Relationship between pendulum length and period - using a light gate

Apparatus

A wireless lightgate.

Retort stand and clamp.

Small clip (crocodile clip or binder clip).

Pendulum mass (must fit easily through the light gate “forks”)

String

Ruler

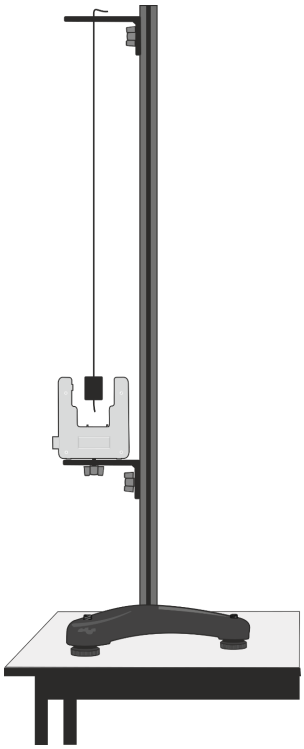
Data recording setup.

Use settings to change data collection Mode to timing.

Timing mode to Time

From A to A

Data collection to start when Start is selected and stop when stop is selected.



The pendulum was the controlling mechanism for the first accurate clocks. Until the pendulum properties were discovered we did not have clocks that could measure time with any precision. The pendulum period (time taken to move through one “swing”) is independent of its swing amplitude (the distance of the swing). How does its period vary as you change the length of the pendulum?

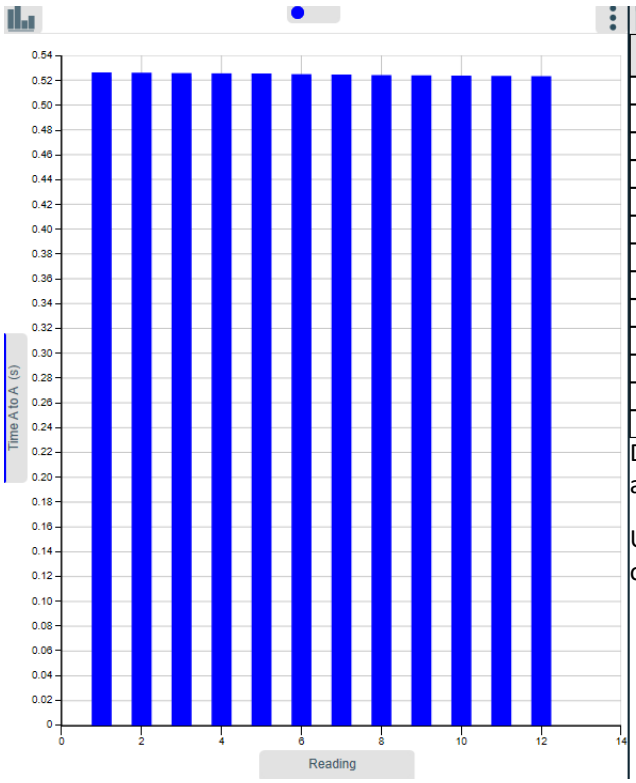
The period of a pendulum is the time it takes for it to complete one whole swing backwards and forwards.

Method

1. Assemble the apparatus as shown. Connect the Light gate to the software.
2. The practical uses Light gate A, A to A (period).
3. When the pendulum is at rest, the top of the bob should be level with the top of the Light gate arms. The bob should be in the centre (side to side) of the arms of the Light gate. You can use the moulding marks on the Light gate to help you align the bob.
4. Make sure that the pendulum can swing freely and moves between the arms of the Light gate.
5. Use a starting value for '**L**' (the length of the pendulum) of about 0.9 m. Measure the length from where the string leaves the top clamp to the centre of the pendulum bob. Write the value down in a results table.
6. Move the pendulum back and release it, you should have swing (amplitude*) of about 10 degrees or less.
7. After a few swings, select Start.
8. Collect 10 period measurements and select Stop.
9. Use Statistics (Stats) and find the average period time for 10 measurements
10. Repeat the experiment 5 more times varying the length of the pendulum by 2 cm each run.

*Amplitude is the height of the waveform from its lowest to its highest point. In this experiment, it represents the furthest distance the bob has moved from the 'rest' position.

Example data



Reading (-)	Time A to A (s)	Time A to A (s)
1	-	0.526208
2	-	0.525958
3	-	0.525718
4	-	0.525417
5	-	0.525389
6	-	0.524800
7	-	0.524448
8	-	0.524100
9	-	0.523904
10	-	0.523670
11	-	0.523392
12	-	0.523152
-	-	-

Display layout changed to give two panels, one as a bar chart and the other as a table.

Use the coloured dots over the graph to turn on or off the data you wish to examine

Results T vs. l		
Pendulum length (T) (m)	Period T (s)	T^2

Results and analysis

Plot graphs of Period vs pendulum length and period^2 vs. pendulum length.

Questions

1. What is the relationship shown, between period and length of pendulum, by the graph? Write down your answer as fully as possible.
2. How much did the period vary for a set length of pendulum? Try collecting the data for a long time, how much does it vary then?
3. What happens to the pendulum over time?
4. When you see a clock using a pendulum what is the clock work doing? What makes a pendulum clock accurate?

Extension work.

1. Does the mass of the pendulum have any effect on the period for a given length of string?
2. Use the graph to find the period for a given length of pendulum, verify by practice.
3. Use the equation that describes the relationship of the period to pendulum length and re-arrange to make an estimate of g (acceleration due to gravity)