Laboratory Notebooks and Reports for Physics 338: Advanced Physics Lab

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This document describes the standards and procedures for keeping a lab notebook for Phys 338. It also describes the requirements for informal and formal lab reports.

I. LABORATORY NOTEBOOK

You are required to keep an accurate and complete log of your work in this course in a laboratory **notebook**. This notebook must contain all the information needed to analyze the experiment, as was the case in your introductory physics course.

A good lab notebook serves multiple purposes. Even before you start, it can help you organize your thoughts and set clear goals. As you perform the experiment, it gives you a structured place to record your observations. As you review your work and write up your results, a good notebook can help you identify problems and resolve discrepancies. If needed, the notebook will contain enough information for you (or someone else) to repeat the experiment.

A. Guidelines

- For most experiments, you will work individually, though you are encouraged to consult with each other and share findings and ideas.
- Each student should keep an individual lab notebook. If you are working in teams on an experiment, you may make one master copy and then make photocopies for everyone to share.
- The format of the notebook is entirely up to you. A bound notebook is traditional, but some students find an all-electronic logbook, such as https://www.labarchives.com/ to be more convenient. A collection of loose pages collected into a folder can work, but you have to be very careful to date and number the pages, and keep them all in order.

  In a professional setting, it is often necessary to look back at notes taken months or even years earlier.
- Enter the date and any names of collaborators for each experiment.
- Enter all your data *in ink* in your notebook. Do not record your data on loose scraps of paper that can get lost or thrown away. For data which is taken electronically, you do not need to make long printouts, but your notebook should contain enough information (e.g. filenames) so that you can find that electronic data.
- Include any sketches, diagrams, or schematics that help explain what you did.
- Note any instrument settings or readings necessary to repeat the experiment.
- When recording or tabulating data, be sure to include appropriate labels and units.

II. INFORMAL LAB REPORTS

For most experiments, you will submit a brief informal lab report by the date indicated on the schedule. The report should be typed, though diagrams and calculations may be handwritten, as long as they are legible. Every student must submit an individual lab report. You may certainly consult and collaborate with other students in the class, but the analysis and conclusions should be your own.

This report need not duplicate material in the original hand-out or in your text, but it should include the following:

- Introduction. Give a *brief* introduction both to the theory and experiment. Specific references to a text or the lab handout should be used instead of laborious copying. Be sure, however, to clearly state the main idea of the experiment and the basic technique to be used.
- Procedure. It is not necessary to discuss the procedure unless you make any modifications to the experiment.
- Data: Give a clear presentation of your data. Make sure there are clear labels. Include units. Include uncertainties, where applicable.
- Figures and Graphs: Include diagrams when helpful. For any graphs, make sure the graphs are legible. Include clear axes labels. All figures and graphs should have captions.
- Results and Discussion: You need not reproduce algebra steps, but be sure that enough information is given that another student in a course similar to Phys 338 could understand what you have done.
- Answers to any questions in the lab write-up.
- Any other interesting observations.

- Overall conclusion. Give a brief but clear statement of your results, including uncertainties.

Lab reports will be graded on a scale of 0-100. The key points you will be graded on are:

1. Evidence that you have identified and understood the key physical concepts involved in the experiment.
2. Quality of data taken—within the limits of the apparatus, this reflects the care with which you performed the experiment.
3. Analysis and interpretation of data.
4. Clarity and organization of your presentation.

III. FORMAL REPORTS

For the Iodine spectroscopy lab and for the Fourier project, you will submit formal reports in the style of a journal article. A journal article is normally highly structured in order to make it easier for readers to read and understand the work, and to place it in the appropriate context.

We will follow the guidelines for the *American Journal of Physics*. The general guidelines are available at https://www.aapt.org/Publications/AJP/Contributors/submissions_information.cfm. There are also specific links describing the manuscript format, https://www.aapt.org/Publications/AJP/Contributors/Formatting_the_manuscript.cfm and providing a sample template https://www.aapt.org/Publications/upload/SampleManuscript-2.zip.

A. Basic Structure

Your formal journal article should have the following sections. See https://www.aapt.org/Publications/AJP/Contributors/Formatting_the_manuscript.cfm for more details about what goes in the individual sections.

- Title.
- Authors and affiliations. List yourself first, and any lab partners next.
- Abstract.
- Introduction.
- Experimental section. Describe the apparatus and experimental procedures. Include diagrams when helpful.
- Results. For any graphs, make sure the graphs are legible. Include clear axes labels. All figures and graphs should have captions. Be sure to include estimates of your uncertainties.
- Conclusion.
- Appendices. (only if necessary)
- Acknowledgments (usually not needed in this course)
- Endnotes and Citations.

B. Peer Review

Before publication, most journal articles are subject to peer review. The article is sent to one or more (usually anonymous) referees who are asked to evaluate both the scientific merit of the work and its relevance to the mission of the journal. This review process is an essential part of the scientific enterprise. It can help catch errors and mistakes before publication. It can also help authors see how other experts in the field will read and interpret their work.

Usually, referees report back with questions about the work or with suggestions for improvement. They may point out aspects of a paper that were incomplete or hard to understand. The journal editor will then ask the author to consider the referee's comments.

If the author wishes to resubmit the paper, he or she must submit a revised version along with a cover letter explaining the choices made during the revisions. An author may disagree with a referee about a specific change, but must still defend that choice.

The American Journal of Physics referee guidelines are available at the journal web site. https://www.aapt.org/Publications/AJP/Reviewers/review_procedures.cfm These can also help you as an author understand the journal's expectations.

In this course, we will also use the peer review process. You will submit a draft of your iodine spectroscopy paper, and your work will be (anonymously) reviewed by two classmates using a detailed checklist. You will then receive the referee reports and revise your paper in light of them. You will then submit your revised report and include a cover letter explaining your choices of revisions.

IV. TYPESETTING TOOLS

Most journals accept manuscripts in LaTeX format. Some also accept Microsoft Word documents, provided that the author follows very careful guidelines for preparation.

In this course, you may use whatever tool you prefer, but I strongly encourage you to try LaTeX for both your informal and formal reports. You will likely find that

LaTeX is useful in any future scientific career. I will be happy to help you with any technical problems that may arise.

A. LaTeX

LaTeX is part of a freely available system for typesetting documents. It is designed to be particularly well-suited for documents with mathematics, but is used for general-purpose writing as well.

A good starting place is to look at the TeX User's Group (TUG) website: https://www.tug.org/begin.html. That includes links to download and install LaTeX, as well as links to various getting-started tutorials. There are also cloud-based versions, such as Overleaf https://www.overleaf.com, that many students have found convenient.

Once you have installed LaTeX(or registered for a free account at one of the online versions), you can download the *American Journal of Physics* sample document from https://www.aapt.org/Publications/upload/SampleManuscript-2.zip. That document is intended as both a tutorial and a template for you to use to write your own report. This document is also based on that template, and is available in our LaTeX example directory accessible through our Moodle site.

LaTeX will handle automatic numbering of figures, tables, and references. The AJP template shows how to use all of those features. LaTeX can also handle bibliographies with BibTeX, though AJP does not use BibTeX.

B. Microsoft Word or Google Documents

If you would rather use Microsoft Word or a similar tool, you may do so. You still want to make your final product look like the *American Journal of Physics* sample, but you'll have to do all the formatting manually.

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