This article, "Keeping A Good Laboratory Record Book", was written by Professor Roland Smith, Blackett Laboratory, Imperial College of Science, Medicine and Technology, London, England. Professor Smith has generously allowed the article to be made available to students at the University of Canterbury.

Keeping A Good Laboratory Record Book

Dr Roland Smith

As part of first year laboratory course you are required to keep a lab book. The keeping of detailed records of your work is essential both as a student and as a professional scientist. More generally, recording what you did, what you found, who you spoke to, how much money you spent etc are critical aspects of good business practice outside the field of scientific research. The aim of this document is to highlight why lab books are important and how you should go about keeping them.

1. Why keep a lab book?

There are a number of extremely good reasons for keeping a suitably detailed and robust lab book. Some of the most important of these are:

Experiments may take months or years to complete, and analysing data and writing up your results is impossible without decent records. You will *never* remember all the critical details without a written record. Indeed, you often don't find out what the critical points are until well after an experiment has been finished.

On occasion very significant amounts of prestige or money can be involved in who did what and when. For this reason lab books are legal documents of record and in industry it is very common for lab books to be counter signed by your supervisor every week to set up a well defined paper trail.

Both industrial and academic research projects are often carried out in large teams. People leave projects, go on holiday, have accidents, equipment fails etc. For this reason a permanent record of work done, experimental details, operating procedures etc need to be available, and, most critically, be understandable to other people.

Lastly, on a more personal level, your demonstrators will mark your lab book and your degree results will to some extent depend on how well your lab book is kept.

2. What should a lab book be?

A lab book should be a real time record of what you do in the lab as it happens. It has to be:

Complete The lab book should contain everything, *including* the mistakes. If something is wrong, cross it out in a way that still lets you read it.

Tough No loose papers, graphs etc. Securely glue or staple things in. In a real lab environment expect to have your lab booked dropped, kicked, used to prop up equipment, stained with coffee and so on.

Clear The lab book doesn't have to be pretty, but it must be legible and contain sufficient detail (headings, figure captions, table titles, units etc) to make the contents understandable *years* later.

True The lab book is a record of what you see and do. Don't embellish it, don't draw plots of raw data the way you *think* they should look, draw them the way they are. Don't throw away "bad" points and things which don't appear to agree with theory at the time.

3. What should your lab book include?

A lab book does not have to be carefully structured and presented to the same degree as a formal lab report. However there are a number of key thinks that need to be included. A complete record of an experiment or project will probably contain the following points:

Heading	A suitably descriptive title for the work.
Date and time of start	(and additional dates for each day you work on it).
Aims	What is it that you want to do?
Background	References to lab scripts, text books, manuals etc
Description of set up	Best accomplished with the aid of simple figures. What apparatus did you use, how was it put together, what was it supposed to do?
Initial set up and preliminary data	It is very common to set out to do a quick, sloppy job on an experiment first time round, with the expectation that this will show you what you need to go back and do well to get your real data.
Review	Almost nothing worthwhile works properly the first time. This is one of the key lessons that lab work will teach you. What went wrong first time round? How are you going to fix it?
Definitive data	Once you understand the experiment you can home in on the key results you need and do these with particular care. Usually a clear, well labelled table with units, errors on individual readings etc.
Data analysis including error calculations	Any result from an experiment is meaningless without consideration of the errors involved.
Comparisons and conclusions	Did the experiment agree with theory, work as expected, need doing again etc.
Summary	What was the final result, what worked well, what didn't, what could be improved in the future? This part is particularly critical for the "short" lab experiments
Closure	Be clear where one thing finishes and another starts.

Note: Some people reserve the last page of the lab book for an ***index*** of the book's contents which grows as the book is used. To do this you need to number the pages in your lab book. Even if you don't use an index, numbered pages can be very useful for cross-referencing other material in the book. e.g. you might re-do an experiment on Nov 17th 2002 that you first attempted on Oct 24th 2002. On Nov 17th you might write on page 60: "I have found a systematic error which must have affected the results taken on Oct 24th 2002 (see page 35)…". Cross reference this by adding a note to your original work on page 35 saying: "Nov 17, 2002, See note on page 60".

