Pendulum Lab - Chapter 9

Do you know what a *pendulum* is? You can construct a pendulum by tying one end of some thread to a washer and attaching the other end to a surface so that the washer is suspended and swings forward and backward freely.

The *period* of the pendulum is the amount of time it takes for the washer to swing forward *and* backward once. The period of a pendulum depends on the length of the thread. In this lab, you will discover the relationship between the period of a pendulum and the length of its thread.

Materials

You will need the following materials:

1. thread
2. scissors
3. a timing device
4. tape
5. a washer (or some other small, dense, object that can be tied to the thread)
6. a meter stick

Preparation

Knot one end of the thread to the washer. Tape the other end of the thread to a surface well so that the washer is suspended and swings freely. The distance from the middle of the washer to the tape should be at least 100 centimeters.

Recording the Data

Record the distance from the middle of the washer to the tape. Then time how long it takes for the washer to swing back and forth four times. Divide this time by 4 to find the period of the pendulum. Repeat this procedure several times. Discard the times that ate very different from most of the times, and average the remaining times.

Repeat this procedure for various lengths of thread. When the thread is quite short, time how long it takes for the washer to swing back and forth eight times and divide this time by 8 to find the period.

Analyzing the Data

1. Display your data in a table.

2. Let $f(L)$ be the period (in seconds) of the pendulum, where L is the length (in centimeters) of the thread. Use a graphing calculator to draw a scattergram of your data.

3. Find an equation for f.

4. Use a graphing calculator to graph your model and the scattergram in the same viewing window. Graph your model and the scattergram by hand. How well does f model the data?

5. Find all intercepts of your model, and describe what they mean in this situation.

6. Is f an increasing function, a decreasing function, or neither? What does that mean in this situation?

7. Use your model to estimate the period of the pendulum if the thread's length is 150 centimeters.

8. Use your model to estimate the length of the thread if the pendulum's period is 0.1 second.

9. Suppose that a big chunk of concrete attached to some thin, strong cable is suspended from the skydeck of the Sears Tower in Chicago. The skydeck is 1353 feet above Wacker Drive. Assume that the concrete, when at rest, almost touches the street. Estimate the period of this pendulum. (Note: You can use f to model the Sears Tower pendulum, even though a concrete chunk weighs a lot more than a washer.)

10. What is the length of a pendulum that has a period of 1 minute?