# How to write your report

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**Abstract**

You can either write an abstract or an aim for your report. It is meant to be simple and straight forward. No equations, no diagrams just words. Usually you write this last as it can be one of the hardest parts to clearly write. Ideally it should match your conclusion. The generic format of the report is a journal article format.

## 1 Introduction

This is a simple report structure to use if you are unfamiliar with the scientific method of writing. It may seem somewhat onerous at first, but the structure also allows for great freedom. It is very different to other types of writing such as newspaper journals or web pages on the net. Once mastered, it is like riding a bike, but requires practice.

The introduction is the creative section of a report. It is also the second hardest part to write, because how long is a piece of string? Any future employer will judge the quality of your work. Therefore, develop clarity in your expression and present your results in the best manner. This part has greater ramifications in your life than your exam mark, so treat it as an exercise it itself, which will return you great benefits.

The ultimate goal is to engage and keep the attention of your reader. Imagine you are writing for someone like yourself but not familiar with this topic. Therefore, you want to introduce the topic with a balancing act between enough and too much.

The best approach is to read something related, whether it is online or a text book or the lab notes, and without looking at it, try to rewrite what you have read in your own words. This will create a framework for your own understanding. You will naturally only remember bits and pieces and have questions regarding the material, so go back and reread the material and once you are clear, put it away and continue writing. You may need to consult multiple sources, if so reference them. Just rewriting the equations used in the lab is not sufficient. If it is too hard or complex, as a last resort you may refer to some reference source.

Something else to note; your report is fundamentally different to the lab instructions. You want to just state what you did, what results you obtained

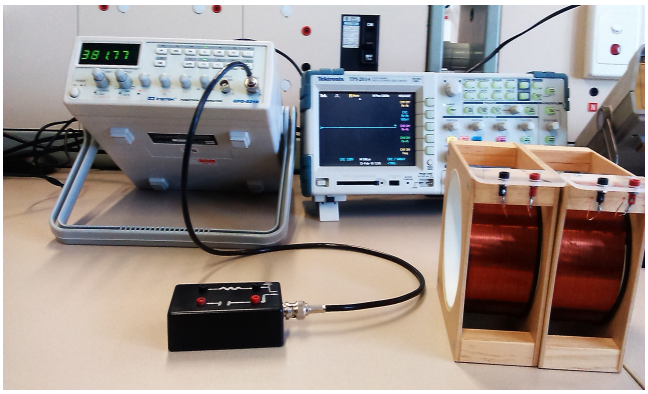

Figure 1: Photographs of lab equipment are to be encouraged. Take note of make, model, etc. You must include a figure label and caption and refer to it in your text.

and what your conclusions are. So NO copying large slabs from the lab manual and blindly including it in your report.

# 2 Theory

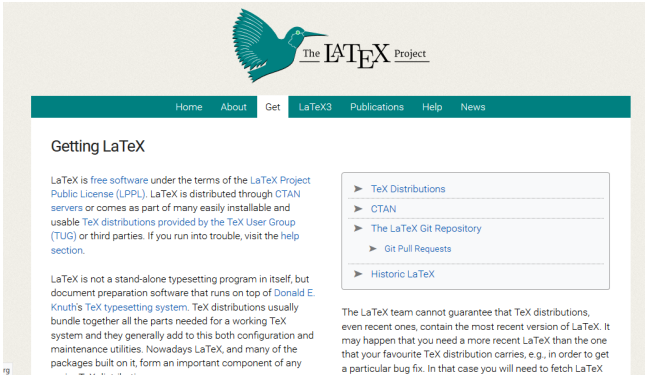


Figure 2: LaTeX project

You may use pretty much any text editor to write your report. Word is ok but not the best. It is a WYSIWYG program (What You See Is What You Get). It is easy to use but produces pretty ordinary results. The best is LaTeX, which is a type setting package, which calculates character and figure placing for greatest effect. But is harder to master. Nearly all postgraduates use it because of its wide scope. Plus it is free! A good reference to why you should use it is `https://tex.stackexchange.com/questions/1756/why-should-i-use-latex`.

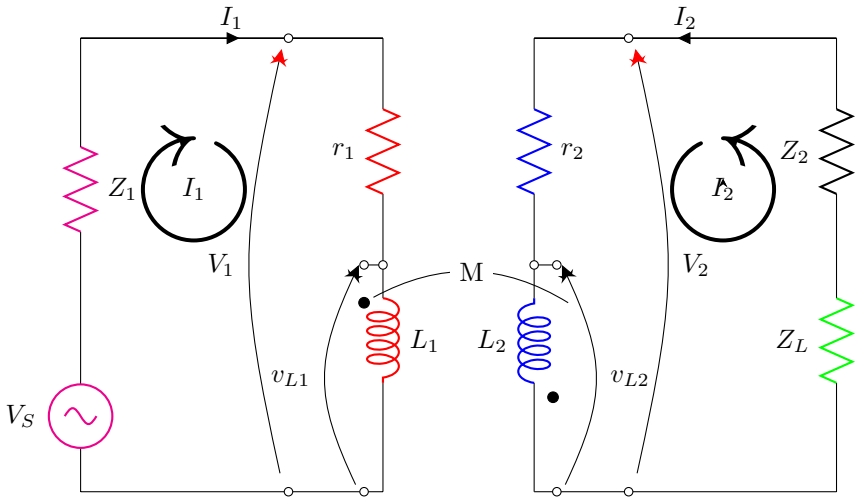


Figure 3: These circuit diagrams have been generated with circuitikz which is a LaTeX package

To use it requires two programs: the engine and the frontend. A good resource can be found here `https://www.latex-project.org/get/`. See Figure 2.

