Laboratory Investigation Name _____

Physics@Frisch: Form L7.1A Date _____ Period _____

Harmonic Motion

PROBLEM

How do you describe the back-and-forth motion of a pendulum?

INTRODUCTION

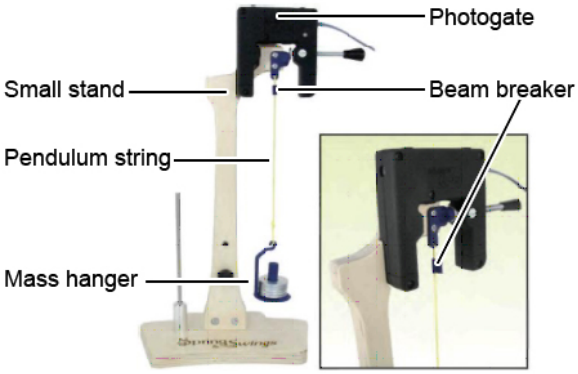
One type of motion repeats itself over and over like a child going back and forth on a swing. This kind of motion is called harmonic motion. The word harmonic comes from the word harmony meaning "multiples of." Any system that exhibits harmonic motion is called an oscillator. In this investigation, you will: experiment with a pendulum and see what you can do to change the period; and set up your pendulum to measure a 30-second time interval.

MATERIALS (*per group*)

Beam breaker; Data Collector; Mass hanger; Measuring tape; Pendulum string; Photogate; Small stand; Washers.

PROCEDURE

1. Set up the pendulum. Slide the pendulum string into the bracket at the top of the stand as shown at right.. Attach the mass hanger to the loop end of the pendulum string. Attach the beam breaker to the string just below the bracket (see photo at right). Attach a photogate to the top of the stand as shown at right. Plug the photogate into the Data Collector (photogate A input).



2. Turn on the Data Collector and choose timer mode from the home screen. In timer mode, choose the period function (p). Period is the time for one cycle. The pendulum breaks the beam once as it swings through its complete cycle. Thus, the DataCollector's period readout corresponds directly to the time it takes the pendulum to complete one full cycle.

3. In this experiment, the period of the pendulum is the dependent variable. There are three independent variables: the pendulum mass, the amplitude of the swing, and the length of the pendulum string.

a. Put a few washers on the mass hanger, adjust the string length to about 15 cm, and swing the pendulum through the photogate. Notice the period measured by the photogate. Record the result in the data table on the next page. You can change the mass by varying the number of washers on the mass hanger. Double the number of washers and repeat your observation.

b. The length of the string can be changed by removing it from the slotted bracket and placing it back in. Adjust the length of the string to about 8 cm and repeat your observations.

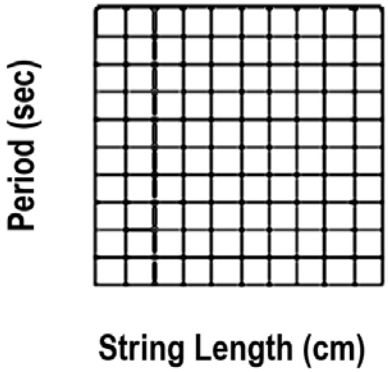
c. The amplitude can be changed by varying the starting angle of the pendulum (low, medium, and high angle). Vary the angle and make your observations.

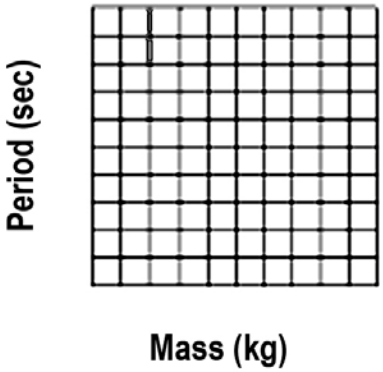
4. Design an experiment to determine which of the three variables has the greatest effect on the period of the pendulum. Your experiment should provide enough data to show that one of the three variables has much greater an effect than the other two. Be sure to use a technique that gives you consistent results. When you are changing a variable, it is a good idea to change it by a lot. For example, when you vary the mass, try experimenting with no washers, 5 washers, and 10 washers. Change each variable three times to see the effect. Record your observations in the data table on the next page

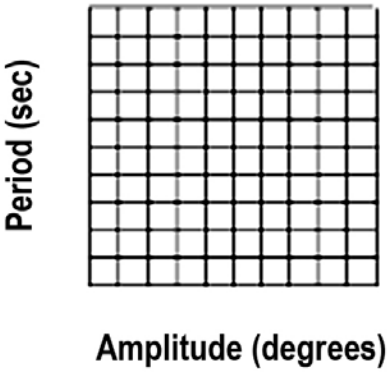
5. Make a separate graph to show how each variable affects the period. To make comparison easier, make sure all the graphs have the same scale on the y-axis (period).

OBSERVATIONS

Trial	Length of Pendulum	Period	Mass (Number of washers)	Period	Amplitude of Pendulum	Period
1						
2						
3						







CONCLUSIONS

1. Of the three things you can change (length, mass, and amplitude), which has the biggest effect on the pendulum, and why? In your answer, you should consider how gravity accelerates objects of different mass.

2. If mass does not affect the period, why is it important that the pendulum in a clock be heavy? _____

3. Based on your data, how would you design a clock with a pendulum that has a period of 1 second. _____