Tips for Lab Reports

Chloe Gingras

Version 1.1 — January 2022

Expanded and adapted from Thomas Brunner's marking scheme and Jack Sankey's project report guidelines, both from W21.

NOTE: If you did well on Lab 6 in PHYS257, keep doing what you're doing. This is mainly intended for those who weren't happy with their grade. Either way, the grading scheme remains the main checklist.

DISCLAIMER I: Some, *but not all*, of these tips are generic, i.e. the vast majority of profs/TAs will agree with them. I've tried to delineate clearly between widely accepted methods (which are always good) and my personal opinion (which will be helpful in your first lab report because *I*'m grading it).

DISCLAIMER II: What Prof. Cooke says supercedes what's written here. If you find inconsistencies, feel free to email me and update this document.

1 Notes on some of the report's sections

Introduction

- I recommend a length between a few sentences and half a page, unless your Intro includes the Theory section, in which case a page is fine.
- In my opinion, one sentence on the scientific history behind this lab is enough.

Theory

- Can be absorbed in the Intro or the Methods section if that works best.
- I find that reproducing derivations from the lab manual in the Theory section is mostly wasted effort. For Lab 1, just state the conclusions from those derivations.

Methods

In the Methods, we expect to see a sketch of the experimental setup. For Lab 1, make your own. For Lab 1, write as if you'd gathered the data yourselves.

Results

Usually somewhere between half a page and a page. Figures and/or tables expected.

Discussion

If possible, should be the longest part of the report. Don't repeat your results or, worse, give *new* results in this section.

Conclusion

Generally half a page or less.

Appendices

Use **sparingly**. No need for code or calculation examples, unless they're brought up in the main body of the report.

2 Notes on the grading scheme

Title

- Be specific: don't title your report "Lab 1" or "Ratio of Specific Heats".
- Common structures include stating the end goal + the method(s) + success or failure; subtitles may be used if the title exceeds 20ish words, but try to contain your enthusiasm.
- Capitalize properly.

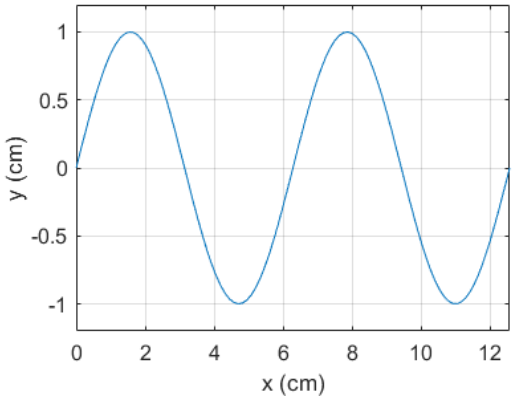
Abstract

- One structure I find works well:
  - One sentence on what was done
    - Mention the method(s) or the experiment here if they have names, but don't elaborate further.
  - A couple sentences on key results. When giving numbers, include error and units.
  - (Optional) One or two sentences on general conclusions and/or agreement with theory and/or key thoughts
- Generally, try to stick to one paragraph.
- Generally, no equations in this section.

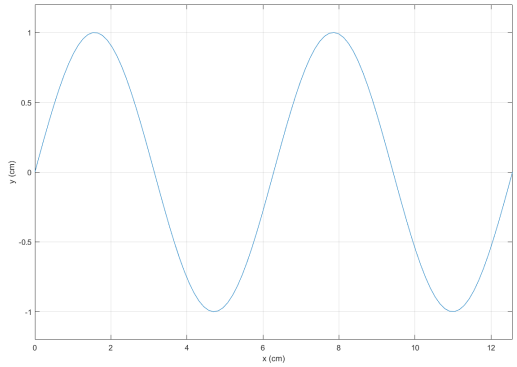
Figures

Use the grading scheme as a checklist.

- For axis labels, use previously introduced symbols, e.g., "A (m)" rather than "Amplitude (m)."
- Here's why we don't put units on a logarithmic axis.
- Minimize whitespace in and around figures. A method I've used to ensure good proportions and legibility is to save the figure as small; see Fig. 1 as an example.
- In my experience, trying to manage figure location in LaTeX needlessly frustrating and time-consuming.
- Wrapfigs are accepted, and indeed recommended.
- Beyond that, a good figure:
  - Has panel identifiers (a), (b), (c), ... (inserted, preferably, in LaTeX) for multiple panels.
  - Includes only what is important to the discussion.
  - Has a caption that is a self-contained description of the figure, including (from Sankey's guidelines):



(a) This figure was saved small.



(b) This figure was saved large.

Figure 1: Comparison of figure legibility and proportions. Both figures depict $y = \sin(x)$, both were made using the same code and default settings, and they occupy the same space, but 1a looks noticeably better than 1b. Also, note that these figures don't have a title above the image: with the caption, they don't need one.

    - A caption title, e.g., "Apparatus for measuring pants."
    - Panel descriptions, highlighting all features of the panel, e.g.:

      (a) Dependence of raw conductivity σ on temperature T for Ge (blue curve), Cu (green) and Si (red) samples. Thermometer was positioned at point B in Fig. 1(c), and heat was applied with torch C in Fig. 1(b). [Optional] The pants peak neat $T = 320$K is visible above background only for the Ge sample, suggesting pants.

