

## 6. THE FORMAL REPORT

After the experiment has been performed and the data analysed, it is necessary to communicate the results to other people. The most common and effective way of doing this is to write a formal report.

The writing of reports is a routine everyday activity for engineers. An engineer must be able to compile and summarise rather complicate information and to present it in a clear and simple manner. Obviously, writing good reports requires practice. This is why the writing of reports is an essential part of every student's training. After most of experiments in the Teaching Laboratories, you will need to submit a formal report. A marker, who is a member of the academic staff, will thoroughly examine your report and give you feedback.

### 6.1. General Tips

There are several requirements to any formal report.

- A report should contain **complete** information. However, it should not be over-detailed. Do not provide details that are obvious or trivial, like switching on the power.
- A report should contain **correct** information. It must be based on the experimental data that are available in your daybook.
- A report should be **concise**. Do not make it excessively long, otherwise you will lose the reader's attention (and your marks!). As a guideline, the main body of a report (text excluding figures, tables and graphs) should not exceed five pages of a single-spaced A4 typescript or its equivalent.
- A report should be **clear** and **easy to read**. The reader should be able to understand not only **what** you have written, but also **why** you have written this or that. For example, the information, which you provide in the 'Introduction' or 'Theory' sections, should be directly relevant to the reported experiment.

"Is the hand-written or computer-generated form of report preferred?" is a common question. We encourage students to produce computer-generated reports because it is a professional standard our days. However, hand-written reports are also acceptable, and you will not be penalised for not using a computer. Also, you may include hand-written diagrams or graphs in a computer-generated report.

A general requirement to any report is that it must be **legible**. Illegible reports will be returned unmarked! A hand-written report must be clearly and neatly written, with the diagrams drawn with the aid of a ruler. In a word-processed report you should use a reasonably sized font (e.g. 12 point Times New Roman) and a single or 1.5 line spacing. Ensure that the diagrams are large enough to be clear. Margins should not be smaller than 2.5cm. Use a good quality paper.

### 6.2. Structure and Layout

A report should be structured into sections and possibly subsections, which are consistently numbered. Each section should have a short meaningful heading.

A typical report should contain the following sections.

**Title Page.** This should include the title and the code number of the experiment, name of the author, names of the School and the University, and submission date.

**Abstract, or Summary** (separate page). This is a very important part of a report. It summarises very briefly (in a few sentences) what is in the report, typically the object of the work and the main conclusions.

**Table of Contents** (separate page). It gives the list of all headings and subheadings with their page numbers. It should also contain the list of graphs. (Therefore, this is the last page of the report that you prepare.)

**Introduction and Theory.** This section depends very much on the actual work. In general, it should include the aims and objectives of the experiment, and the theoretical background. Do not make this section excessively long. The theory must be **directly relevant** to the experiment. **Never** duplicate the theory that is given in the experiment instruction sheets. You will not receive extra marks for this; on the contrary, you will lose your marks! Note that this section is split sometimes into two sections, 'Introduction' and 'Theory', for example, if the theoretical part is long. You may do this if you feel that it would be appropriate.

**Equipment and/or Materials List.** You should provide a list of all apparatus that you used. Sometimes you will need to mention their technical parameters. However, you do not need to provide their serial numbers. (These should be available in your daybook.)

**Procedures.** This is a record of how exactly you performed the experiment. Typically, it is just a matter of following the instructions; however, you must not simply copy the instruction sheets. You should describe what you have done, and not give the instructions to a reader! Particularly note any details which are not specified in the laboratory script. As an example, the script instructions may suggest to use an appropriate scale of a manometer, or any other measurement device. In your report, you need to provide a specific scale which you actually used.

**Results.** Here you present all measured and/or calculated results including digital printouts, waveform traces etc. In many cases, graphical representation is more preferable, especially if a quantity was measured or calculated as a function of an argument. Use graphs to show large amounts of data and to illustrate trends or discontinuities. Tables may be useful for small amounts of data that are not closely connected. Typically, tables with the raw data are not required. Do **not** duplicate the data both in tables and graphs unless you have a good reason for that.

**Note** that tables and graphs should be sequentially numbered, and each one should have a meaningful title.

**Discussion.** This part is very important. To discuss the results means to provide an interpretation, to relate them to theory, to comment on their accuracy and any discrepancies with your expectations, to highlight the most important points of the experiment, to present the reasoning on which the conclusions are based etc.

**Conclusions.** These should summarise your findings, present your deductions, and probably give your recommendations.

**References.** If work from a book or journal/conference paper is mentioned in your report, you should provide a reference. This is given as a sequential reference number enclosed in square brackets i.e. [1] where the work is mentioned in the text. For example, "This method was discussed by Smith and Brown [2]". In the 'Reference' section, you should give the list of all references under appropriate numbers. A reference to a book must include author(s), title, publisher and year; sometimes you may need to provide chapter and/or page numbers. A reference to a journal paper must include author(s), journal name, volume number, page numbers and year; often, it is a good idea to provide the title. These may look like as follows:

[1] Jones S., "Principles of Reference Writing", Smith Press, 1990.

[2] Smith A.B. and Brown C.D., "Methods for writing references", International Journal of Writing 75, 125 (1980).

Note that particular details of the reference format may vary. You can find many examples in your textbooks.

