Lab: Conservation of Energy AP Physics

Thanks to Craig Fletcher for developing many of the ideas incorporated in this lab.

Background

One of the simplest places to observe conservation of energy is in a pendulum: ideally, the total mechanical energy of a pendulum with a light string and a mass at the end should remain constant throughout the pendulum's motion. Of course, any "real world" pendulum is going to experience some loss of energy during its motion.

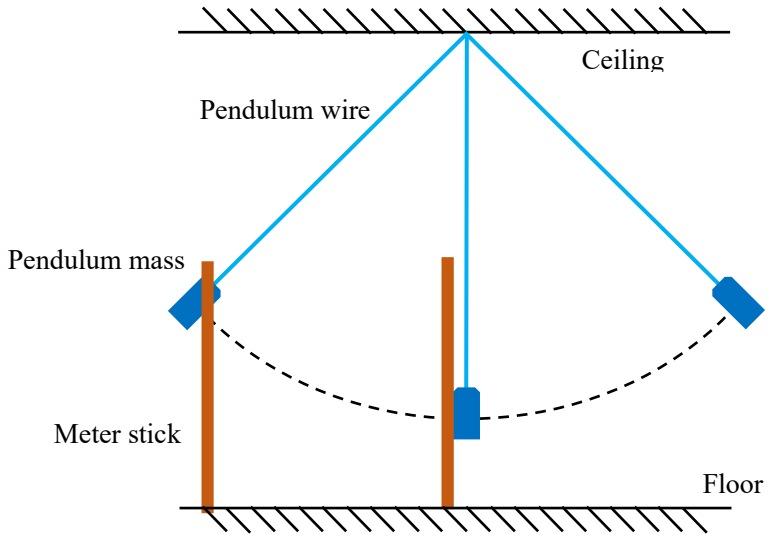
Objective

To compare the mechanical energies at various several positions in a pendulum's swing.

Equipment

Ceiling support	pendulum string / wire	pendulum bob
meter stick	balance	photogate timer

Set-Up

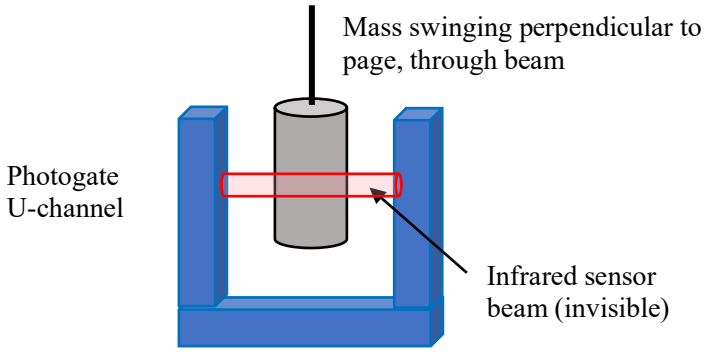


Procedure

Part 1. Single Swing Energy Loss

Take measurements to identify the amount of energy converted to heat in a single swing of the pendulum.

1. Set up a mass-and-wire pendulum so that it is suspended from the ceiling and free to swing back and forth.
2. Pull the mass back to a convenient height—around a meter or so—indicated as the position on the left in the diagram above. Record this initial height.
3. Release the mass from rest, and let it swing once across the room (to the right in the diagram), and then back to its original position on the left. Record this final height.
4. Measure the initial release height and the final return height for a number of trials.
5. Measure the mass of pendulum weight as well, and record all data in a data table with headers and units.



Part 2. Top vs. Bottom Energy

Take measurements to identify the amount of energy converted to heat in one-quarter of a single swing of the pendulum, from the highest point of release to the lowest point of its motion.

1. Set up a photogate at the lowest point of the mass's travel such that the mass will pass through the infrared beam without hitting the U-shaped channel. Configure the photogate so that it will record the amount of time it takes for the mass to pass through the sensor.
2. Identify the release height (on the left side of the diagram, as in Part 1) and the height of the mass at its lowest position as it passes through the photogate.
3. Use calipers or some other measuring device to identify the width of the mass.
4. Release the mass from its initial height so that it passes through the photogate. Record the time, along with all of the other information from this part, in a second data table.

Questions

1. How much energy was lost in the course of a single swing in Part 1 of the experiment? To what factors is this energy loss due?

2. What is *parallax error*? Draw a diagram that briefly shows how parallax error could affect your measurement in Part 1 of this experiment, and discuss what can be done to reduce parallax error.

3. For Part 2, it would be reasonable to expect that the energy "lost" during the pendulum's motion would be one-fourth of the energy lost from Part 1. Was that the case? Explain your results.