Physics 201 Lab 1
Projectiles and Free-Fall

Jan 14, 2013

Equipment

- Carbon paper
- Meter sticks
- Photogates
- Steel balls
- Plastic balls
- Vernier calipers
- Ballistic launchers
- Wood stacking blocks
- Superballs

Launching For Height

In this section, we will be using the ballistic launcher. It will be set up to launch vertically using superballs. Set up the photogate so that it measures the velocity of the ball just as it leaves the launcher (see Figure 1). Measure the diameter of the ball and input this length into the computer.

Pay careful attention to how the center of the ball is aligned with the photogate. The full diameter of the ball must block the light path. This is because the photogate actually measures the length of time the beam is blocked. It calculates the velocity by dividing this duration into the input length. If the alignment is not correct, the measured velocities will be too high.

Using the first launch position, record the vertical launch velocity of the superball. (Do it several times to get an average.) Now measure the height difference between the photogate and the top of the trajectory of the superball (average several trials). What is the calculated value for the height based on the average velocity? Do you need to know the mass of the ball to calculate the height?

Repeat this process for the second and third launch positions. This time, calculate the expected height before you actually measure it.

How did the calculated and measured heights compare in each case? Was there a trend in your results? Give a possible explanation for any discrepancy.

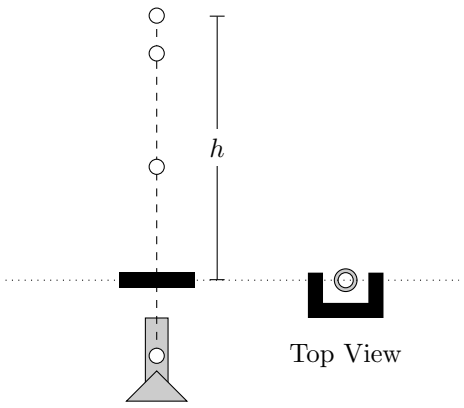

Figure 1: Vertical launcher with proper photogate alignment

Launching For Range

You will not need the photogate and computer for the remainder of the lab.

Adjust the ballistic launcher to fire at an angle (record the angle). Start with a shallow angle (less than 45°). Place a piece of paper over the carbon paper to measure the average range of the ballistic launcher. You may need to raise the paper with some blocks of wood to measure the range properly (see Figure 2)

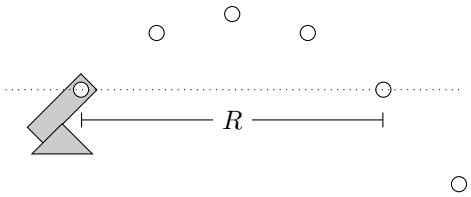

Figure 2: Horizontal launcher with proper range measurement

There are three different launch positions, make sure that you are using the same one each time. Get at least five data points, average them, and find the standard deviation.

Use the range equation to calculate the initial velocity of the projectile.

$$R = \frac{v^2}{g} \sin 2\theta$$

By treating this as a textbook problem, what factor(s) do we ignore in our calculation?

Predict which one will go farther, the steel ball or the plastic ball. Test your prediction (only once please!). Was once enough to tell the difference? Speculate on the reason for the difference in the range of the two balls.

By varying the launch angle, find the angle that launches the plastic ball the farthest. What angle is predicted by theory? Why does this differ from the actual result that you found?