The style of the Senior Physics Lab reports is that of a scientific journal paper. The main difference is that journal papers are about new research, whereas the lab report is about an established experiment that you conducted in the lab. Nevertheless, our intention is that you obtain some practice in the concise and accurate style of writing that scientists use. This is an essential skill for a science graduate.

New Report Style
Beginning 2009, Reports should be submitted in the format used for the Journal Physical Review Letters or PRL. This journal is considered the top specialized physics journal and it is fitting that Senior Physics students gain experience in preparing manuscripts suitable for publication in such a journal. Guidelines and examples are available from the journal website: http://prl.aps.org/. Reports should conform closely to these guidelines, making use of the templates available. Reports should include: A title, authorship, abstract, 4 figures, main text and references. The complete manuscript should amount to 4 pages. Slightly shorter manuscripts are permitted, but not exceeding 4 pages. An example Physical Review Letter is available from the Senior Physics webpage.

Report Preparation
Preparing reports should be done using the Latex software package. Although MS WORD and alternatives are acceptable, students are strongly encouraged to invest in learning to use Latex, available for free on all operating systems (http://www.latex-project.org/). With Latex installed, students should make use of the PRL template files available from: http://authors.aps.org/revtex4/.

Specific details about the style of Reports (journal submissions) is available from:
http://authors.aps.org/INFOAUTH/msprep.html

Make sure you remember to print your report and submit to the Student Support Office, rather than submit to PRL!

HELP
Preparing a report using unfamiliar software and template files is a difficult task! Although a challenge, it is important that you master these skills. They will be important to you in the future as you prepare scientific documents (an Honours thesis for instance).

If you are truly stuck, please contact David Reilly, rm 357 (reilly@physics.usyd.edu.au). It will be expected that students asking for help have made a significant attempt at getting Latex up and running.

General Guidelines for Preparing a Scientific Paper
The following is the general structure of a paper, but as you will find from browsing the published literature there are wide variations that depend on the content of the paper. Use the following as a basis from which to work but remember that it’s not a template. Your report should be understandable to a scientifically literate person (eg. another senior physics student) without referring to the lab manual.

Abstract
This is a paragraph at the beginning of a paper that summarises briefly the experiment, the main quantitative results and their implications. Authors of journal papers usually write the abstract after they have finished writing the paper. When conducting a literature search, it is the abstract that is accessible to everyone even when the whole paper is not (you usually have to be a subscriber to a journal to obtain the full paper). So
the abstract is very important for informing the readers of the contents of a paper. This enables readers to decide whether to obtain and read the full paper. A good abstract will save the reader a great deal of time.

Introduction
This section is where the paper starts. It does not rely on the abstract. It usually includes some background or history to the area of research. It is very rare for an idea to arise by itself since there is always some precedent that has led to the ideas being tested in an experiment. It might also include some application of the principle behind the experiment. For example, say the experiment was about the sign of the charge carriers in a semiconductor. One application is a magnetic field sensor that uses the Hall Effect. Finally, some motivation is required for conducting this experiment. Why would anyone want to conduct this experiment? What did you test or examine? That is, give the reader a “road map” about where you are headed in the following sections.

Theory
If there is some background mathematical theory or qualitative ideas that need to be introduced so that the experimental results can be understood, then this is the place to do it. The section itself doesn’t have to be called “Theory”. In fact, you will find it missing in some papers because there was no background theory to discuss. In many cases the theory is not extensive enough to place it in a dedicated section and is simply incorporated in the Introduction.

Experimental Procedure
Since the paper is about an experiment or experiments, then there must be some description of the apparatus used. A reader can only gain confidence in the results if they are confident that you had appropriate apparatus and were able to describe its function and limitations (every piece of apparatus has its limitations, no matter how expensive it is!). In many cases you need to describe in some detail those parts of the apparatus that are critical to the understanding of the experimental results. A diagram goes a long way in helping the reader understand your description of the setup. If more than one setup was used, or there are several parts to an experiment, then you should use subsections. Stand back from the experiment and ask yourself which are the most important bits . . . and focus most on those. Calibration of an instrument, for instance, is important but doesn’t need a long description.

Results and Discussion
A discussion of the results is best placed along with the presentation of the results. It breaks up the flow of a report to separate the results and discussion into two different sections. The analysis of your results should be quantitative (with errors) and honest: attempt to explain discrepancies in physical terms, don’t dismiss them. If you used subsections in describing your experiment(s), then use them again, and use cross-referencing between sections (e.g. using the calibration curve/table in Fig X/Table Y, or the results from section Z) rather than repeating information given elsewhere in the report. Remember that the more you can connect the different parts of the experiment in your writing, the better the paper/report will read.

Conclusions
A conclusion is NOT a place where you say: “. . . therefore, I conclude that I have discovered the following new physical principles . . .”. It is nothing more than a summary of what the experiment was about, i.e., the results and what they mean. It is really an extended abstract (there is usually a word limit for an abstract), summarising the results in more detail and maybe suggesting ways this experiment or future experiments might be improved or extended. Quite often a professional scientist will skip most of the paper and go straight to the conclusion to save time. This section is usually the weakest part of most student reports since they just want the report to be over and done with. Try to spend some time on this section. This will also help you in writing the abstract.

References
We expect you to read relevant material beyond the lab manual when preparing your report. All references, including web references, must be acknowledged. References should be cited by number, either as a super-
script or within square brackets, with a numbered list at the end of your report. The extent of your outside reading can make a big difference to the scientific impact of your report.

Common mistakes and helpful hints

- Remember to write in the correct tense. You have already completed the experiments that you are reporting about. So they WERE done ... they are NOT being done now as you write the report. They are NOT going to be done as the reader reads further into the report. For example, the experiment WAS carried out and the results ARE presented in Fig. X.

- Do not write instructions as if you are writing a laboratory manual.

- Do not write in dot point format. The writing must be in a narrative style.

- Do not derive formulae or include intermediate steps in calculations.

- Equations and figures should be numbered, with symbols defined in equations and informative captions included for the figures. Figures should be referred to in the text, eg. as shown in Fig X.

- Do not do join-the-dots plots for your graphs; they do not convey any extra information. However, if you have more than one plot on the same graph, then it may be appropriate to join the points or, better, use different plot symbols or colours to distinguish the points.

- Explain how you determined your errors. There must always be a reason for an error estimate.

- Always compare experimental and accepted values. Examine the assumptions that may underpin an accepted or theoretical value before writing off your own results.

- Express discrepancies in terms of errors, not as small, large or 5%! Use Origin/Excel routines to determine errors in fitted parameters, but be aware of their limitations.

- Exclude any waffle when trying to explain discrepancies—show physical insight. Report markers have very sensitive BS detectors!

DJR: 25/7/09