Guide to Writing an MPhys Final Project Report

The following notes provide a guideline to report writing, and more generally to writing a scientific document. Please take the time to read them carefully. Even if your project did not go as well as you had hoped, there is no reason why you should not **score a high mark for you report** if you are prepared to work at it.

1. Why a report?

The production of a good piece of technical writing for a project report is as much a part of the project as doing the experimental work. However excellent and original a piece of work the project may be, unless the results can be communicated to other people it may as well not have been done! Communicating results of an investigation in a clear and useful way is a key part of science and is the reason for devoting a lot of effort to this aspect.

2. What level?

The main part of the report should be comprehensible by other stage 4 students. If more detailed information is to be included about some aspects (for instance, a complicated mathematical derivation, of which only the result is essential to the main discussion) consider including this as an appendix.

3. How much detail to include?

It is not necessary, or even desirable; to describe every minute detail of what was done. One of the most important aspects of good technical writing is to be concise, yet remain informative. The ability to select what is essential, and to omit what is merely incidental detail, is a skill every scientist needs to develop. In view of this, your report must comply with the word-limit specified on the applicable module description. An overlong report is liable to receive a lower mark than it otherwise deserves.

4. The nuts and bolts.

Two copies of the report need to be submitted. Students who have worked in pairs must write and present independent reports, stressing those aspects of the project for which they were individually responsible.

5. Format of reports.

Whilst not mandatory, there are good reasons for the usual format of a report. Sections that you need to include are,

Title
Authors
Abstract
Table of contents
Introduction
Background Theory
Experimental techniques and methods
Results and analysis
Discussion and conclusions
References
Appendices (if used)

In more detail…

5.1. First Page.

This should contain the title, the author(s) and the date.

Title.

This should convey the area and scope of the project. For example,
"Electro-rheological fluids" is poor – what aspect is the report concerned with? Their chemical structure? Their method of manufacture? A strategic assessment of their likely industrial usage over the next twenty years?
A better choice might be "The development of a technique to quantify the viscosity of electro-rheological fluids".

5.2. Second Page.

The Abstract.

The second page should consist only of the abstract. The idea of the abstract is to provide a brief summary of the report. The reader should be able to pick up from the abstract what the project entailed, how it was undertaken and an indication of what was found. An abstract should not review the report, but should rather act as a sampler of the contents of the report. Remember that the abstract may be the only part of your report that many readers ever see. It is therefore often appropriate to include the key measurements obtained. Typically the abstract should be less than 200 words.

A poor example of title and abstract might be,

The length of a piece of wood.

> The length of the piece of wood was found to be shorter than it should have been. We had problems with our measuring device and could not obtain good results. With better equipment we could have got better results.

It is poor because,

The length of the piece of wood was found **(how was it measured?)** to be shorter **(by how much?)** than it should **(should? - says who?)** have been. We had problems **(what sort of problems?)** with our measuring device and could not obtain good **(what is meant by good?)** results. With better equipment we could have got better results **(a cop out!)**.

A better title and abstract might be,

Interferometric measurements of the length of a piece of wood and discrepancies with previous spectroscopic measurements

> The length of a piece of wood was measured using an interferometric technique. Our results gave a length shorter by 1.5% than that found by Hamel et al [1] who used a spectroscopic technique. However, our measurements suffered from a large random error (2%), which we attribute to the use of a lamp as the source of light. An alternative interferometric measurement strategy employing a laser is suggested that would reduce this random error. It should then be possible to

determine whether the two measurement techniques are in agreement or produce systematically different results.

[1] Hamel, R. et. al. Physical. Review. K, vol 34, pp 127, 2010

5.3. Third page.

This should comprise a ***table of*** contents, indicating the page numbers of the different sections. Optionally it might be followed by lists of figures (i.e. photos, schematic diagrams and graphs) and tables.

5.4. Subsequent pages.

The bulk of the report now follows, namely:

Introduction.
This is where you need to outline the underlying concepts (and if required a brief version of any theory) needed to discuss the project. This is also the place to review previous work in your research area. What was already known about your research topic, when you began? How was your project intended to build upon this existing knowledge?

Theory section.
Use the theory section to explain in more detail the underlying concepts and equations that will be needed to understand and interpret the experimental results. If a long derivation is needed try to avoid having the reader become bogged down with lines of turgid algebra. Add some textual explanation to put the mathematically nervous reader at their ease. Consider placing the derivation in an Appendix if it is not absolutely necessary to your argument. Alternatively, if little theory is needed, consider merging this section with the introduction. Be sure to indicate whether the theory developed represents your own ideas or a review of existing work. In either case, use this section to demonstrate your understanding of the area.

Results and discussion.
Present your results in a logical sequence, highlighting what is important and how the data you obtained have been analysed to provide the results you discuss. You should discuss what you infer from the data, remembering to quote errors whenever drawing any inference from data and to discuss the relative confidence you have in different aspects of the measurements. Are your results in agreement with the predictions of your theory section? Do they support or refute any previous measurements? If they are new results, what are their implications? A poor example:

> The straight line fit between dog type and owner size gave a slope of 0.3.