I am using TeXstudio, which was introduced to me by a past PHY40001 student, as my frontend which is free. My engine is MikTeX which can be easily found on the web. Warning! They are both large programs to download. A good compromise is Overleaf (`https://www.overleaf.com/14800877fhzrxycpywxf#/56389971/`) which is an online LaTeX editor which takes care of the details so that you can write like Word and produce good looking documents straight away instead of the weeks required to learn a full LaTeX language. See Figure 4

The purpose of the theory is to place the experiment in context and to support it with the nitty, gritty aspects behind the experiment, such as Faraday's law or Ampere's law or whatever. It is a chance to show your understanding. Develop the equations used with enough, but not too much detail. Define all the terms used. Very complex material can be relegated to an appendix if it ruins the flow of the report.

It does not need to be as detailed as the lab manual. Was it mentioned that a lab manual is very different to a lab report? You may include more detail if you wish. It is really up to you. But keep it focussed and concise.

For example:

The basis of mutual coupling is Faraday's law, which states that the induced electromotive (emf) force, $\varepsilon$, in a circuit is proportional to the rate of change of magnetic flux, $\phi_B$, through that circuit.

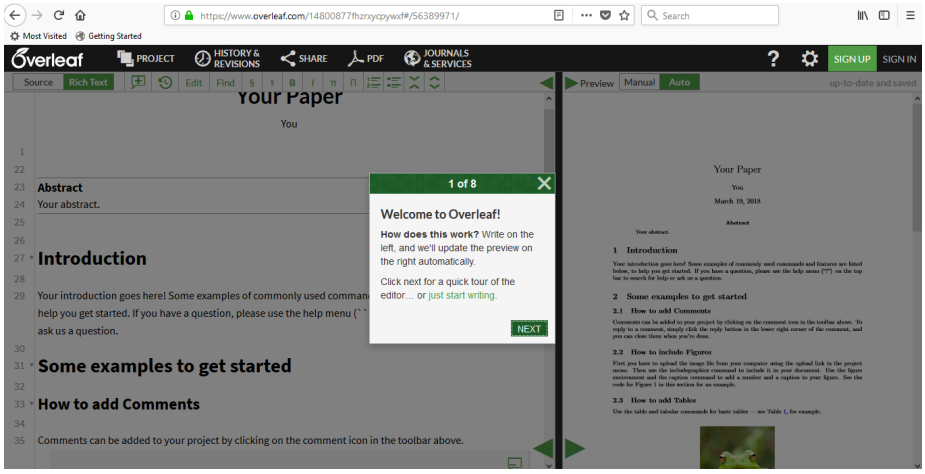


Figure 4: Screenshot of Overleaf

$$\varepsilon = -\frac{d\phi_B}{dt} \tag{1}$$

The flux is defined as total number of field lines summed over a surface area $\tilde{\mathbf{a}}$ of the loop. The surface integral this time is not necessarily closed.

$$\phi_B = \int_S \tilde{\mathbf{B}} \cdot d\tilde{\mathbf{a}} \tag{2}$$

Not so familiar perhaps is that the emf generated through a loop is the same as the potential difference between the ends of the loop. The potential drop around a loop is the basis of Kirchhoff's voltage law.

$$\oint_C \tilde{\mathbf{E}} \cdot d\tilde{\mathbf{l}} \tag{3}$$

where, $\tilde{\mathbf{E}}$, is the electric field which is summed as a dot product with the path, $\tilde{\mathbf{l}}$ around the loop, $C$. This is a one dimensional line integral, or path integral as opposed to the flux which is a surface, $S$, or two-dimensional integral.

Hence Faraday's law can be written as

$$\varepsilon = \oint_C \tilde{\mathbf{E}} \cdot d\tilde{\mathbf{l}} = -\frac{\partial}{\partial t} \int_S \tilde{\mathbf{B}} \cdot d\tilde{\mathbf{a}} \tag{4}$$

# 3 If there are multiple parts then break it up into sections or even subsections

It is better to breakup large sections into smaller ones. Each section may have its own introduction, theory, method etc.

Use an equation editor for equations and number where appropriate. Even Word has a good equation editor.

$$\begin{aligned} V_R &= \frac{R}{R+Z}V \\ &= \frac{R}{R+(r+j\omega L)}V \end{aligned} \tag{5}$$

# 4 Apparatus

Note the make, model etc., of equipment used and include photos for good record keeping. This is important if ever you need to refer back to an experiment. If something was faulty, then you have it on record which piece was faulty.