  - Captions should themselves represent a complete story for an expert in the field. The main text provides sufficient information with a story-like flow for someone new to the field.

- If the figure has a proper caption, it doesn't also need a title at the top. See Fig. 1 again.

Equations

- Mistakes I commonly see regarding punctuation:
  - Omitting from the equation the period or the comma that the sentence may require
  - Capitalising the first word after the equation when the sentence continues

  Here's a correct example.

  > Werner Heisenberg framed the inherent fuzziness of the physical world when he demonstrated the first formulation of the uncertainty principle,
  >
  > $$\Delta x_i \Delta p_i \geq \frac{1}{2}\hbar, \tag{1}$$
  >
  > where the position x and the momentum p are measured along the same axis i [3].

- Less than one equation is too few, but if you throw in all the equations from the lab manual just to be safe, you'll lose points when most of them don't help presentation.

- In my opinion, don't overthink it: just write the 2-4 most obvious/useful/high-level equations. (At least, that's an appropriate number for Lab 1.)

- If you can later say, "Eq. (3) was used to fit the data," you should probably include Eq. (3) in an earlier section. If you can't say that but you find the equation important enough to mention, consider leaving it unnumbered, or even leaving it in the text (in decreasing order of importance).

Text

- Use the symbol instead of spelling out the symbol: write "when σ increases, so does τ" rather than "when sigma increases, so does tau." And use the correct symbol: O's aren't zeros.
- Chemical symbols are capitalised (Ar) but element names are not (argon).
- To write N_2 without italicising the N in LaTeX, write: `N$_2$`
- Units are not in italics.
- For things that were done (in the lab or the analysis), use past tense and use "we": say "we did this", not "we will do this" or, even worse, "this will be done."[1] For the rest, use present tense. E.g.: "We *used* [past] the instrument's precision in our uncertainty calculations. The resulting values *overlap* [present]."
- Avoid repeating values constantly by referring the reader to the table where values are presented. E.g., say: "Table 1 shows that $\gamma_1 < \gamma_2$" rather than "As stated above, $\gamma_1 = 1.25 \pm 0.15$ whereas $\gamma_2 = 0.75 \pm 0.12$. Therefore, γ_1 is greater than γ_2." (Easier to write, easier to read, space-efficient.)
- Don't tell the reader that something should be obvious to them: avoid words like "clearly", "obviously", etc. It reads like an apology, whereas it's okay to point out obvious features.

Some generic but excellent advice from Jack Sankey:

> All panels of all figures must be discussed, in order, in the main text, and, conversely, all data mentioned in the main text should have at least a "typical" example shown in a figure (at least in an appendix if it is not central to the story). Basically, if you show it, talk about it. If you talk about it, show it.

References

- Provisionally, I'll apply last year's guidelines to Lab 1:
  - Wikipedia and the provided lab book are **accepted** references.
  - The lab manual is **not** an accepted reference.
- Cite everything you didn't come up with yourselves, including equations and figures.

Lab Book

- **Required for online labs** even though you're not taking the data yourselves. Use the provided lab book as inspiration; add, condense, expand, or remove as you see fit.
- Emphasize experimental procedure, not your at-home analysis. Code does **not** count as a lab book.
- Potentially relevant (mix and match and tailor to each lab):
  - Precisions on equipment (name, number...)

[1] In my experience, many French-language style guides forbid the use of "we" and encourage the use of passive sentences like "this was done." In English, embrace the "we."

  - Summary of experimental steps
  - Ideas for causes of experimental error
  - Comments on how data file precision affects your uncertainties
  - Answers to questions posed in the experiment video posted on myCourses, if any
  - ...

- Sketches and bullet points welcome. (You can reuse sketches from the lab book to show the experimental setup in the Methods section, for instance.)
- I expect $\sim 1 \pm 0.5$ pages when typed.
- If you write it by hand, make sure that your handwriting is legible and that the scan/picture has high contrast.

Bonus

Although you won't be penalized if you don't (yet), I highly recommend using LaTeX immediately. First, Overleaf is a much better collaboration platform than Word. Second, the template will prevent you from making basic mistakes like forgetting page numbers and figure captions. Third, if you're not comfortable with LaTeX now, imagine being forced to use it for Lab 3 when you'll be much busier. Make use of the extra time you don't have to spend in the lab this week.

3 Miscellaneous and nitpicks

- If you enter multiple submissions, please comment to let me know which one to grade.
- For the sake of simplicity, unless you have a reason for deviating from it, try to follow the order of the lab manual.
- Absolutely exclude tables containing large amounts of superfluous data – **even if they are intermediary results**. It's wasted effort.
- Avoid repetition: 5 pages is short enough.
- Human error during manipulations is a valid cause of error, but it isn't a scapegoat or a catch-all.
- If you use the LaTeX template, remember to change the header for every lab.
- Personally, I'm a big fan of the general guideline that round numbers up to ten should be spelled out, and numbers 11 and above should be in numerals. (You won't be marked on it, though.)

4 Useful links

- Overleaf's symbol table: how to type common symbols
- Examples of how to do subfigures and wrapfigs

Feel free to send me other pages you check often to help other students!