

PHY 1033C - Lab 5

Simple Pendulum

In today's lab, we will examine the relationship between the period of a pendulum and its length. Galileo had worked out a relationship between gravitational acceleration, g , and the length and period of a pendulum which we can check and get a measurement of the value of g . Galileo also suggested that the period was independent of the amplitude of the swing. **Note that steps with an asterisk are ones that specifically ask for data to be collected, and so should be completed before lab time is up.**

1. To measure the period, use one of the stop watches to time ten full swings (back and forth is one swing); then take the time and divide by ten to find the period. It is best to start and stop the watch when the pendulum bob goes through its highest point – it is easier to count out 10 swings this way than when using the lowest point.
- *2. We will first investigate Galileo's claim that a pendulum has the same period regardless of amplitude. Take data for $l = 1.00$ m for four different starting angles, 10° , 20° , 30° , and 45° . Create a table for this data.

Note: The starting angle need not be very precise. You can eye estimate the initial angle by starting at 45° and breaking it down into fractions from there.

3. How well did your four periods match each other? Was one particularly longer than the others? What does this say about the period's dependence on the amplitude of the swing?
- *4. Now, focus on the relationship between l and T . Create a table for l and T . Measure the period for at least four different values of l , we recommend 0.25, 0.50, 0.75, and 1.00 m, and also note that if l were 0.0 m, then T would be 0.0 s, so you can include that as part of your data too.
5. Add an extra column to the table for T^2 . Since the relationship that Galileo found was

$$l = \left(\frac{g}{4\pi^2} \right) T^2$$

the length l linearly increases with T^2 and so if you create a plot with l as the vertical axis and T^2 as the horizontal axis, the slope of your graph should be $g/4\pi^2$. Make your graph plenty **big**.

6. Draw in a best fit line and find its slope to estimate g by

$$g = 4\pi^2 \times \text{slope}$$

How well does your experimental estimate match the known value for g of 9.81 m/s^2 ? Compute the percent difference between your g and the known value.

$$\% \text{Diff} = \left| \frac{g - 9.81 \text{ m/s}^2}{9.81 \text{ m/s}^2} \right| \times 100\%$$