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THE SIMPLE PENDULUM

Purpose

To measure time with a stopwatch and to calculate the acceleration due to gravity using a simple pendulum.

Apparatus

Stand, clamp, metal sphere, string, stopwatch, meter ruler.

Theory

The period of oscillation of a simple pendulum is given by the relation $T = 2\pi\sqrt{\frac{L}{g}}$ where

T is the period in seconds
L is the length in meters
g is the acceleration due to gravity.

The standard value for g is 9.81 m/s^2. If the value of T is measured for a particular length of pendulum L, an experimental value for g may be determined by rewriting the above equation to give $g = \frac{4\pi^2 L}{T^2}$

Procedure

1. Set up the stand and clamp and suspend the metal sphere by the string from the arm as shown. Adjust the length of the pendulum to be 100 cm to the nearest mm. This is the length from the point of support to the center of the metal sphere.

2. Displace the sphere between 5 and 10 cm sideways and time 50 complete oscillations of the pendulum with the stopwatch. Read the time to the nearest 0.01s. Remember to count zero when you let go of the metal sphere.

3. Repeat procedure (2) with the length of the pendulum 95, 90, 85, 80, 75, 70, and 65 cm and enter the data in the table. In each case set the length of the pendulum to the nearest mm.

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Calculations

1. Calculate the period of oscillation for each length of the pendulum to 3 decimal places by dividing the times by 50.
2. Calculate the values of the acceleration due to gravity to **3 significant figures** using the equation above.
3. Determine the average value of the acceleration due to gravity and its percent error from the standard value.
4. Now open the below given link in your browser. (Link only works in the school.) http://10.0.10.49/webMathematica/index.html
   and click on the **data analysis** page.
   Using the page draw (τ^2 - L) graph. What does the slope represent? Find the gravitational acceleration, g, using the slope. (π=3.141592)
   PRINT out the plot and the results.

Data

Length of pendulum in cm	Time for 50 oscillations in seconds	Time (τ) for 1 oscillation in sec (τ = Period)	τ^2 (sec^2)	Calculated value of g in m/s^2
100				
95				
90				
85				
80				
75				
70				

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65				

Average value of the acceleration due to gravity = _____ m/s^2

$$\text{Error} = \frac{|Truevalue - measuredvalue|}{Truevalue} x100 = \_\_\_\_\_$$

Questions

1. What is the advantage of measuring the time for 50 oscillations in order to find the period, compared with measuring one oscillation directly?

2. Do you need to correct your time measurement for your reaction time? If not, why not?

3. What effect does the mass of the pendulum bob have on the period of the pendulum?

4. What would be the length of a "seconds pendulum", that is a pendulum of period exactly one second?

5. If you were to have performed this experiment on the moon where the acceleration due to gravity is only 1/6 that on earth, would you have expected different values of the period? If so, how different?

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