Appendix I. Notebooks

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A. Introduction

You will need a notebook that generates duplicates of your notes. When you finish each lab period you must hand in these duplicates to your lab TA. In the past few semesters, the bookstore has stocked Roaring Spring® Paper Products item #77644 for this course. Buy this type of notebook if it is available; if it is not available, you may purchase another type of notebook as long as it is sewn-bound, produces duplicate copies, and has rulings that make it easy to draw graphs. If you are not sure how to use the notebook to produce duplicate copies, ask!

A laboratory notebook should be treated as a diary of your activities related to the lab. It should be possible for anyone with training similar to yours to read your notebook and reconstruct your experiment, see or locate your data, and follow your analysis of the data. Scientists and engineers frequently must refer to old notes to re-examine work they did months or years ago. They also have to pore over the notes of their predecessors. In some fields of study, where inventions and patent rights are a major concern, every page of a notebook must be signed and authenticated by the person in charge of the laboratory so that the notebook can be used as evidence if a legal dispute arises. Lab notebooks are serious business. While it's unlikely that your lab notebook for this course will be evidence in the Supreme Court, it is important that you master accepted practices and learn how to function as a professional.

Your notebook must be neat and include no loose sheets. Make notes and record data in ink. A ballpoint pen is required for the type 77644 notebook because soft tip pens won't produce clear copies. Include any equations that you use or derive for data analysis. If you want to insert a computer printout or figure, glue or staple it into the notebook. Draw quick, neat, sketches of the experimental setups and make brief comments on your procedures.

Making the notebook neat does **not** mean you should write everything on loose paper and then transcribe it more neatly into your lab notebook, eliminating mistakes. This is one of the worst things you can do. Even your mistakes should appear in the notebook, perhaps with a light line crossing them out and a notation near them referring to a later page for the correction.

Be sure to write your name, e-mail address, course and lab section number (*as in section #1A or #8B*) on the cover of your notebook. The first page of the notebook should have a *Table of Contents*. List all experiments in the Table of Contents with the notebook page number on which they begin. The table should take the following form:

Exp. #	Exp. Name	Pg.
1	DC-CIR	2
2A	EPF	8
...		

B. Categories

The information in the following categories must be recorded in your notebook. Except for the Header, the information doesn't have to be organized the way the following description is organized. Rather, you should record information in your note-

book as you work through the lab. It is possible, for example, that you may do analysis of some information before you acquire data from another part of your experiment or even set up that experiment.

Before you leave the lab, you must hand in a copy of your notes to your TA. ***Never tear the originals out of your lab notebook!*** (If you forgot to bring your notebook and used a "loaner," staple the originals into your notebook as soon as possible.) While these notes are the only part of your notebook that the TA will grade, it does not mean that nothing else goes into your notebook. Any analysis and thoughts about the lab that occur outside the laboratory should also be described in your notebook, even though these won't be graded.

B.1. Header

Start a new right-hand page with header information for each experiment. The header must include:

1. title of the experiment;
2. your name, your partner's name, the TA's name, and your signature. Your signature indicates that the work described is yours;
3. course, section number, date of the experiment, and station number (*on the computer monitor*).

List the experiment in the Table of Contents at the front of your notebook.

B.2. Apparatus

Describe your apparatus. If equipment is numbered, include the number. If the experiment is set up for you, make a sketch of the apparatus and connections. If it is not set up for you, you should make this sketch after you have set it up.

B.3. Lab Notes

Make brief but clear notes at every stage of the experiment. It is not necessary to write complete sentences in this section, as long as what you write is understandable to a third party (*and to you a week later*). Make notes on procedures used to make measurements or to record data and on any problems you encounter. The notes should state how each measurement is being made, what your estimates of the uncertainties in that measurement are, and how you made those estimates.

B.4. Data

When data were all taken by hand, it would all appear in the notebook. With so much data now stored on a computer, this principle has been relaxed. However it is still standard practice to record the names of all computer files and the part of the experiment to which they pertain. You might, for example, write that *"DC_CIRgsc2_1.opj refers to data taken for the filament set at 3 amperes and the accelerating potential at 300 V."* Record what variables are stored in the files, including their units. You might also write some small sample of the data in your notebook.

Estimates of uncertainties and justifications for those estimates must accompany measurements and must be written when the measurements are made and not later.

Partners share data in some experiments, but *each person* must record data and the names of computer files in ink in his or her own notebook soon after it is taken. Don't plan to transcribe them after you leave the lab.

B.5. Analysis

Equations, calculations and graphs should appear as you use them or create them. Explain your analysis procedures with brief comments. Computer calculations must be illustrated with sample equations.

Show details of the calculations. Write each equation neatly and substitute in the values of the variables directly below the equation. Show enough steps so that the process is clear to the reader.

B.6. Error Analysis

Refer to your estimates of the uncertainties in the measured quantities and decide which ones may be neglected. Refer to the equations you used to calculate each derived quantity and apply one of the error propagation methods to determine the effect of each significant uncertainty on the final calculated quantity. Show equations and details of the calculations. See Appendix V on *Uncertainties and Error Propagation* for further information.

B.7. Summary of Results

Summarize clearly and concisely your conclusions, successes and failures in the experiment. For example, suppose you measured the value of g and determined the uncertainty in that measurement. You might quote your result as

$$g = (9.98 \pm 0.06)\ \text{m/s}^2$$

and note that your result is within 2 standard deviations of the accepted value and is therefore satisfactory. *Don't forget units.*

C. Grading

Your notebook will not generally be read in great detail but rather will be examined to see if you are keeping proper notes. TAs may refer to your notes to clarify questions that arise while grading your papers and/or worksheets. You should not *plan* on this review while writing your papers; as described in Appendix II, papers are supposed to be self-contained documents.

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