**Appendices.** You may wish to provide some detailed data or another relevant information, but you feel that it would make the body of your report too long, or distract the reader's attention. In this case, you may include this material as an appendix. For example, this handbook has several appendices. If an appendix is related to a particular section of your report, do not forget to include a reference to it!

**Note** that you do not need to follow this list exactly. If you feel that it is appropriate, you may include other sections with your own headings, or combine several sections together, for example, 'Results and Discussion'. Also, you may describe a part of the measurement procedures and immediately present the obtained results, and even discuss them, and proceed to further measurements after that. You should judge yourself which layout would better fit your particular report, and judgement improves with practice. Do not forget to provide appropriate section headings!

### 6.3. Illustrations and Graphs

Illustrations (figures) provide an efficient way of presenting information, because the pictorial information is absorbed much better than any other form.

- All figures (graphs, circuit diagrams, flow charts, etc.) should be either computer printed or drawn carefully in ink or pencil using a ruler. Make sure they are not too small or large.
- Figures must have meaningful headings and be numbered in a consistent manner, either in a simple numerical order or with the section number in front. (The same applies to tables).

Always follow this **checklist for plotting graphs**.

- Graphs, if they are not computer printed, must be drawn on the graph paper.
- Do not overload a graph with irrelevant details. To be easily absorbed, the amount of information should be not excessively large. For example, two (or more) lines on a graph are a good idea only if they are compared to each other.
- Try to emphasise the parts of the data that are most important. This can be achieved by adjusting the axes scale, selecting linear or logarithmic scale, offsetting the plots etc.
- The axes must have titles, which include the name of the measured quantity and the units in brackets.
- The scale of the axes must be clearly labelled. Choose the scale so that to use the maximum area available. The origin of the axes does not need to be zero!
- Plot the independent variable as the abscissa ( $x$ -axis). Plot the dependent variable as the ordinate ( $y$ -axis).
- If two or more quantities are plotted on the same graph use a different symbol for each.

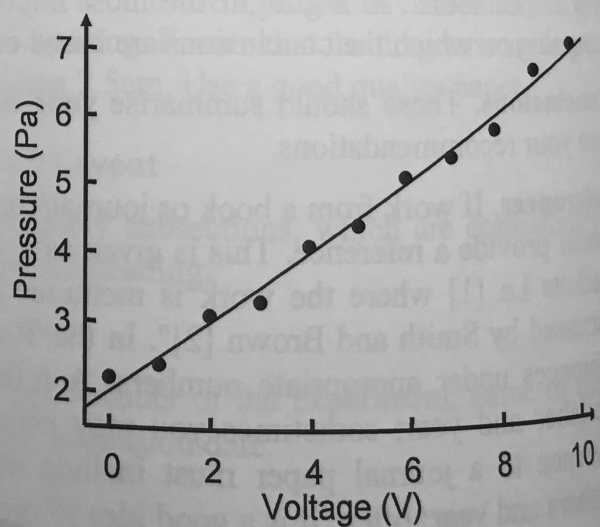


Figure 6.1. Example graph.

- If you draw a line through your data, take the accuracy and the "noise" in your measurements into account. **Do not** draw the lines that connect neighbouring points (which may be a default option for some software).
- Draw a smooth curve through all points - the first and last points do not have a magical quality about them.
- If you plot a theoretical curve to compare with experimental points, do it in such a way that the curve can be clearly distinguished from the experimental results.
- Graphs should be drawn so that they may be read from the bottom or the right hand side of the page.

Refer to the example graph!

#### 6.4. Language and Grammar

No one will read a report in order to assess the correctness of the language. However, a report becomes much less readable if the use of English is poor, and spelling mistakes can distract from the contents of the report. Use grammatically correct English, and check the spelling.

There are several rules for writing reports which you are advised to follow.

- Use impersonal, passive form of a verb. Do not use "I", "we", "they", "him", "her", etc. For example, say "The voltage was measured" rather than "I measured the voltage".
- Use mostly the past tense when describing what was done during the experiment. The use of the present tense is appropriate, for example, when inferring general relationships from the data or giving the background details.
- Do not use very long sentences. Short sentences are much easier to absorb.
- Start a new paragraph when introducing a new aspect. Do not make paragraphs too long.
- Explain fully all abbreviations and notations the first time they are used, for example,  $I(V)$  (current-voltage) characteristics. Avoid slang.
- Measurement units. You must use the SI units so named after the System International d'Unites (French). Their list is given in the Appendix A2.
- You should use spaces between parts of compound units and between numbers and units, but not after the prefixes related to multiplication factors. Unit symbols are the same in the singular and the plural. They should not be followed by the full-stop:

$$1 \text{ newton metre} = 1 \text{ N m} = 1 \text{ joule} = 1 \text{ J}; 10 \text{ microvolts} = 10 \mu\text{V} = 10^{-5} \text{ V}$$

#### 6.5. Reports marking

The reports are marked out of 100. For typical short reports, the mark consists of the following components.

- Report Organisation - maximum mark 10.
- Clarity and Tidiness - 5.
- Language - 5.
- Experimental Methods and Procedures - 15. This mark will reflect, first, how you performed the measurements, and second, how you described them.
- Results Presentation - 20.