This section maybe included into the method if you prefer.

# 5 Method

This is the straight forward section. Just simply say what you did with enough detail that anyone who wanted to repeat the experiment could follow. But not so much detail that they fall asleep! And try not to use dot point format as used in the instructions. Paragraph format is much better.

For example:

We measured $V$ and $V_R$ simultaneously using a multitrace digital oscilloscope while varying the frequency. Using Equation whatever, the self inductance $L$ of the coil was calculated.

Even better is past tense impersonal. The voltages $V$ and $V_R$ were measured simultaneously using a multitrace digital oscilloscope while varying the frequency.

1. Don't use itemization like this!
2. Use paragraph format

# 6 Results

Your results will often be displayed as a table. Like a figure, it also requires a caption and a label. But unlike figures, which has the caption and label underneath the figure, table captions and labels go above the table. Be sure to introduce your table in the text and refer to its label.

For example:

The measured results are shown in Table 1. Use convenient units and be careful of significant figures. Include estimated errors of the measurement.

A table by itself is not particularly useful. However, a graph is very useful to show trends and relationships. These are so important that you must make them of sufficient size and clarity that anyone can see them. Like the text

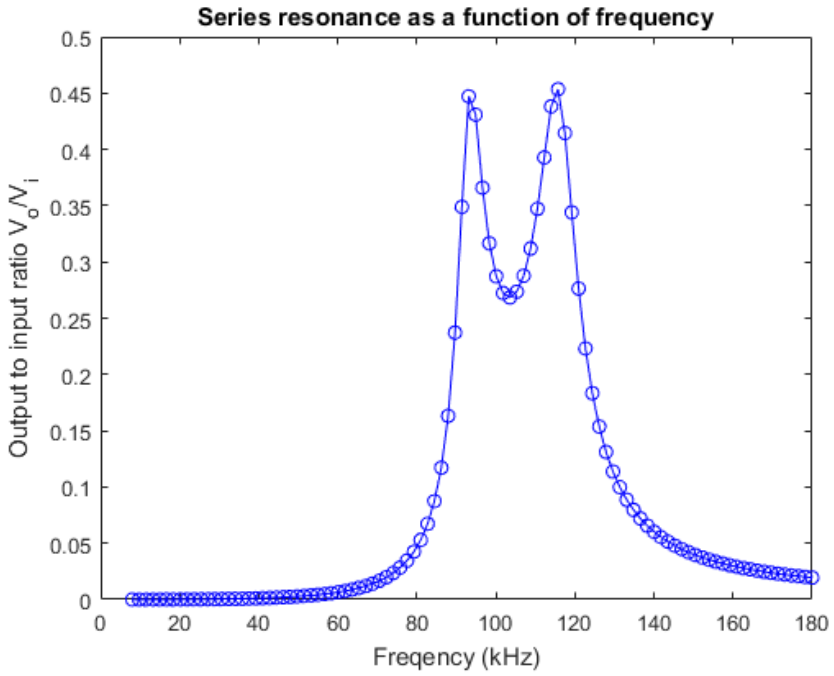


Figure 5: Matlab plot of theoretical resonance. Note the axis labels, title and caption. Graph must be of sufficient size to see detail

editing programs, there are plenty of good plotting programs, such as Matlab, Scilab, Octave, Origin. Excel is good if used correctly. Often Excel joins any data points with a straight line as the default setting, which interferes with your analysis. Be sure to label axes and include units. See Figure 5.

Include errors where you can and where it is feasible. Any result is only as good as the accuracy and precision of your measurements. Be sure to know the difference between accuracy and precision. Include error estimates in your tables and errorbars on your graphs. If you are using a formula to calculate a quantity, then there are methods to calculate its error. The simplest method is to use relative errors which always add. A more comprehensive method is to use calculus.

## 6.1 Questions

Answer questions in the lab manual where appropriate.

Table 1: Measured values and calculated self inductance $L$

| frequency(kHz) | $V_1 \pm 0.08$ (V) | $V_R \pm 0.02$ (V) | L (mH) |
|---|---|---|---|
| 2.04 | 4.48 | 3.92 | 1.2 |
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# 7 Discussion

Often neglected by students, this is probably the most important part of your report. This is where you make some self imposed judgments of your work. It is not meant to be subject but objective. Discuss your results as to what they mean. It takes quite a bit of reflection. If your results are excellent you may not have too much to write. But if they are far from from perfect, this is your chance to explain them. If you made a terrible mistake this is your chance to explain yourself and make some attonement. Making a mistake is not the end of the world. But fudging your results to get what you expect is! Copying or plagiarizing is even worse!

Some of the best and worst cases in history have been made through mistakes. Worse than a mistake is irrelevance. In the words of Wolfgang Pauli, not even wrong!

# 8 Conclusion

May be separate or included in the discussion and should match your aim or abstract.

# 9 Appendix

For stuff too big or detailed for the main text

## 10 Bibliography or references