

Period of a Pendulum Lab

Teacher's Guide

Topic:

Waves

The following information is provided to the student:

Question:

What variable(s) effect the period of a pendulum and what mathematical equation(s) describe the dependency?

Purpose:

To determine the variable(s) effecting the period of a pendulum and to write a mathematical equation which relates the period to the variable(s) effecting it.

A complete lab write-up includes a Title, a Purpose, a Data section, a Conclusion and a Discussion of Results. The Data Section should include several tables of data with labeled column headings (and units) to demonstrate a systematic study of the effect of mass, amplitude and length upon the period of the pendulum. Variables which appear to effect the period should be plotted in an effort to determine the equation. Power regression analysis should be performed in order to determine the power equation relating the pendulum to the variable which effects it. Class data should also be included. The Conclusion section should respond to the two-part question raised in the Purpose. The Discussion of Results should describe the evidence which led to your conclusion. Variables not effecting the period should be identified and any minor variation in period resulting from changes to these variables should be interpreted in light of your conclusion. The reliability of your experimentally-derived equation should be evaluated by a comparison to a theoretical equation. Percent error analyses should be performed for the coefficient and the power.

Materials Required:

Pendulum system; photogate timer; meter stick; protractor; hooked mass set.

Description of Procedure:

Students place a hooked mass on the end of a string in order to construct a pendulum. A photogate timer is placed on the lab table and adjusted so that the pendulum safely passes back and forth through the gate. Students use a systematic and controlled procedure to investigate the effect of mass of bob, amplitude of motion, and length of the string upon the period of the pendulum. Data are collected and (where applicable) plotted and analyzed in order to determine the equation relating the period to the variables which noticeably effect it.

Alternative Materials and Procedure:

A stopwatch can be used in place of a photogate timer. If using a stopwatch, recommend that students measure the time for 5 or 10 or ... back and forth periods.

Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

The Laboratory

Suggestions, Precautions, Notes:

1. This lab serves as an effective assessment of students' ability to conduct a controlled investigation of the effect and non-effect of several variables upon another measurable quantity. After defining terms, it might be wise to sit back, stay out of the students' way and observe to see if they have acquired such a skill.
2. Use the Pendulum setting on the photogate to directly measure the time for one period.

Auxiliary Materials:

None

Scoring Rubric:

| W2. Period of a Pendulum Lab | Score |
|--|--------------|
| <p>___ Included, labeled and organized all parts of the lab report.</p> <p>___ Data section includes several tables of data – one for each variable; column headings and units are stated. Data appear to be systematically collected ; controlled the variables well. Data appear accurate. Included a graph of period versus the independent variable (the one which has an effect on the period). Performed power regression, recorded the statistics (A, B, power and R) and wrote the equation; avoided y and x in the equation and used symbols of actual variables being studied.</p> <p>___ Conclusion identifies the variables effecting and not effecting the period and identifies the equation relating the period to the length of the pendulum. Defined symbols used in the equation.</p> <p>___ Discussion of Results explains why the variables not effecting the period were ruled out; references data to support the conclusion. Identified the experimentally-derived equation relating the period to the length. An error analysis is performed to evaluate reliability of equation; compares equation to that found in the textbook or other locations. Performs percent errors for the coefficient value and the power value.</p> | ___/___ |

Connections to The Physics Classroom Tutorial:

Readings on pendulum motion are not currently available.

Connections to Minds on Physics Internet Modules:

There are no sublevels of Minds on Physics on the topic of pendulum motion.