Better would be:

> The data show a linear dependence between dog type and size of dog owner, with a slope of 0.3+/- 0.03. The degree of correlation was high ($R^2 = 0.98$). However, there is a noticeable divergence from this linear dependence for small dog types, as can be seen in the left hand side of figure 8. Interestingly, the only other study of this type, reported by Chow and Fang [12], found no correlation between dog type and owner size. However, Chow and Fang studied rich country dwellers, who own mainly working dogs whilst we studied urban dwellers, who keep dogs as pets. Both results together may suggest that country dwellers choose a size of

dog on practical grounds whereas urban dwellers choose dogs for aesthetic reasons.

Make sure that all diagrams, graphs etc. are properly labeled and have a caption. A neat hand drawn diagram is preferable to a poorly made computer diagram, or a poor resolution image copied from the web.

Summary and conclusion.
This is the section in which you need to put it all together. It differs from the abstract in that,

- It should be more informative, which can easily be accomplished because you may devote more words to it.
- You should include a concise version of your discussion, highlighting what you found out, what problems you had, and what might be done in the future to remedy them. You should also indicate how the investigation could usefully be continued. If your experimental apparatus or technique had limitations, how do you plan to overcome these? If your results suggest an interesting hypothesis, what new experiments could further test this hypothesis?
- Pages, diagrams, references and tables must all be numbered.

6. A word on references.

These are very important. Your report should be sufficient to indicate to the reader what you have done, what you found out AND provide enough information for them to repeat the work if they so wished. You will have made use of information from a variety of sources, e.g. the speed of light from a book. In these cases you must include reference to such sources. It may be that your project showed no evidence for cold fusion, but this might be because you followed a method of electrode fabrication that was later shown to be unreliable. By including a reference to the source, others can check your work and reduce the time taken to make further advances.

There are generally three styles of reference according to whether the source is a book, journal article or web site.

Book - you need to cite title, authors, date published, edition (if not first), city of publication and publisher. e.g.

> Elements of Nuclear Physics W. E. Burcham, (London) Longman, 1979.

Journal article - you need to cite title, authors, journal title, journal volume, page range and year of publication.

> The speed of light by interferometry A. Dixon, Journal of Light, vol. 3, pp. 123-234, 2003.

A web page – you need only give the URL of the web page

> http./www.gobbeldygook.co.uk

A word of caution on web based information. Journal articles and most books are peer reviewed. This means that other workers in the field have checked them for accuracy etc.. This is not true of web sites. Be careful in taking information from such sources and if at all possible verify the information by checking in books etc. You should also read the web information critically to see that it makes sense to you. ***You***

are a physicist and should take pride in not being duped into making simple mistakes by faulty information.

7. Assessment criteria.

These are used by markers to assess your report. You should look at the these before drafting your report . The current version can be accessed from the relevant page in the School Handbook at the bottom of the section on formal reports at:

http://newton.ex.ac.uk/handbook/MPhysFinalRepAssmnt.html

8. Producing the report.

I suggest the following plan for writing a report.

1) Identify the story you wish to tell. Often this can be simply done by deciding which diagrams and graphs of data you wish to include.
2) Draw up a plan of what you want to say and how this fits around the diagrams/graphs you want to use.
3) Extend you plan to an outline that includes all the section headings you will need.
4) Check through the outline to see that sequence is sensible and that nothing vital has been ignored.
5) Check your outline through with someone else e.g. project partner, supervisor or tutor.
6) Write a first full draft of the report.
7) Check the first draft through for consistency, obvious errors and omissions (e.g. figure captions missing? References still to do?) If you can get a friend to read through it critically so much the better.
8) Revise the draft and re-check until satisfied.
9) Submit report.

9. While writing and planning the report pay attention to the following points:

A) Make sure you mention the background to, and aims of, the investigation. How does your project relate to existing work in the field?
B) Include the basic concepts and theory relating to the investigation. Try to make a critical assessment of any related work.
C) Describe the procedures used. If specialised equipment was designed and constructed, give details. Identify major sources of error and explain how they were dealt with.
D) Only data directly relevant to the calculation of final results should be presented, omit raw data. Graphs are a particularly effective way of presenting results - only use a table where it would make more sense than providing a graph.
E) Final results should be presented clearly and concisely; include an analysis of errors, but omit details of arithmetical manipulations.
F) If computer code was used or written, give details of the checks and validations you performed on the code.
G) The interpretation of the results must be discussed, and improvements and possible extensions to the work suggested. Explain how your results relate to those already available.
H) Give references to any books, articles or other sources of information (e.g. web sites) that have proved useful in preparing the report, or in carrying out the work.

For more advice on report writing, try following some of the links in the “Writing essays and reports” section of the undergraduate handbook:
http://newton.ex.ac.uk/handbook/Advice.html

SJ Matcher and W. L. Barnes, March 2004