

Pendulum Lab

Definitions:

Pendulum: A body suspended from a fixed point that can swing freely back and forth.

Bob: The object or weight at the end of the pendulum.

Starting Angle: The starting angle of the pendulum from the center line.

Length: The distance from the fixed pivot point to the center of the bob.

Period: The time for the pendulum to swing from one side to the other and back.

Weight: The mass or weight of the bob.

Purpose:

To determine if the (1) starting angle, (2) length, or (3) weight of the pendulum affects the period of the pendulum.

Procedure:

You should carry out three separate experiments; one varying starting angle, one varying length, and one varying the bob's weight (the experiments can be done in any order). If the period varies when you change the parameter (starting angle, length, or weight) then the period of the pendulum *does* depend on that parameter. If the period does not change (significantly), then the parameter *does not* affect the period.

Notes:

- The best way to measure the time is to use multiple swings (maybe 5 or 10) then divide the total time by the number of swings. For example, if 8 complete swings (across and back) took 13 seconds, the period (the time for one swing) would be

$$\text{Period} = \frac{13 \text{ s}}{8} = 1.62 \text{ s}$$

- Measuring periods is not, and can never be, exact.
- Measuring the period multiple times will improve your accuracy. This will also tell you how much error there is just due to chance and human reaction times. This can help you decide when changes in the period are really being caused by changes in the parameter.
- You should measure the period for at least 3 values of each parameter.
- You should note what fixed values you used for the other parameters in each experiment (so that, in principle, someone else could re-produce your experiment from the information provided in your report).
- You do **not** have to make measurements for every combination of starting angle, length, and weight. To determine whether amplitude affects the period, you do an experiment varying amplitude only.
- Change the values **a lot**. If you measure the period for lengths of 30 cm, 32 cm, and 34 cm, you'll probably get little variation in the period even if length does affect the

period – you won't be sure. But if you use wildly different lengths (as long and as short as you can manage), it should be clear whether length has a large effect.

- In changing one parameter (like weight) you will likely introduce small changes in other parameters (like length) which introduces some error.
- You can use any units, even non-standard one. For instance, you might measure the weight in units like pennies or clothes hangers. It doesn't matter if you don't know what that is in terms of grams or ounces.
- When changing the weight, try to use objects that have the same shape and size. Avoid oddly-shaped objects (like shoes) and avoid liquids which slosh around.
- Don't use starting positions above the support point.
- Don't let the pendulum swing until it stops.

Write-up:

1/22

- Due in nine days, at the start of class, Wednesday, ~~October 1~~.
- Show all the data you collected, organized into tables.
- Discuss what your data means, how you interpret it. Discuss the results, don't just rehash what you measured. Explain what you saw in your data that led you to your conclusion.
- You are not expected to explain why things do or don't affect the period.
- Make a conclusion, **yes** or **no**, for the three questions; 1. Does starting angle affect the period of a pendulum? 2. Does length affect the period of a pendulum? 3. Does weight affect the period of a pendulum?
- Your report does **not** have to be typed but clarity and neatness do count
- Extra credit is awarded for efforts beyond the requirements, but it takes a lot of extra effort to earn even a little extra credit.
- Late reports will be accepted but penalized as follows: -10% for slightly late (turned in by the start of class Thursday 1/22). Penalties for work turned in even later will be much more severe, maybe -50%. 7

Extra Credit:

How would you make a pendulum with a period of four seconds?

Note:

Every student does their own experiment and should have different results and discussions; this is not a team lab in any way.