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Date:
Group Members:

USING PENDULUM TO DETERMINE “g”

“What is “g” in SuTextCollege?”

BOS Syllabus Reference

“Students perform an investigation and gather information to determine a value for acceleration due to gravity using pendulum motion or computer-assisted technology and identify reasons for possible variations from the value 9.8 m/s^2.”

Aim

To determine the rate of acceleration due to gravity using the motion of a pendulum.

Apparatus

- retort stand
- boss head and clamp
- approximately 1 metre of string
- 50 g mass carrier or pendulum bob
- Stopwatch
- metre rule

Theory

When a simple pendulum swings with a small angle, the mass on the end performs a good approximation of the back-and-forth motion called *simple harmonic motion*. The period of the pendulum, that is, the time taken to complete a single full back-and-forth swing, depends upon just two variables: the length of the string and the rate of acceleration due to gravity. The formula for the period is as shown below:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

where T = period of the pendulum (s)
l = length of the pendulum (m)
g = rate of acceleration due to gravity (m/s^2).

Method

1. Set up the retort stand and clamp on the edge of a desk as shown in figure 1.7. Tie on the string and adjust its length to about 90 cm before attaching the 50 g mass carrier or pendulum bob to its end.

2. Using the metre rule, carefully measure the length of the pendulum from the knot at its top to the base of the mass carrier. Enter this length in your results table.

3. Set the pendulum swinging gently (30° maximum deviation from vertical) and use the stopwatch to time 10 complete back-and forth swings. Be sure to start and stop the stopwatch at an extreme of the motion rather than somewhere in the middle. Enter your time for 10 swings in the results table.

4. Repeat steps 2 and 3 at least five times, after shortening the string by 5 cm each time.

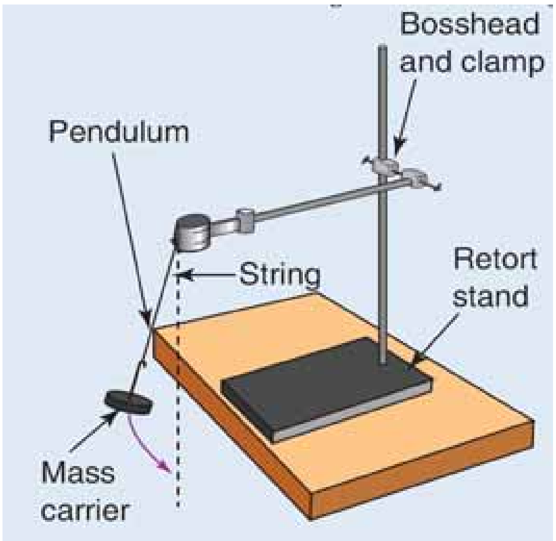

Figure 1.7 *Apparatus for practical activity 1.1*

Results

Record your results in the data table provided, and then complete the other columns of information.

Trial number	Length of the Pendulum, l (m)	Time for 10 oscillations (s)			Period, T (s)	Period squared, T^2 (s^2)	
1							
2							
3							
4							
5							
6							
7							
8							

Variables

List the variables of this investigation

Independent	Dependent	Control

Draw a graph of period squared versus length of the pendulum. Plot T^2 on the vertical axis and length on the horizontal axis.

Analysis

1. Your graph should display a straight-line relationship. Draw a line of best fit and evaluate the gradient.
2. Rearrange the pendulum equation given earlier to the form, $T^2 = kl$, where k is a combination of constants.

3. Compare this formula with the general equation for a straight line: $y = kx$. This comparison shows that if T^2 forms the y-axis and length, l, forms the x-axis, the expression you derived for k in step 2 should correspond to the gradient of the graph you have drawn. Write down your expression:

gradient = ________________________ (complete).

4. Use your expression to calculate a value for g, the acceleration due to gravity.

Questions

1. This method usually produces very accurate results. Can you suggest a reason why it should be so reliable?

2. What are the sources of error in this experiment?

3. What could you do to improve the method of this experiment to make it even more accurate?

4. Why did we draw the graph and work on the gradient rather than finding "g" from the formula for each trial and then taking the average?