Lab: Conservation of Energy AP Physics

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

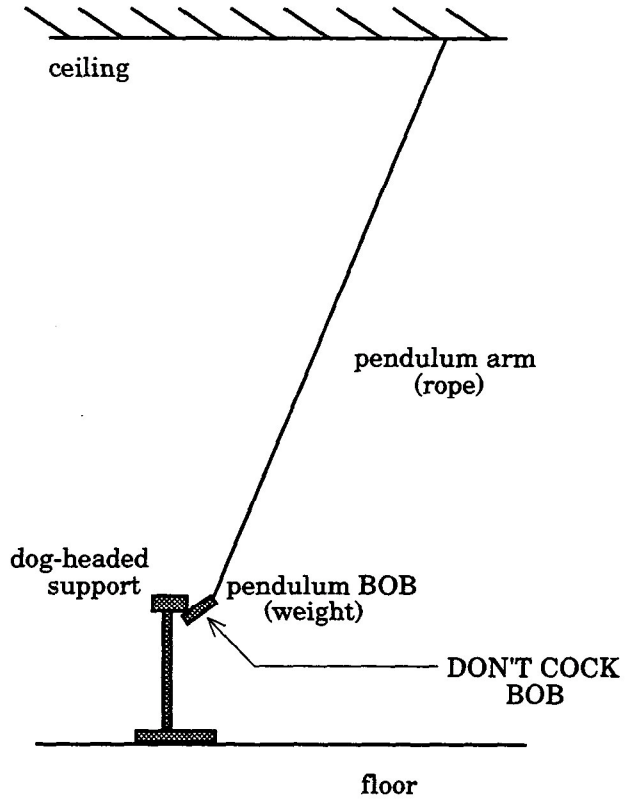
Background
One of the simplest places to observe conservation of energy at work is in a pendulum: the mechanical energy of the pendulum's bob should be identical at the uppermost and lowermost points of its swing.

Objective
To compare the mechanical energies at the top and bottom of a pendulum's swing.

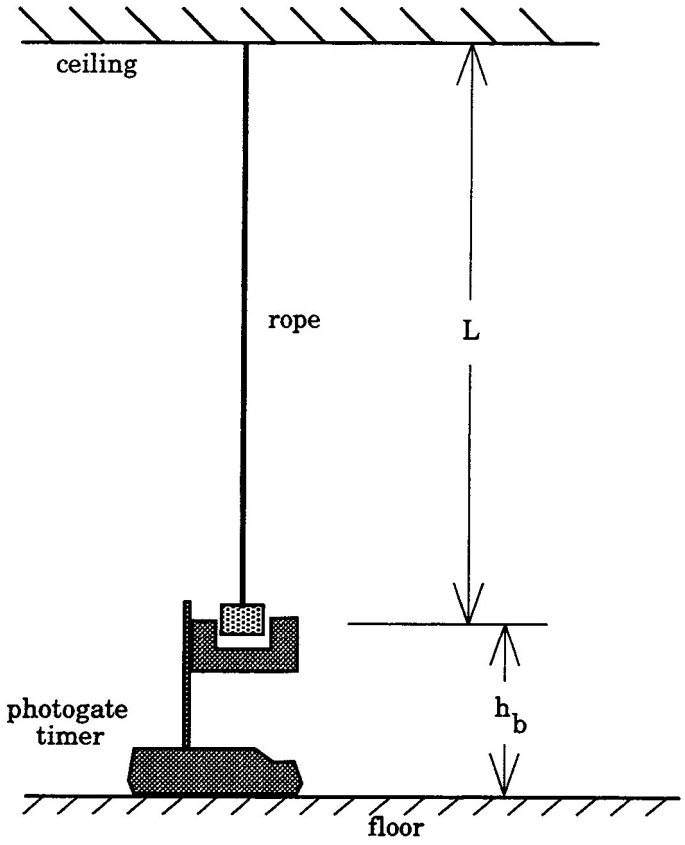
Equipment

Ceiling support	pendulum string	pendulum bob
dog-head support	meter stick	balance
photogate timer		

Set-Up
Part 1:



Part 2:



Procedure
Part 1. Single Swing Energy Loss
Using the dog-head support, hold the pendulum bob so that its *center of mass* is 90 centimeters above the ground. Release the bob, let the bob swing once across the room and back, and carefully observe what height the bob returns to after this single swing.[1] Repeat this process at least five times, and record all data.

[1] There are a number of factors that can mess you up here: the bob must be released so it doesn't oscillate back and forth itself on the end of the string (why?), the bob's return height must be measured at its center of mass (how will you identify that?), the bob's height will be incorrectly seen by someone who is standing up (why?)... It might be a good idea to have several people eyeball the return height each time, and average their values.

Part 2. Top vs. Bottom Energy
Use a photogate and any other measurements you need[2] to compare the potential energy at the 90 centimeter height (as in Part 1) with the mechanical energy at the bottom of the swing. Assume that the floor of the labroom represents the zero potential energy level, and be *extremely careful* releasing the bob: if the bob is not released cleanly, it will veer from its true course and hit the photogate, almost certainly causing a massive release of thermal energy that concurrently results in the destruction of said photogate. Your instructor will help you with this part.

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 picture 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. In Part 2, there may have been a measurable energy loss from the top of the bob's swing to the bottom. If so, does this energy loss correspond to what we would have expected based on our results from Part 1? Explain.

[2] A careful drawing of the situation will help you determine what values will need to be recorded in a data table.