Investigating the Pendulum

PSI Physics Name_____

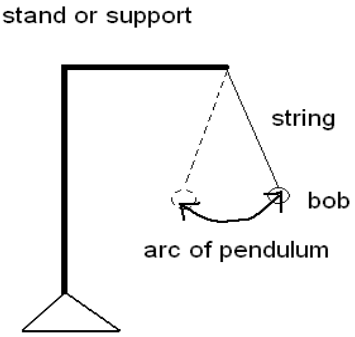
An experiment to investigate the pendulum

Problem: Does the period of a pendulum depend on the length of the string? Does the period of a pendulum depend on the pendulum's mass? Does the period of a pendulum depend on the pendulum's amplitude?

Theory: A simple pendulum consists of a mass, called the pendulum bob, suspended from a support by a thread. A complete swing of the pendulum is over and back. The time for a complete swing is called the period, T, of the pendulum. This is usually measured in seconds.

When a pendulum swings through a small arc it's bob undergoes simple harmonic motion. The force causing the bob to swing along the arc is greatest when it's speed is least. The force is least when the speed of the bob is greatest.

During this investigation you will attempt to verify Galileo's early observation that the period of a pendulum depends only upon its length.



Materials:

- Pendulum support
- Stand
- Nylon thread (100-120 cm)
- Meter stick
- Stopwatch
- Small pendulum bobs (steel, wooden, aluminum)
- Balances.

Procedure:

Part A

1. Measure the masses of the three bobs. Write the masses in the appropriate places in Table 1.
2. Suspend the wooden bob from the pendulum support (use nylon thread)
3. Measure the length pendulum. Fill this in Table 1.

4. Displace the bob from the equilibrium position, and release it.
5. When the starts to swing, measure the time with the stopwatch for 10 full swings. Remember: over and back equals one swing. Write the time in Table 1.
6. Instead of the wooden bob suspend the aluminum bob from the pendulum support (keep the string the same length). Displace the bob from the equilibrium position and release it.
7. When the bob starts to swing, measure the time with the stopwatch for 10 full swings. Remember: over and back equals one swing. Write the time in Table 1. Stop the pendulum and repeat this process two more times.
8. Instead of aluminum bob suspend the steel bob from the pendulum support (keep the same length). Displace the bob from the equilibrium position, and release it.
9. When the bob starts to swing, measure the time with the stopwatch for 10 full swings. Remember: over and back equals one swing. Write the time in Table 1. Stop the pendulum and repeat this process two more times.
10. Columns 1-5 of Table 1 should be filled out now. Calculate the period of the pendulum by using formula T = t/N (N = 10 swings and t = elapsed time). Record all numbers in Table 1.
11. Use the data from Table 2 to sketch the graph: period vs. length (T vs. L). Plot length on the horizontal (x) axis and plot period on the vertical (y) axis. Be sure to include the following on your graph.
    - Title
    - Label x-axis
    - Label y-axis
    - Put units on the x and y axes
    - Make sure your increments are evenly spaced
    - Sketch a smooth curve between your points (you don't have to connect all the points

Table 1

	1	2	3	4	5	6
Block	Trial	Mass of Bob,(g)	Length of Pendulum, (cm)	Number of vibration N	Elapsed Time, (s)	Period, T= t/N (s)
Wood				10		
Wood				10		
Wood				10		
Aluminum				10		
Aluminum				10		
Aluminum				10		
Steel				10		
Steel				10		
Steel				10		

Part B

1. To investigate the relations between the period of the pendulum and the length use the pendulum with the steel bob.
2. Arrange the length of the pendulum to 20 cm.
3. Displace the bob from the equilibrium position, and release it.
4. When the bob starts to swing, measure the time with the stopwatch for 10 full swings. Remember: over and back equals one swing. Write the time in Table 2.
5. Repeat Steps 3-4 with different lengths (40 cm, 60 cm, 80 cm, 100 cm).
6. Calculate the period of the pendulum by using formula T = t/N (N = 10 swings and t = elapsed time). Record all numbers in Table 2.

Table 2

	1	2	3	4
Trial	Length, L (cm)	Number of Vibrations, N	Elapsed time t (s)	Period of pendulum, T (s)
1	20	10		
2	40	10		
3	60	10		
4	80	10		
5	100	10		

Conclusion:

1. Make a conclusion about your major result, and write it below.

2. Does the period of the pendulum depend on the mass of the bob? Explain.

3. Does the period of the pendulum depend on the length of the thread? Explain.

4. The length of the pendulum is increased by factor 4. How will the period change?