Physics 11 IB **The Simple Pendulum**

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1 Aim

To investigate the motion of a simple pendulum and to derive a value for g, the acceleration due to gravity.

2 Planning

2.1 Hypothesis

By using other methods to determine the acceleration due to gravity g, the value of g should be close to 9.8 m/s^2.

2.2 Procedure

1. Measure, record and average a reasonable number of measurements of the period T for 6 to 8 different lengths.
2. Verify the equation of the pendulum $T = 2\pi\sqrt{\frac{L}{g}}$ by means of the graph of T^2 vs L and determine the value of g from the graph.

3 Data Collection

Length (m)	Period (s)
1.00	1.954
	1.959
	1.955
0.91	1.879
	1.888
	1.880
0.80	1.747
	1.754
	1.765
0.82	1.759
	1.757
	1.761
0.72	1.653
	1.645
	1.641
0.60	1.501
	1.506
	1.504

Table 1: Data Collection

4 Data Analysis

See Table 2 and attached graph.

$$\begin{aligned}\text{Slope} &= \tfrac{3.826}{1} \\ &= 3.826\ m/s^2\end{aligned}$$

$$\begin{aligned}\therefore \quad g &= \tfrac{(2\pi)^2}{3.826} \\ &= 10.3\ m/s^2\end{aligned}$$

Length $L(m)$	Period $T(s)$	Average T	T^2
1.00	1.954 1.959 1.955	1.956	3.826
0.91	1.879 1.888 1.880	1.882	3.543
0.80	1.747 1.754 1.765	1.755	3.081
0.82	1.759 1.757 1.761	1.759	3.094
0.72	1.653 1.645 1.641	1.646	2.710
0.60	1.501 1.506 1.504	1.504	2.261

Table 2: Data Analysis

5 Evaluation

In this lab, we were able to estimate the value of the acceleration due to gravity g on Earth by means of a simple pendulum. Because the length of a pendulum L, and the square of the period of the pendulum T^2 are directly proportional, we were able to determine g by calculating the slope of the T^2 *vs* L graph. From our calculations, this value turned out to be $10.3 m/s^2$, while the accepted value for the acceleration is $9.8 m/s^2$.

$$\text{Percentage Difference} = \frac{10.3-9.8}{9.8}$$

$$= 5.10\ \%$$

There are a few reasons for the small error in our estimation:

1. There was some uncertainty in measuring the length of the pendulum L.

2. There was also some uncertainty in timing the period of the pendulum T.

3. There was the force of air resistance present. The amplitude of the pendulum was thus constantly decreasing. During this lab, we assumed that the only force responsible for causing the pendulum to swing was the force of gravity.

4. There was also some friction at the pivot which could have altered our results.

Another important observation to be made is that the mass of the object that swings in the pendulum has no effect on the results (if air resistance is neglected). This is because the period of oscillation of the pendulum depends only on the length L of the pendulum and the acceleration due to gravity g at that point.

6 Conclusion

We have thus studied and investigated the factors that govern the motion of a simple pendulum. We have also determined a value for the acceleration due to gravity on Earth.

This method of determining g could prove useful in many situations. It is possible to determine the value for g for any planet with only a simple pendulum system at hand.

Also, when we move far away from the center of the Earth, the acceleration due to gravity decreases. The new value for g at this altitude could be determined with only a simple pendulum system available.

The acceleration due to gravity can thus be calculated easily at any place with the aid of a simple pendulum system.
