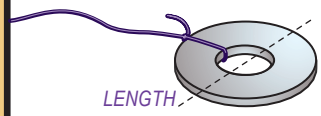
Another FREE SAMPLE LAB from TOPS LEARNING SYSTEMS!

This **TOPS Idea** is taken from an original series of black-and-white line masters, adapted to stand alone as an independent mini-lesson. Please purchase our original book to get the whole in-depth program.

pendulum math

…adapted from **PENDULUMS #01** by TOPS Learning Systems

1. Make three thread-and-washer pendulums with these **L**engths:

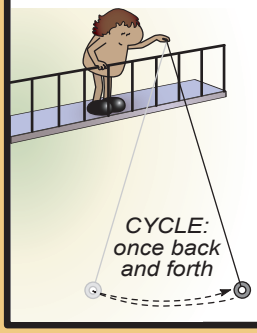


L_1 = 25 cm
L_2 = 100 cm
L_3 = 225 cm

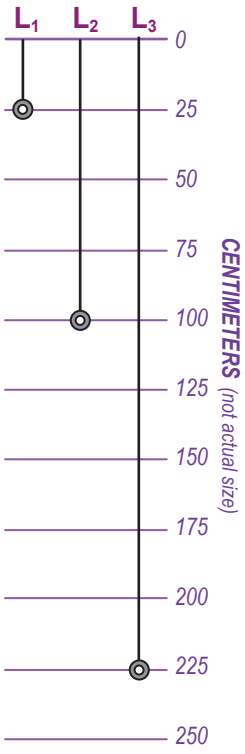
2. Count **T**ime in seconds for each pendulum to make one cycle (back and forth):

T_1 = _____s/c
T_2 = _____s/c
T_3 = _____s/c

3. Show that **$L = 25\ T^2$**. More precisely, $L = (g/4\pi^2)T^2 = 24.8T^2$



4. Make a pendulum that swings with a period of 4 seconds per cycle. Swing it from a high place!



OBJECTIVE

To relate the length of a pendulum to its period. To appreciate the predictive power of mathematics.

LAB NOTES

Copy the activity for each student or lab team.

Step 3. The constant **g** stands for the acceleration of gravity, which is equal to **980 cm/sec²** on Earth.

ANSWERS

2. T_1 = 1 s/c
T_2 = 2 s/c
T_3 = 3 s/c

3. This equation holds for all three pendulums:
$L_1 = 25\ (1)^2 = 25$ cm
$L_2 = 25\ (2)^2 = 100$ cm
$L_3 = 25\ (3)^2 = 225$ cm

4. $L_4 = 25\ (4)^2 = 400$ cm

MATERIALS

- Thread and scissors.
- Three metal washers, same size.
- A meter stick.
- A watch or clock with second hand.
- A step-stool or steady chair.
- A second-story window, stairwell, or bleachers.
- A hand calculator (for Extension only).

EVALUATION

Q. How long is a pendulum with a period of 0.5 seconds?

A. $L = 25\ (0.5)^2 = 6.25$ cm

EXTENSIONS

Q. Imagine launching off on a 1 km rope swing hanging from a "sky hook." How many seconds would you ride before returning to your starting point?

A. $1 \text{ km} \times \frac{1{,}000 \text{ m}}{\text{km}} \times \frac{100 \text{ cm}}{\text{m}} = 100{,}000$ cm

Assuming you could use a high-tech rope with negligible mass:

$T^2 = L/25 = 100{,}000/25 = 4{,}000$

$T = \sqrt{4{,}000} = 63$ seconds

Q. Predict what might happen if you tie additional washers onto your 100 cm pendulum. Do you think it will change the pendulum's period? Test your prediction.

A. Increasing bob mass does not change a pendulum's period. *Objects of any mass are equally accelerated by gravity, whether falling freely or tied to the end of a string.*

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