INVESTIGATING THE FACTORS AFFECTING A SIMPLE PENDULUM

Experiment 5

INTRODUCTION:

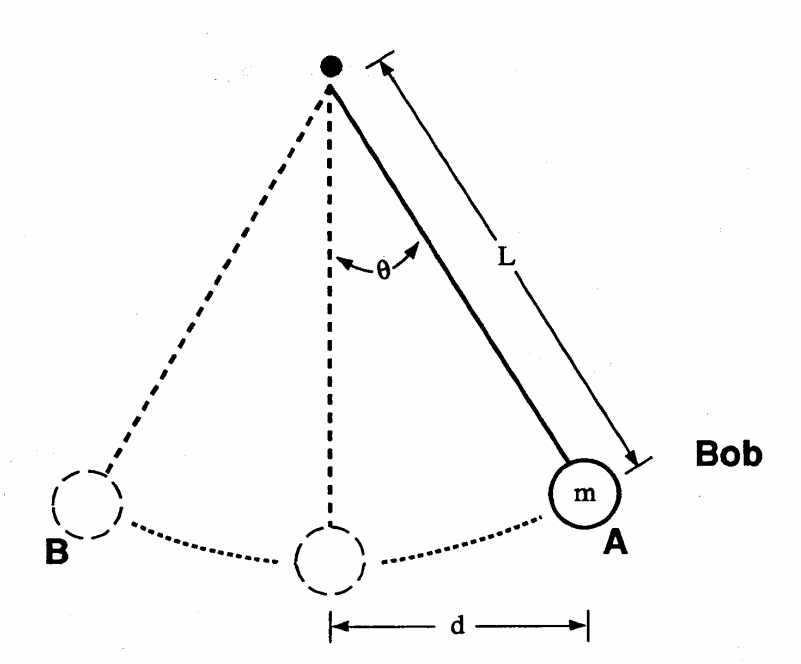
Galileo was a brilliant scientist who lived in the fifteenth and sixteenth centuries. He made many important discoveries. When he was just 17 years old he noticed that a swinging lamp always took the same amount of time to go from left to right and back again. This discovery led to our understanding of the pendulums.

If we suspend a small, massive object (the bob) with mass **m** at the end of a piece of string with a length **L**, we have a simple pendulum. If the pendulum is pulled back a distance, **d**, and released, it will swing back and forth with great regularity. The period, **T**, is the time taken for one swing of the bob back and forth. (See diagram below)

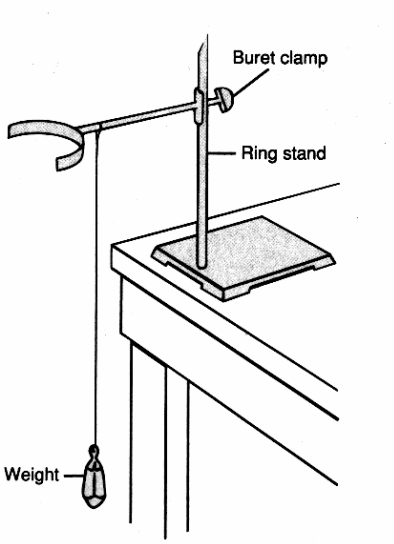
But why do pendulums act so predictable? What affects the behavior of pendulums? In this investigation you will study the behavior of pendulums as several factors are changed. These factors include the mass of the bob, the lenth of the string and the amplitude of the swing. The amplitude is the distance (**d**) the bob is pulled before being dropped.

APPARATUS& MATERIALS:

- Ruler
- Support and clamp
- String
- Various bobs
- Photogate timer



PROCEDURE:



Part A: The Effect of the Mass of the Bob

1. Use the balance to find the mass of three different bobs made from different materials.
2. Set up the pendulum as shown in the diagram to the right with string length of about 40 cm. Be sure the pendulum swings freely through the photogate opening. Start with the wooden bob, and set the photogate timer on the pendulum mode.
3. Draw the bob back 5.0 cm and release. Record the period of the pendulum and repeat the measurement three times.
4. Replace the bob with the aluminum bob, and repeat the measurements, making sure the length and the amplitude of the swings remain the same.
5. Replace the bob with the steel bob, and repeat the measurements, making sure the length and the amplitude of the swings remain the same.

Part B: The Effect of the Amplitude of the Swing

1. Use the pendulum with the steel bob, as it was set up for the last run in Part A. Keep the pendulum length the same. Therefore, the first column in Part B can be completed using the data from the last column in Part A.
2. Repeat the experiment, running three trials with the bob drawn back 7.0 cm before release.
3. Repeat the experiment, running three trials with the bob drawn back 9.0 cm before release.

Part C: The Effect of the Length of the Pendulum

1. Use the pendulum with the steel bob, as it was set up for the last run in Part A. Use the meterstick to measure the length of the string from the pivot point to the middle of the bob. This will be the longest length you will use, therefore, the first column in Part C can be completed using the data from the last column in Part A.
2. Shorten the pendulum about 10 cm, and measure the length of the string to the nearest 0.1 cm. This is the medium pendulum. Run three trials at this length with a 5.0 cm amplitude.
3. Shorten the period another 10 cm, and remeasure the length to the nearest 0.1 cm. This is the short pendulum. Run three trials at this length with a 5.0 cm amplitude.

Name:_____

REPORT FORM
Experiment 5

Part A: The Effect of the Mass of the Bob

	Time in seconds for 1 period		
	Wooden bob (mass _____g)	Aluminum bob (mass _____g)	Steel bob (mass _____g)
Trial 1			
Trial 2			
Trial 3			
Average			

Part B: The Effect of the Amplitude of the Swing

	Time in seconds for 1 period		
	5.0 cm amplitude	7.0 cm amplitude	9.0 cm amplitude
Trial 1			
Trial 2			
Trial 3			
Average			

Part C: The Effect of the Length of the Pendulum

	Time in seconds for 1 period		
	Length of long pendulum _____cm	Length of medium pendulum _____cm	Length of short pendulum _____cm
Trial 1			
Trial 2			
Trial 3			
Average			

ANALYSIS OF DATA:

1. Draw three graphs, one of each variable vs. the period of the pendulum.

2. Analyze your graphs to determine which factor(s) affect the period of the pendulum, and answer the following questions.

QUESTIONS:

1. Complete the statements below:
   A. In part A, the steel bob was _____times heavier than the aluminum bob, and _____times heavier than the wooden bob. Within the margin of probable experimental error, does the period of the pendulum depend on the mass of the bob? _____. If yes, does the period **increase** or **decrease** with increasing mass of the bob?_____

   B. In part B, the third amplitude was _____times greatger than the second amplitude, and _____times greater than the first amplitude. Within the margin of probable experimental error, does the period of the pendulum depend on the amplitude? _____. If yes, does the period **increase** or **decrease** with increasing amplitude?_____

   C. In part C, the long pendulum was _____times longer than the medium pendulum, and _____times greater than the short pendulum. Within the margin of probable experimental error, does the period of the pendulum depend on the length of the pendulum? _____. If yes, does the period **increase** or **decrease** with increasing length?_____

2. Why should only one variable be changed at a time?

3. What force causes a pendulum to continue swinging?

4. Why does a pendulum eventually stops swinging?