Dept. of Education and Science – Revised Sample Paper

Question 1.

In investigating simple harmonic motion, a simple pendulum was set up so that it could swing freely about a fixed point. The length of the pendulum was measured. The pendulum was allowed to swing freely through a small angle and the time for 25 oscillations, *t*, was found. This procedure was repeated for a series of values of the length *l*. The data obtained are shown in the table.

l/cm	40.0	50.0	60.0	70.0	80.0	90.0	100.0
t/s	31.1	34.5	38.8	42.5	44.4	47.8	49.6

Is the period of the pendulum proportional to its length?
Justify your answer.
Using the above data, draw a suitable graph on graph paper to show the relationship between the period of a simple pendulum and its length.
Hence determine a value for the acceleration due to gravity, *g*.
How is the pendulum set up so that it swings freely?

Is the period of the pendulum proportional to its length?

No

Justify your answer.

If the period were proportional to the length, then, when the length changed by a certain factor, the period would also change by that same factor. For example, when the length doubles, say from 40.0 cm to 80.0 cm, the period should also double. This clearly is not the case (44.4 is not close to 62.2 even allowing for experimental error).

Using the above data, draw a suitable graph on graph paper to show the relationship between the period of a simple pendulum and its length.

The following table gives the values of *l* along with the corresponding value for the period of the oscillation, T, squared.

l/cm	40	50	60	70	80	90	100
t/s	31.1	34.5	38.8	42.5	44.4	47.8	49.6
T/s	1.24	1.38	1.55	1.70	1.78	1.91	1.98
T^2/s^2	1.55	1.90	2.41	2.89	3.15	3.66	3.94

From the graph of T^2 against l it is clear that they are proportional to each other, that is, the length of the pendulum is proportional to its period squared. The graph is a straight line through the origin.

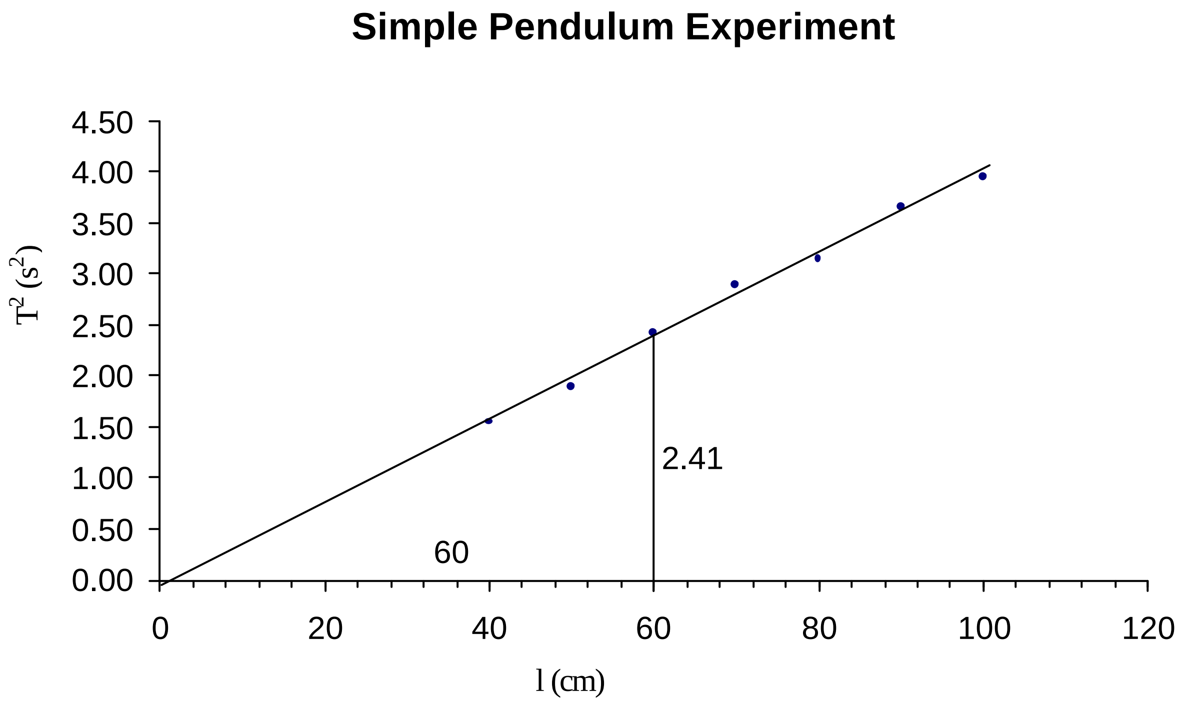
Hence determine a value for the acceleration due to gravity, *g*.

Choosing the points (0, 0) and (60, 2.41) from the graph we get a slope of 0.04. This slope is $\frac{T^2}{l}$.

$$T = 2\pi\sqrt{\frac{l}{g}}, \qquad T^2 = 4\pi^2\frac{l}{g}, \qquad \frac{T^2}{l} = \frac{4\pi^2}{g}$$

$$Hence\ the\ slope, 0.04 = \frac{4\pi^2}{g}$$

$$g = \frac{4\pi^2}{0.04} = 100\pi^2 cm.s^{-2} = \pi^2 m.s^{-2} = 9.8 m.s^{-2}$$



(Note: graph should be drawn so that it fits, within reason, onto the whole of the graph page)

How is the pendulum set up so that it swings freely?

The pendulum is suspended between two halves of a split cork