# PH121 Lab Report Guidelines

Lab reports are intended to provide a record of what you did and learned from that day's experiments. They should be completed as a group with full participation by all members.

Your paper should report a synthesis of your work, not simply a sequential list of what was done! Indeed, an important aspect of writing a scientific paper is concern for the audience. A general reader does not have the experimenters' perspective about what happened in the lab, so the authors must take pains to orient them and gently guide them through the paper. Ideas should be organized into manageable sections and introduced in a logical sequence that builds upon itself. When reviewing the text, ensure that any claims you make are supported and explain things as you envision your reader needing.

Organize your report into sections roughly as follows

- **Introduction:** What were you asked to study or what question were you asked to answer? Why? Include just enough context for you statements to make sense, but don't get too specific! Equations should be written using the *Equation Editor,* on a separate line, and centered. ***(~ minimum 1-page double spaced)***
- **Hypothesis/Prediction:** Explain clearly what your hypothesis/prediction is and why you think it is correct. ***Can be combined with Introduction.***
- **Procedure:** What was the experimental equipment used and setup? How did you do the experiment? What did you measure? What did you keep constant? How did you ensure accuracy and validity (many trials)? Be concise! ***(~ minimum 1/2-page double spaced)***
- **Results:** Graphs and tables. Graphs should be scatter plots with **no** automatic lines. Will often contain a line of best fit though. ***Include a description of what you are displaying. (~ minimum depends on the amount of data taken)***
- **Analysis:** What trends do you see in your data? Be sure this is supported by the data, not your opinion! Might include percent error/deviations. Include any insights as to why what the data is implying makes sense. Equations should be written using the *Equation Editor,* on a separate line, and centered. ***Can and sometimes should be combined with Results.***
- **Conclusion:** Your goal is a narrative explanation of what you learned from what you did. You want to construct a synthesis, not a catalog, so what are the big takeaway lessons you're learning? Describe how the physical laws explain the trends you observe in the data. For example, under these circumstances, this happens, and as a certain parameter changes, the output changes in this way, and the physical reason is.... And so forth. ***Usually you repeat your hypothesis/prediction, major findings from the results, and major sources of error.***
- **Final Statement:** Append a final statement affirming that all members contributed significantly to writing the report and that each has read the final document. If any of your lab partners is shirking their responsibilities, please discuss this with your instructor in private.

**Some other general guidelines**:

- Use 11 or 12-point font and double space throughout. Typical lengths or good reports average around 10 pages with 2-3 pages of figures, graphs, and tables. However, this is only an average, some labs may take a little more while others a little less.
- Be sure to collect plenty of data. There is no set rule on how much is needed, but once the experimental setup is in place, it's usually easy to collect a lot of data. Selecting how much data you need is an important part of your experimental design, so consider that carefully as a group. Moreover, the range of variables tested should be sufficiently large to distinguish between a linear relation and any other power.
- Conclusions about the experiment should be supported by quantitative statements about the data (e.g., the cart's acceleration was 0.234 $m/s^2$), not just qualitative observations (e.g., the cart started moving faster). Conclusions must be statistically meaningful and well supported, e.g., phrases like "will always" are much too absolute and precise.
- Data should always be reported with proper units and appropriate significant digits**.**
- Collect data to the highest precision available with your equipment. Report all measurements to that same degree, including appropriate trailing zeros, e.g, "3.45, 3.28, and 3.00."
- Start with fundamental equations and derive ones applicable to the situation at hand. While you need not show every algebraic step in the derivation, the final version should be manipulated into a compact form. For example, fractions should not contain further fractions in the numerator or denominator, while multiple algebraic factors should be brought together and simplified if possible.
- Leave quantities in algebraic form during your derivation rather than substituting in numerical ones. For example, $a_g$ should not immediately be replaced with 9.8 $m/s^2$.
- Consider the implications of a curve fit to your data beyond the range that you've examined. For example, does the y-intercept imply something about what the experiment would show in some limit? If so, is it reasonable? If not, reconsider the kind of curve fit used.
- Data and theory never agree perfectly, and identifying sources of error is part of your analysis. Try to quantify any proposed source of error and relate it to whatever discrepancy you wish to explain.

**Formatting**

- Figures and graphs should be labeled sequentially for reference in the text and should appear after the paragraph in which they are introduced. Both should be adjusted to fit within the page width.
- Symbols and coordinates should be identified before they are used. Identify all symbols near where they first appear in an equation.
- Equations should be set apart on a line by themselves, centered, and numbered sequentially with a parenthetical digit aligned to the far right margin. Cite those equations later in the text by number as needed, e.g., "…as shown in equation (3)…."
- Use subscripts on variables to distinguish different ones, e.g.,

$$\alpha_1 \times r_1 = \alpha_2 \times r_2$$

- Variables should be italicized unless they are Greek letters, e.g., "…the initial linear velocity $v_o$ and the initial angular velocity $\omega_o$ are related by…,"
- Words belong in sentences, symbols belong in equations, i.e., do not rely extensively on using symbols as shorthand within the text. Instead, express them in terms of what they mean and what you want them to convey. For example, a phrase such as:

  "Here $v_{ox} = v_o$ because $\theta = 0°$"

  is better expressed as something like:

  "Here, the initial speed is entirely horizontal because the gun is level."
- Include correct units on all numerical quantities, ***abbreviated appropriately***.
- Include a leading zero on all values less than zero, e.g., write 0.42 rather than .42.
- For extensive amounts of data, one need not list all the actual numerical values obtained within the paper itself, but one typically graphs them alongside the predictions. However, you may include the data in an appendix.