Name ____________________ Date _____________ Mods __________
Partners __________________
____
____

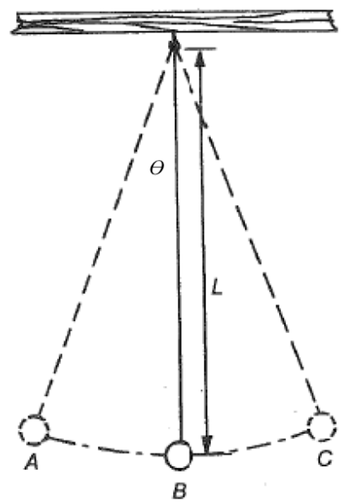
Mr. Forrest: A.P. Physics 1: 2019
Modified from Mrs. Ozment

The Cut Pendulum!

Standards to be assessed:

EN 2: _______ EN 3: _______ LB 5: _______
[if experiment is actually completed: (LB1: _______ LB2: _______ LB 4: _______)]

Background:
A simple pendulum consists of a mass called a pendulum bob suspended from a support by a light (negligible mass) thread. A complete oscillation of a pendulum consists of one swing over and one swing back. The time for a complete cycle is called the periods (T) of the pendulum and is usually measured in seconds. When a pendulum swings through a small angle, its bob is undergoing something called Simple Harmonic Motion. A feature of this type of motion is that the force causing the bob to swing is greatest when its speed is least, and the force is least when the speed of the bob is the greatest.



Purpose:
Some students wanted another attempt at the "Bull's Eye" projectile lab, and I also indicated that I wanted to give students practice in deriving formulas. This activity relates to both of those things in that students could use similar methods to launch a pendulum bob into a target by releasing it from a raised position and using a razor blade to cut the string as it passes through B. Assume that for the questions that follow students would have access to materials normally available in a physics laboratory.

Procedure:

1) When the bob is at rest at position B we can assume that is a low energy state. If you lift the pendulum bob to position A you have increased its gravitational potential energy. In the space to the right, show the general formula for gravitational potential energy for an object that is raised a height Δy above the low energy location. →

2) We can't measure the exact height lifted easily, but we can probably measure the angle pretty well. At location B, the distance of the pendulum below where it is connected is shown to be a string length of L. Although it's lifted to the side, find the vertical component of distance below the connection point when the pendulum is at point A. You'll need to use trigonometry for this. Make sure your answer is in terms of the variables shown and fundamental constants, which are L, Θ, and g. You may not need to use all the variables. →

3) Now determine the amount the height of the pendulum bob has been increased (Δy) when move from the initial location at B and the new location at A. Again, put this in terms of the variables shown and fundamental constants, which are L, Θ, and g. Once again, you may not need to use all the variables. →

4) Now combine what you did in # 1 with what you did in #3 to determine the increase gravitational energy of a pendulum bob of mass M that has been raised through an angle Θ. Put this in terms of the variables shown and fundamental constants, which are L, Θ, Δy, and g. As before, you may not need to use all the variables.

5) Assume the pendulum bob is released from point A. Describe what happens to the bob's gravitational potential energy and kinetic energy as it moves from location A to location B. Also describe the bob's motion as it moves from position A to B.

6a) Mathematically, write a general equation for the type of energy of the bob as it's released at point A and the type of energy of the bob as it passes through point B. (This should start with something like Einitial = Efinal).

b) Now rearrange the formula to solve for the speed of the bob (v) if the pendulum string is cut as it passes through point B. Make sure to now use the terms and variables from before, which are L, Θ, Δy, and g. As before, you may not need to use all the variables.

7) Now let's plug in some reasonable values. Say the length L is 0.70 meters, the initial angle is 15°, and that mas of the pendulum bob is 0.15 kg.

a) Determine the speed of the bob as it passes through point B.

b) Determine the kinetic energy of the bob at point B

c) Thinker question → to be discussed in class: How would your answers in a) and b) change if the mass of the bob was doubled?

d) How could the information about the speed of the bob be used to make a prediction for where to place a cup to catch the pendulum bob?