



Pendulum Lab: Conservation of Energy

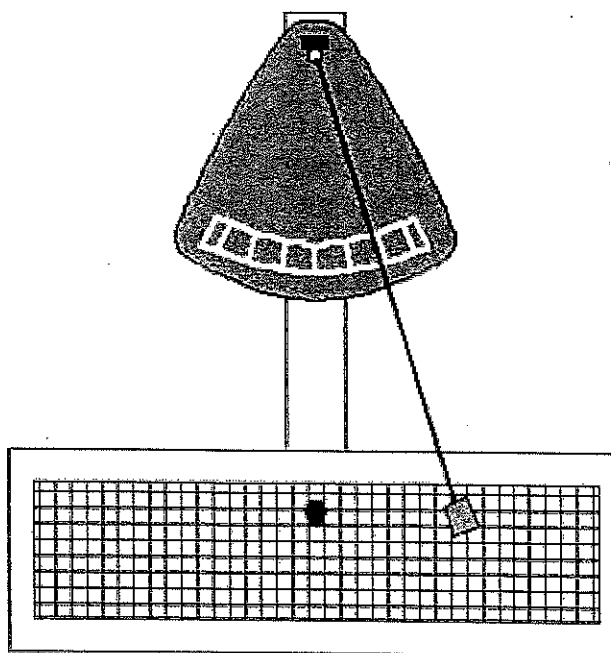
Objective: To investigate the transformation and conservation of energy in a pendulum.

Materials: Workshop Stand, Pendulum, Bolt, String, Pinch Clamp, Meter stick, Stopwatch. Timer and photogate

Background: The Law of Conservation of Energy states that energy cannot be created or destroyed, but it can be transformed from one form to another. One type of energy is potential energy, which is stored energy. For example, an object is lifted to a height and has the potential to fall. Another type is kinetic energy, which is energy of motion. Mechanical systems also convert some energy to heat, through friction.

Procedure:

1. Use the bolt to attach the Pendulum plate to the highest hole of the Workshop Stand.
2. Measure and record the mass of the aluminum cylinder.
_____ (kg)
3. Use the Pinch Clamp to create a pendulum that is approximately 60cm long. Hang the aluminum cylinder at the end. (Measure the length from the bottom of the pivot hole, where the string will bend, to the center of the hanging cylinder.)



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4. Stand directly in front of the Pendulum, close one eye, and make sure the "0" mark is aligned with the string as it hangs straight down. Turn the Pendulum plate as necessary.
5. Attach the grid board at a height that accommodates the entire swing of the pendulum.
6. Align the board so that the vertical lines are parallel to the pendulum string.
7. Hold the aluminum bob out so that the string is lined up with the line marked 20. (20° away from the center.) Make a mark at the bottom center of the bob.

Note:

When measuring the difference in height (Δh) the pendulum undergoes, measurements should be made from the center of the pendulum bob which approximates its center of mass. However, in this experiment it is easier to measure Δh from the bottom of the pendulum for which the effective difference is negligible.

8. Release the pendulum and mark its position on the other side. Describe what you observe about the two heights.

9. With the pendulum hanging straight down, make a mark at the bottom. Measure and record the vertical distance between the upper (in #7) and lower marks. (Each square is one centimeter.) _____
10. Convert #9 to a distance in meters. $h =$ _____ (m)
11. Calculate the difference in the bob's potential energy from the top to the bottom of its swing. ($g = 9.8 \text{ m/s}^2$)

$$PE = mgh$$

12. How much kinetic energy should the bob have at the bottom of its swing?
_____ (J)



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14. Position a single photogate so that it is open toward the top and the bob is centered between the ends. (See diagram, right.) The bob should be able to swing freely back and forth through the photogate.



15. Plug in the cable from the photogate to the timer port 'A'. Set the timer to "Interval" mode and activate photogate A.

16. Pull the bob out to 20° and release it. (Be sure to cleanly release it without pushing.) What is the bob's velocity? _____ (m/s)

$$v = \frac{d}{t} \quad d = \text{width of the bob}$$

17. Repeat the measurement 5 more times. Record and average the velocities.

Avg. Velocity: _____ (m/s)

18. Calculate the bob's kinetic energy at the bottom of its swing.

$$KE = \frac{1}{2}mv^2$$

19. How does the experimental kinetic energy in #18 compare with the calculated value in #12? Explain any difference.

