

Gravitational Acceleration Lab

Objective: Determination of (g_{planet}) the gravitational acceleration of various planets from the period data of the pendulum by using the dimensions and period of a pendulum to determine the gravitational acceleration of the planet on which the pendulum is set in motion.

Part 1. Gravitational Acceleration on Earth

Pre-Phase (Homework):

Go to the University of Colorado – Boulder PhET website. Conduct four experiments with a 1 kg mass and a 10° pull-back angle from the vertical as controlled variables. The pendulum lengths should be between 0.250 m to 2.500 m, inclusive. Using the photogate timer, determine the period of the pendulum, in seconds.

The studied planet is: Earth.

Table 1. Relationship between the Length, l (m), and the Period of the Pendulum, T , (s).

	Experiment #1	Experiment #2	Experiment #3	Experiment #4
String Length (m)				
Period, T (s)				

Problem Lab:

Determination of the Acceleration of Earth, g_{Earth} , from the behavior of a pendulum.

- Using the data in Table 1, find the product between the string length and $4\pi^2$ and record it in the first row of Table 2, below.
- Calculate the square of the periods on Table 1 in the second row of Table 2, below.

Table 2. Relationship between the String Length, l (m), and the Square of the Period of One Oscillation of a Pendulum, T^2 , (s^2).

	Experiment #1	Experiment #2	Experiment #3	Experiment #4
String Length times $4\pi^2$ (m)				
Square of the Period (s^2)				

- At small angles, θ , the Period of a Pendulum, T , and the length of the string, l , are related by the formula:

$$T^2 = \frac{4\pi^2 l}{g}, \text{ where } g \text{ is the acceleration by gravity.}$$

$$\text{Rearranging the equation, } 4\pi^2 l = g T^2$$

- On graph paper, create a graph with T^2 on the x-axis and $4\pi^2 l$ on the y-axis. Draw a line of best fit and calculate the slope. The average value of g is the slope of the line, in m/s^2 .
- What is the average value of the determined g for Earth? _____
- The actual gravitational acceleration on Earth is 9.80 m/s^2 . Calculate the percent error in your measurement.

The percent error is:_____.

Part 2. Gravitational Acceleration on Another Planet

Pre-Phase (Homework):

Go to the University of Colorado – Boulder PhET website. Conduct four experiments with a 1 kg mass and a 10° pull-back angle from the vertical as controlled variables. The pendulum lengths should be between 0.250 m to 2.500 m, inclusive. Using the photogate timer, determine the period of the pendulum, in seconds.

The studied planet is: _____ (Choose a planet aside from Earth to repeat the experiment).

Table 1. Relationship between the Length, l (m), and the Period of the Pendulum, T , (s).

	Experiment #1	Experiment #2	Experiment #3	Experiment #4
String Length (m)				
Period, T (s)				

Problem Lab:

Determination of the Acceleration of the planet, g _____, from the behavior of a pendulum.

- 1- Using the data in Table 1, find the product between the string length and $4\pi^2$ and record it in the first row of Table 2, below.
- 2- Calculate the square of the periods on Table 1 in the second row of Table 2, below.

Table 2. Relationship between the String Length, l (m), and the Square of the Period of One Oscillation of a Pendulum, T^2 , (s^2).

	Experiment #1	Experiment #2	Experiment #3	Experiment #4
String Length times $4\pi^2$ (m)				
Square of the Period (s^2)				

- 3- At small angles, θ , the Period of a Pendulum, T , and the length of the string, l , are related by the formula:

$$T^2 = \frac{4\pi^2 l}{g}, \text{ where } g \text{ is the acceleration by gravity.}$$

$$\text{Rearranging the equation, } 4\pi^2 l = g T^2$$

- 4- On graph paper, create a graph with T^2 on the x-axis and $4\pi^2 l$ on the y-axis. Draw a line of best fit and calculate the slope. The average value of g is the slope of the line, in m/s^2 .
- 5- What is the average value of the determined g for planet? _____