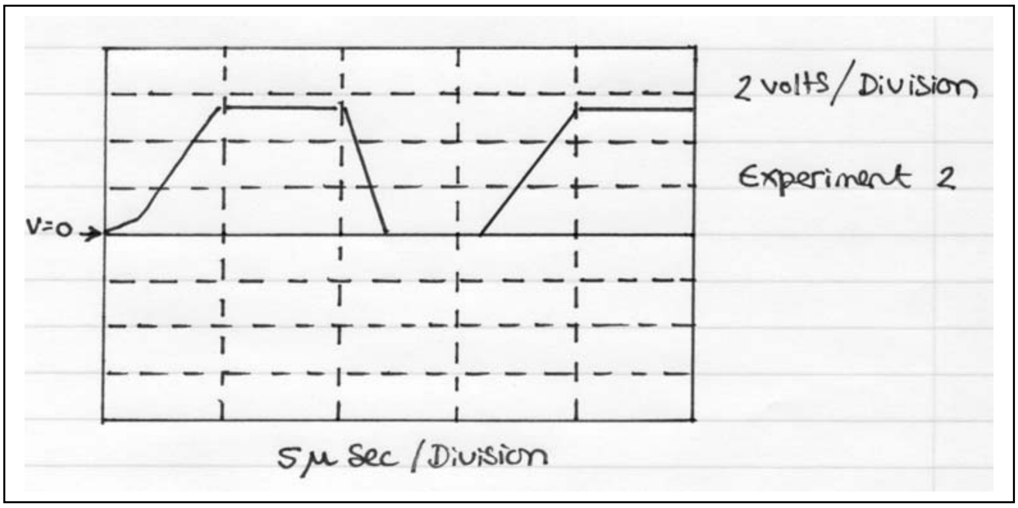
4. Some notes on computing experiments.

The guidelines above are primarily aimed at practical experiments such as the electronics or optics sections of first year lab. The computing lab involves somewhat different skills and is typically documented rather differently in your lab book. You should still keep a lab book for the computing experiment and it should include a record of the problems you are trying to solve, general methods employed by routines etc along with hard copies of program listings and example print outs. However much of the information that would be explicitly included in a lab book in a "traditional" experiment will appear as typed comments in the code rather than notes and figures written by hand.

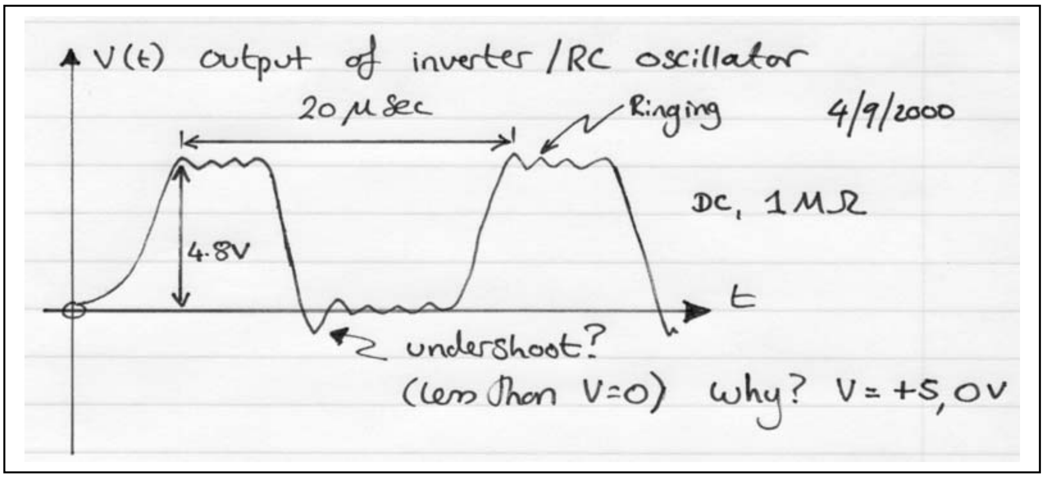
5. Neatness versus speed: Getting the balance correct.

