Predicting Projectile Motion

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Introduction

Projectile motion can be easily analyzed and determined using physics. Several formulas can be used to determine with great accuracy all of the factors involved in this kind of motion. With knowledge of the velocity of a particle and its distance from the ground, you can easily predict where the particle will land.

Background

Projectile motion is a very common concept and is utilized in many applications in real life. Daredevil Evil Kineivel uses these principles when jumping large distances on his motorcycle. He must know the distance he will jump if he wants to land safely. Basketball is another great example of projectile motion.

In this experiment we will roll a ball down an incline produced by a ramp and several textbooks. The ball will pass through two photogates and then fly off the desk and hit the floor at our predicted point.

Objective

Our objective is to predict the distance the ball will travel before it hits the floor. We will achieve this by measuring the height of the desk from the floor (height) and using the two photogates to determine the velocity (velocity) of the ball.

$$time = \sqrt{\frac{height}{4.9}}$$

$$distance = velocity * time$$

Note: The time formula is valid under the assumption that the ball will be traveling horizontally when it rolls off the table. In order to assure this, the ramp must be placed at least 2 inches from the edge of the desk so that the ball is allowed to roll perpendicular to the height of the desk.

Equipment List

Verneir LabPro
Vernier LoggerPro Software
Vernier Photogates (2)
Ramp
Ball
Meter Stick
Textbooks

Experimental Procedure

1) Setup two photogates and LoggerPro so that you can determine the velocity of a ball rolling through the photogates.
2) Stack several textbooks and place a ramp between the books and the two photogates.
3) Ask two students to make predictions of their own as to where the ball will land.
4) Measure the height of the desk from the floor.
5) Input the height value into the time equation. This will yield the amount of time the ball spends traveling through the air before it hits the floor.
6) Allow the ball to roll down the ramp several times and use the sensors to determine 5 velocity measurements, take the average. DO NOT allow the ball to hit the floor.
7) Input the time and velocity measurements into the formula for distance.
8) Mark off the distance on the floor that the equation predicted.
9) Allow the ball to roll off the desk and have the students watch as the ball lands where the formulas predicted. Compare the results with the predictions made by the students.

Analysis

1) How were we able to predict where the ball would land?
2) How did the prediction using physics formulas compare to the predictions made by your classmates?
3) How would being able to predict how things will behave using physics help you in a real world situation? Give an example.