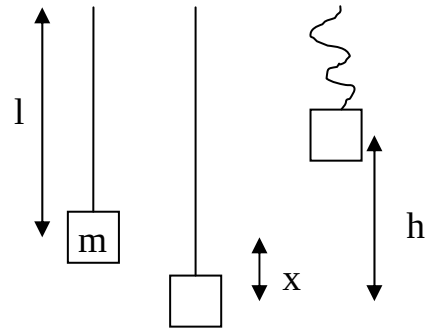
Physics Practical 8
Mass on an Elastic String

Introduction
This is a practical designed to introduce the ideas of finding a research question deriving a hypothesis and planning an experiment. The area of research will be a mass hanging on the end of an elastic string.

Area of the research
The first thing to do before formulating your research question is to find out what the mass and string does, then you can decide which aspect of its physical properties you would like to investigate. The best way is to do some trial experiments to see what the system does. For example if you pull down the string and let it go then the mass flies up in the air. It might be interesting to investigate how the height is related to the distance the mass is pulled down from the starting point, or how the frequency of oscillations is related to the number of elastic strings.



Research Question
The research question should be of the form "How is x related to y". So you need to look for possible quantities that could be related, e.g.

- What is the relationship between the distance the string is pulled down and the height the mass reaches?

Variables
Your research question should contain two variable, one that you will change (Independent variable) and on that changes as a result (Dependant variable). In the example given the mass will be pulled down and the height it reaches is measure so:

- Independent variable: Distance pulled down
- Dependant variable: Height reached

There are many other possible variables that you don't want to change, these are called controlled variables. E.g. The mass of the object, the number of strings.
It is important to make a list of the controlled variables in your report.

Hypothesis
Once you have decided on a research question you should try to formulate a hypothesis, this will be important when you come to analyse your data. Try to use the physics you have learnt in class (e.g. Newtons laws of motion and conservation of energy) but if you we haven't covered the necessary theory try to make a reasoned argument. If possible derive an equation relating the quantities in your research question

Designing your experiment
The next stage is to plan and carry out an experiment to test your hypothesis.

- How you are going to measure your chosen quantities?
- How are you going to ensure that all other quantities remain constant?
- How are you going to minimize the uncertainties in your measurements?

Carrying out the experiment

From here onwards the experiment will be like the others you have done this term. Collect your data in a table and draw a graph to show whether your hypothesis is true or not. Don't forget to include uncertainties.

Conclusion and evaluation

Your conclusion should be either your experiment proved the hypothesis or it didn't. In either case you must state why you make this conclusion making reference to your graph and in particular the experimental uncertainties. You can also include comments on how the experiment could be improved and any interesting (and relevant) observations that you might have made.

Writing the Report

The report should have the following titles

- Research question

A statement of the form "what is the relationship between y and x"
State clearly the independent and dependant variables
List the controlled variables

- Hypothesis

A reasoned argument as to what you think the relationship between y and x is.
Explain why you think this is the case.

- Method

A description of the way you are going to carry out the measurements including a diagram.
You must say what apparatus you use to make the measurements.
Include details of how you made sure the controlled variables didn't change.

- Results

Include the raw data. If you use the gradient of a data studio graph include an example.
If you find the mean of several values include the individual values in the table not just the mean.
You must include an estimate of the uncertainties in all your measurement, with details of how you got the uncertainties (e.g. by repeated measurement)
Most experiment will lead to a graph, use graphical analysis and include error bars.

- Conclusion

Did your results support your hypothesis within the uncertainties of the measurements?
State any value you have calculated and compare with the book value if known.

- Evaluation

This is the difficult bit. Look at your results and make comments about anything that may have affected your results. Comment on the uncertainties, do the error bars look reasonable compared to the line? Think like a detective you must provide evidence for anything you write in the evaluation. You shouldn't say there were big errors if your line was perfectly straight. Try to suggest ways to reduce some of the errors in the experiment. Again these must be known errors that you have evidence for not something you make up.