where appropriate: *e.g.*, lab manual? textbooks? other? Each reference should be cited at one or more particular points in the body of your paper. (See the sample scientific articles for examples.)