

MEASUREMENT OF g WITH A PENDULUM

Specification reference: A level Component 1.6 – Vibrations

Theory:

The period of oscillation of the pendulum is given by the equation $T = 2\pi \sqrt{\frac{l}{g}}$ where l is the length of the pendulum and g is the acceleration due to gravity. The equation can be written as $T^2 = \frac{4\pi^2}{g} l$ which can be compared with the equation for a straight line $y = mx + c$. Thus a graph of T^2 against l should be a straight line through the origin with the gradient of the line equal to $\frac{4\pi^2}{g}$. The acceleration due to gravity can be determined from the value of the gradient and is equal to $\frac{4\pi^2}{\text{gradient}}$.

Apparatus:

Simple pendulum mass in the form of either a lead or brass bob

Length of cord or thread - at least 1.0 m in length

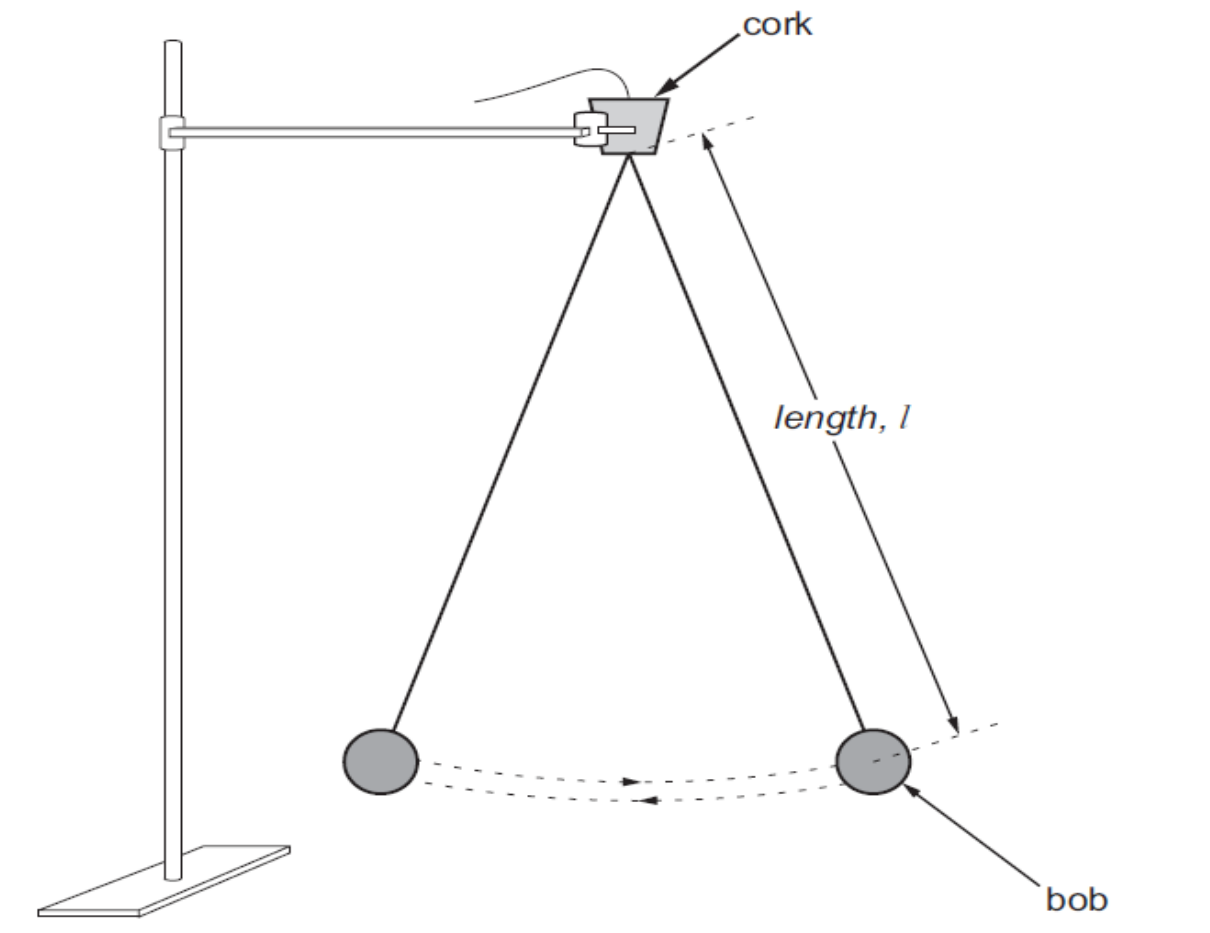
Stand, clamp and boss – the height of the stand should enable the length to be adjusted to at least 1.0 m