A lab book is a real time record of what you do in the lab. However there is a danger that if you spend too much time on the lab book and not enough on the experiment you will not have much useful to say in it. For this reason you need to get the balance right between time spent keeping the lab book and time spent actually getting the experiment done. A quick, well-annotated freehand sketch done in two minutes can convey just as much information as a careful engineering drawing done to scale with a ruler, set square and compass. On the other hand a column of numbers alone will be useless a couple of days after the experiment unless accompanied by a brief description of what is being recorded and why. Let's look at a few examples:

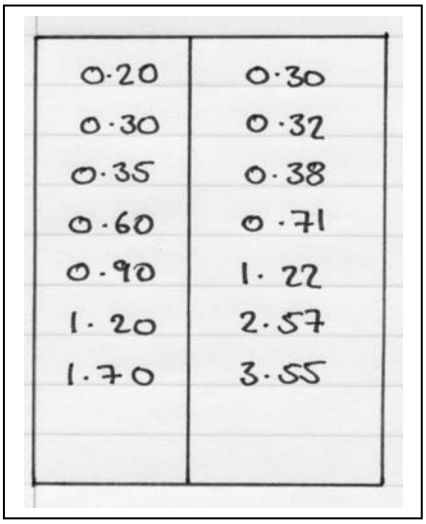
The figure of an oscilloscope trace below carries some essential information, but is over complicated. There is no point in including an explicit scale for example when a simple note of peak signal height and peak-to-peak separation is just as informative. Never use a ruler to draw the actual scope trace, you tend to miss important details.



The simple sketch overleaf is quicker to draw, conveys more information and is actually easier to read important points off. Freehand drawing of the scope trace makes it much easier to include things like the "ringing" effect seen below. The text on the figure identifies it with a specific measurement and also highlights some queries that might need looking at again.

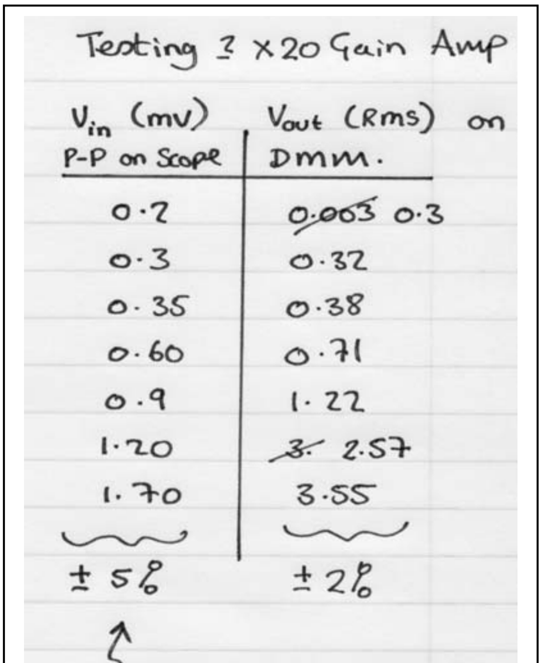


This list of numbers is perfectly legible but I have no idea what it means.



0.20	0.30
0.30	0.32
0.35	0.38
0.60	0.71
0.90	1.22
1.20	2.57
1.70	3.55

This set is a bit messier, but accompanied by a simple heading and description which will actually make it useful when it comes to writing up the experiment. Errors have been corrected in such a way as to leave the "wrong" result clear. This is a critical point, experimental physics almost never happens in a perfectly logical order in the real world. Sometimes you make real mistakes, on some occasions (particularly late at night) what you think is wrong at the time is actually correct and will be needed later. For this reason ***never*** *remove pages from your lab book, tipex things out etc.*



Testing 3 x20 Gain Amp

V_{in} (mv) P-P on Scope	V_{out} (Rms) on DMM.
0.2	~~0.003~~ 0.3
0.3	0.32
0.35	0.38
0.60	0.71
0.9	1.22
1.20	~~3.~~ 2.57
1.70	3.55
± 5%	± 2%

Sin~~e~~ wave Signal P-P measurement.

Original document written October 2000. Last updated September 2005.