

The Pendulum Swings

Determining the Variables that Affect a Pendulum

In this laboratory activity you will determine the relationship between the period T of a pendulum and its mass m , amplitude A , and length L . Your teacher will instruct you on how to construct your pendulum. You will take and record measurements throughout this activity and you will create your own data tables to organize and display your data. You will use computer graphing software such as Graphical Analysis™ to construct your data tables and graphs and then import them into a word processing program such as Microsoft® Word to complete your lab report. The questions that follow, with appropriate answers, should be typed into your report.

MATERIALS

meter stick	ring stand
2 meters of string	C-clamps to secure the ring stand base to the table
3 masses and hangers*	stopwatch
pendulum clamp	balance
scissors	protractor
*1- or 2-hole stoppers will also work	computer graphing software

PROCEDURE

Listen carefully to your teacher's instructions. You will be asked to describe your actual procedure in your laboratory report.

Name _____

Period _____

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LAB REPORT

Include the following when writing your lab report:

I. Title

II. Purpose

III. Labeled Apparatus Sketch

IV. Procedure

V. Data

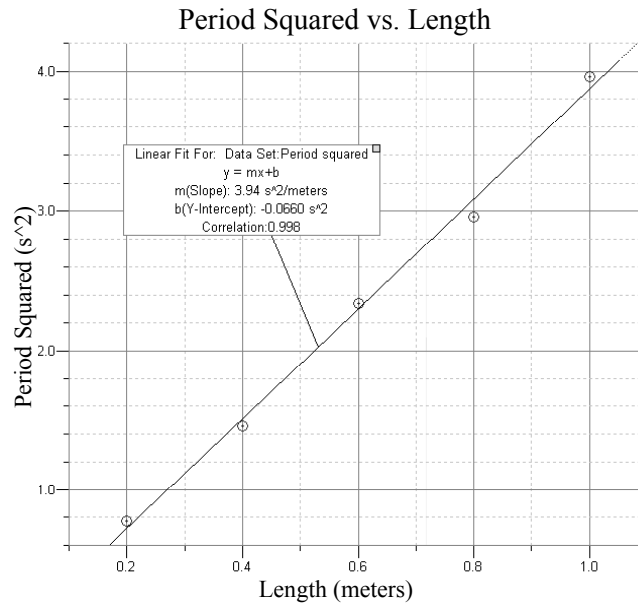
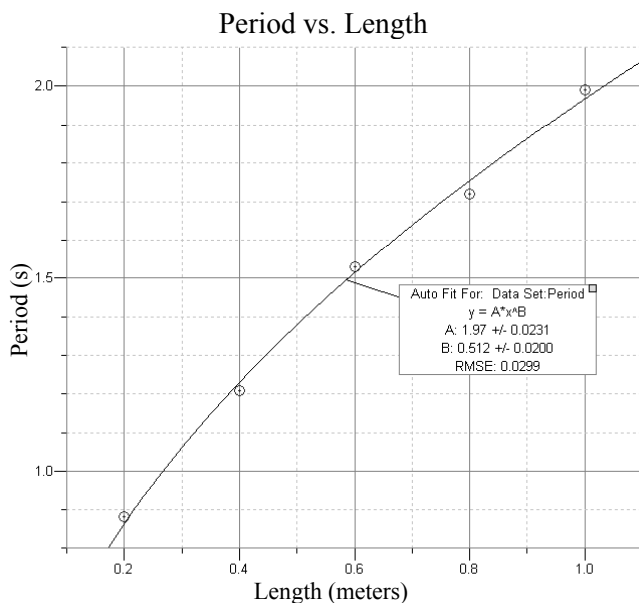
VI. Analysis

VII. Conclusion (Include the answers to the Conclusion Questions in this section)

CONCLUSION QUESTIONS

1. What are the variables in this experiment?
2. What data should be recorded for your pendulum?
3. What steps did you take to maximize accuracy and precision and minimize your systematic error while collecting your data?
4. What effect does varying the mass of the pendulum have on its period? Justify your answer.
5. What effect does varying the amplitude of swing of the pendulum have on its period? Justify your answer.
6. What effect does varying the length of the pendulum have on its period? Justify your answer.
7. According to your data relating the period of the pendulum to its length, would it be accurate to say that the period of a pendulum is *directly proportional* to its length? Explain your answer.

8. Your graph of Period vs. Length is not a straight line. Using the analysis feature on your graphing program, find an equation that relates the period to the length.
9. The standard equation which relates the period of a pendulum to its length is $T = 2\pi\sqrt{\frac{L}{g}}$, where g is the acceleration due to gravity, 9.80 m/s^2 . How well does your data match this equation?
10. Using the period for the longest length of your pendulum, determine a value for the acceleration due to gravity g . Find the percent error between your value for g and the accepted value of 9.80 m/s^2 .
11. A student fixes a pendulum to a ring stand and clamps the ring stand to a table. The table is then placed in an elevator, and the period of the pendulum is measured for several different lengths while the elevator is moving. The data is then plotted in the Period vs. Length and Period Squared vs. Length graphs below.



Using one or both of the graphs, determine a value for the apparent acceleration due to gravity, and whether the elevator is accelerating upward or downward. Justify your answers.