Stopwatch

Metre rule

Either a rubber or cork bung split in two so that students/learners can change length easily

G-clamp to secure the stand



Further guidance for technicians:

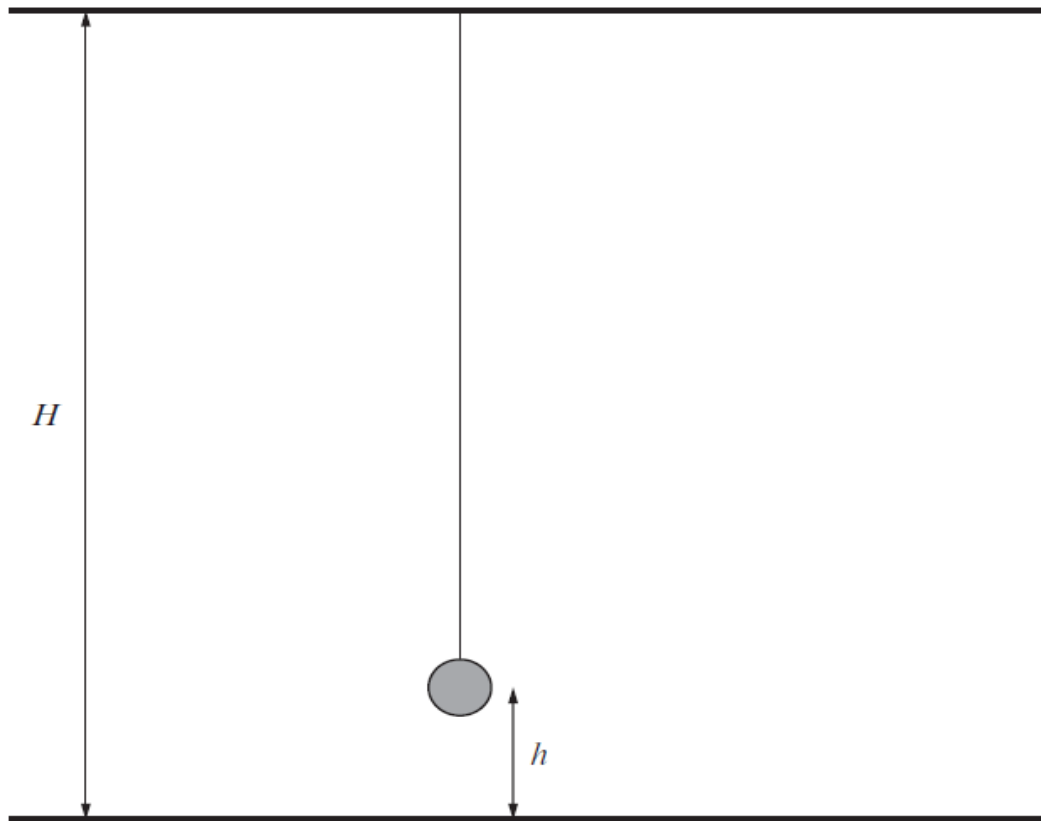
The resolution for the stopwatch should be ± 0.01 s. The G clamp ensures that the apparatus is stable during the oscillations of the pendulum.

Experimental Method:

Adjust the length of the pendulum (measured from where the thread emerges from the cork/bung to the centre of the bob) by drawing the thread through the cork. The pendulum should be given a small displacement. The time for a number of oscillations (a minimum of 5) should be measured and the period of 1 oscillation determined. The oscillations can be determined by measuring against a fixed point. Repeat with different lengths at suitable intervals.

Extension:

The height of the room can be determined by writing the equation as $T = 2\pi\sqrt{\frac{H-h}{g}}$ where H is the height of the room and h is the distance from the floor to the centre of the bob.



Data Logging: Displacement sensors could be used to obtain individual oscillations digitally.

Practical Techniques:

- Use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data.

Relevant previous practical past papers:

- PH3 2010 Task B4
- PH6 2013 Data analysis task