Internal Assessment Resource

Achievement Standard Physics 91168: Carry out a practical physics investigation that leads to a non-linear mathematical relationship

Resource reference: Physics 2.1A

Resource title: Grandfather Clock

Credits: 4

| Achievement	Achievement with Merit	Achievement with Excellence
Carry out a practical physics investigation that leads to a non-linear mathematical relationship.	Carry out an in-depth practical physics investigation that leads to a non-linear mathematical relationship.	Carry out a comprehensive practical physics investigation that leads to a non-linear mathematical relationship.

Student instructions

Background information

Two Year 12 Physics students were looking at a grandfather clock in a museum. There was a large mass near the bottom, and they noticed it could be adjusted up or down.

They wondered how the clock worked to keep correct time, so when they got back to school they **MODELLED** the clock as a simple pendulum (a mass suspended from a string, swinging gently to and fro).

Physics theory suggests that the relationship for a pendulum of length (L) and its period (T) is given by:

$$T_{pendulum} = 2\pi\sqrt{\frac{L}{g}}$$
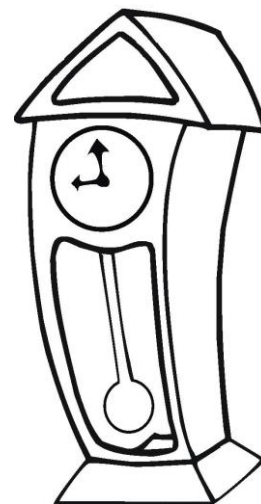
Task

Carry out your own investigation into the relationship between pendulum length and its period.

You will be given a period of 2 hours in which to collect and analyse data, and write and hand in a report. You will work independently.

No material is to be taken from the laboratory.

Gather data
Equipment: String, a meter ruler, clamp stand, 50 g mass and a stopwatch.
As you go about your investigation, you should:

- [ ] identify the dependent and independent variables
- [ ] identify any variables to be controlled
- [ ] record *all* raw measurements in an appropriately headed results table, using appropriate units
- [ ] make sufficient measurements to allow you to draw a graph that will help you determine the relationship
- [ ] adjust your method as necessary to maximise accuracy.

Analyse data

Plot an appropriate graph to explore the mathematical relationship between pendulum length (L) and its period (T). Include a curve of best fit (the raw data will not give a straight-line graph).

L and T, are not proportional variables. Decide the type of relationship that this graph suggests.

Process the data so that you can draw a straight-line graph. Plot and draw the graph.

Using information from the straight-line graph, find and state the mathematical relationship between L and T.

Prepare your report

Write a report that evaluates and explains the results of your investigation.

Your report should include:

- the dependent and independent variables
- the techniques you used to improve accuracy of measurement
- a suitably headed table which records *all* raw measurements with appropriate units and to an appropriate number of decimal places
- the non-linear graph you have drawn
- the type of mathematical relationship that the non-linear graph suggests exists between the variables L and T
- a suitably headed table which records processed data in appropriate units and quoted to an appropriate number of significant figures, and the straight-line graph you have drawn
- a conclusion that states the correct mathematical relationship between L and T based on your straight-line graph
- a discussion that validates the conclusion.

In the discussion that validates your conclusion, you should address such critical issues as:

- variables that required controlling (explain why they needed controlling and how you controlled them)
- difficulties encountered when making measurements (explain how you overcame these difficulties)
- why there was a limit to the range of values you chose for the independent variable
- any unexpected results (suggest what might have caused these and what effect if any they may have had on the validity of the conclusion)
- the relationship between your findings and physics ideas.