Physics 202 Lab 1
Simple Harmonic Motion

Apr 8, 2013

Equipment

- Meter sticks
- Graph paper
- Force sensors
- Photogates
- Height-finder protractors
- Thread
- Scissors
- Stopwatches
- Pendulum clamps
- Pendulum weight sets
- Small springs
- Large springs
- Lab stands
- Hanging weight sets

Simple Pendulum

Recall that the frequency for a pendulum is

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$

Basic Simple Pendulum

Set up a pendulum the lab stand, clamp, thread, and a hanging mass. Orient the photogate so that the pendulum swings through the sensor.

Using the formula above, calculate the frequency of the pendulum you have constructed.

Using the Data Studio feature specifically designed for a photogate and pendulum, select to view the period, T, of your pendulum in table format. Verify the accuracy of this equation for the pendulum you have constructed by calculating the average measured frequency.

Calculate the percent difference between your calculated and measured values and list some possible sources of error.

Frequency Dependence on Mass

Now explore the effect on period of changing the mass. Double the mass on your pendulum and measure the average frequency. Is there a difference? If so, why?

Frequency Dependence on Initial Angle

Recall that our equation for frequency, f , was derived using the assumption that θ is less than $10°$. Measure and record the period for several larger amplitudes. Describe the effect that progressively increasing θ has on the validity of the equation for frequency.

How to Make a Clock

Suppose you were making a clock, and you wanted to create a pendulum with a period of exactly 1.00 second. What would the corresponding frequency be? Calculate the length of this pendulum. Set up a pendulum of this length, and verify your result.

Mass on a Spring

Suppose that instead you wanted to have a mass on a spring oscillate with a period of 1.00 second. Recall that the frequency for a mass on a spring is:

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

Determine Spring Constant

In order to construct our clock we need to determine our spring constant. Hang the small spring from the lab stand and clamp. Hang a small mass such that the spring just begins to stretch and measure the distance between the table and the bottom of the spring.

Now hang five difference masses from the spring and measure the distance between the table and the bottom of the spring. The incremental mass is what causes the extra stretch. You can now calculate a spring constant for each trial using $F = kx$ where F is the extra weight (remember, $W = mg$) and x is the extra stretch.

How to Make a Clock (Again)

Now that you have a good idea of the value of the spring constant for the small spring, calculate the mass that you would want to have oscillating on this particular spring in order to observe a period of 1.00 second.

Does it work? Test your calculation and describe your result including possible sources of error.