

State Examination Commission – Physics Higher Level, 2008

Question 1

A student investigated the relationship between the period and the length of a simple pendulum. The student measured the length l of the pendulum. The pendulum was then allowed to swing through a small angle and the time t for 30 oscillations was measured. This procedure was repeated for different values of the length of the pendulum.

The student recorded the following data.

l/cm	40.0	50.0	60.0	70.0	80.0	90.0	100.0
t/s	38.4	42.6	47.4	51.6	54.6	57.9	60.0

Why did the student measure the time for 30 oscillations instead of measuring the time for one?

How did the student ensure that the length of the pendulum remained constant when the pendulum was swinging? (9)

Using the recorded data draw a suitable graph to show the relationship between the period and the length of a simple pendulum. What is this relationship? (19)

Use your graph to calculate the acceleration due to gravity. (12)

Why did the student measure the time for 30 oscillations instead of measuring the time for one?

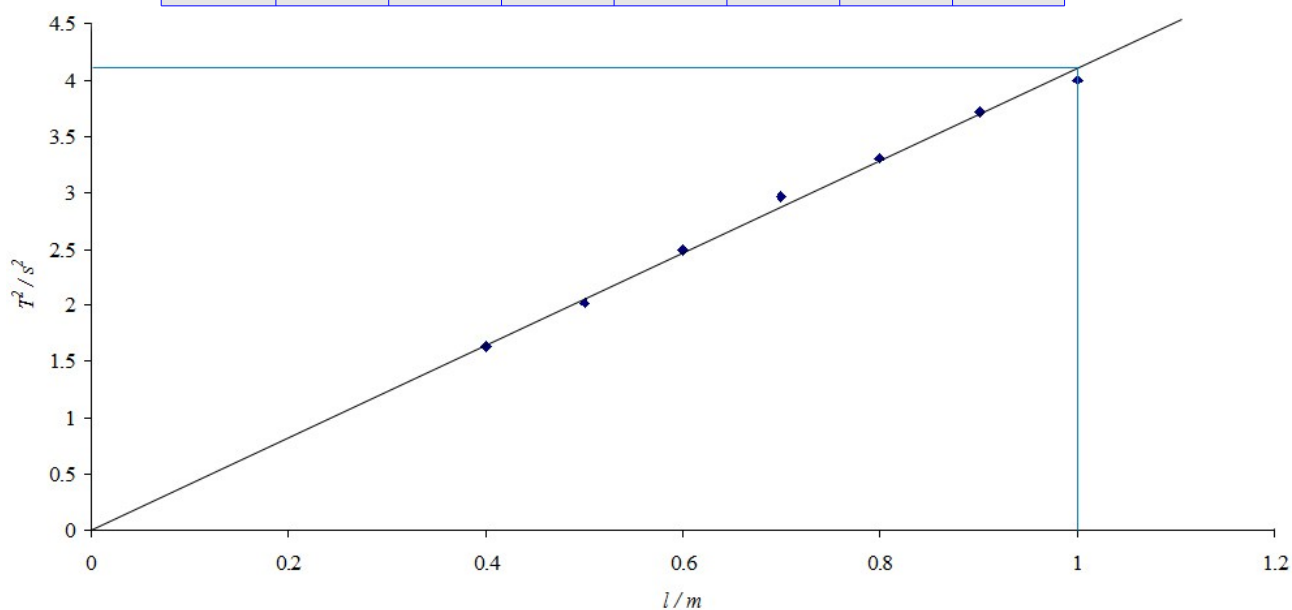
The time for one swing can be determined much more accurately by getting the time for many swings and taking an average. The error in timing one swing can be very large.

How did the student ensure that the length of the pendulum remained constant when the pendulum was swinging? (9)

The student used inextensible thread firmly clamped between two halves of a split cork

Using the recorded data draw a suitable graph to show the relationship between the period and the length of a simple pendulum. What is this relationship? (19)

l/m	0.40	0.50	0.60	0.70	0.80	0.90	1.00
t/s	38.4	42.6	47.4	51.6	54.6	57.9	60.0
T/s	1.28	1.42	1.58	1.72	1.82	1.93	2.00
T^2/s^2	1.64	2.02	2.50	2.96	3.31	3.72	4.00



The relationship is that $T^2 \propto l$ (Straight line through origin)
or $T \propto \sqrt{l}$

Use your graph to calculate the acceleration due to gravity.

(12)

The slope of our graph, T^2/l , can be got by taking the two points (0, 0) and (1, 4.1) as illustrated on graph. These points yield a slope of 4.1

$$\begin{aligned} \text{Now, } T^2 &= 4\pi^2 l/g \\ \Rightarrow g &= 4\pi^2 l/T^2 \\ &= 4\pi^2/\text{slope} \\ &= 4\pi^2/4.1 \\ &= 9.6 \text{ ms}^{-2} \end{aligned}$$