Projectile Motion/ Launch Angle

Purpose

1. To demonstrate the relationship between horizontal and vertical motion
2. To determine which launch angle provides the best range for a traveling projectile.

Introduction

Any object moving through the air is affected only by gravity is called a *projectile*. Projectile motion depends on the launch speed, launch angle, and the acceleration due to gravity. The combination of these factors creates a curved path called a *trajectory*. In this investigation you will determine how a projectiles launch angle affects the horizontal distance it travels, called the *range*.

There are three experimental quantities you can measure using the marble launcher:

▪ **Launch speed** is the initial speed of the projectile, which depends on the force applied by the spring inside the barrel. There are countless positions within the launcher that change the compression on the spring providing different launch speeds.

▪ **Launch angle,** also known as theta (θ), is the angle at which the projectile is launched. You can change the launch angle on the marble launcher by loosening the black know on the back, adjust the launcher to the desired angle, then tighten.

▪ **Range** defines the horizontal distance that the projectile travels before hitting the ground. The range of the projectile is dependent upon the launch speed and launch angle.

Equipment

1. Projectile Launcher
2. Stand to set apparatus on
3. Tape measure (measure in meters)
4. Stopwatch

Procedure

Protocol: collect range data.

A. Clamp the launcher to a table or a block of wood close to the ground. Aim the launcher at 15° above the surface, and make certain it is very steady.

B. Shoot the launcher a couple times to determine the general landing site. Once you have your technique down, shoot the launcher and measure the range of the projectile. Repeat two times, record in Data Table, then calculate the average.

C. Complete the same procedure for angles of 30°, 45°, 60°, 75°, and 90°.

Analysis: graph the data.

A. For this experiment, the range of the marble should demonstrate a maximum value for a specific angle. Plot a graph of the average range (y-axis) versus the launch angle (x-axis).

B. After inspecting the graph, specify which angle provides the maximum range.

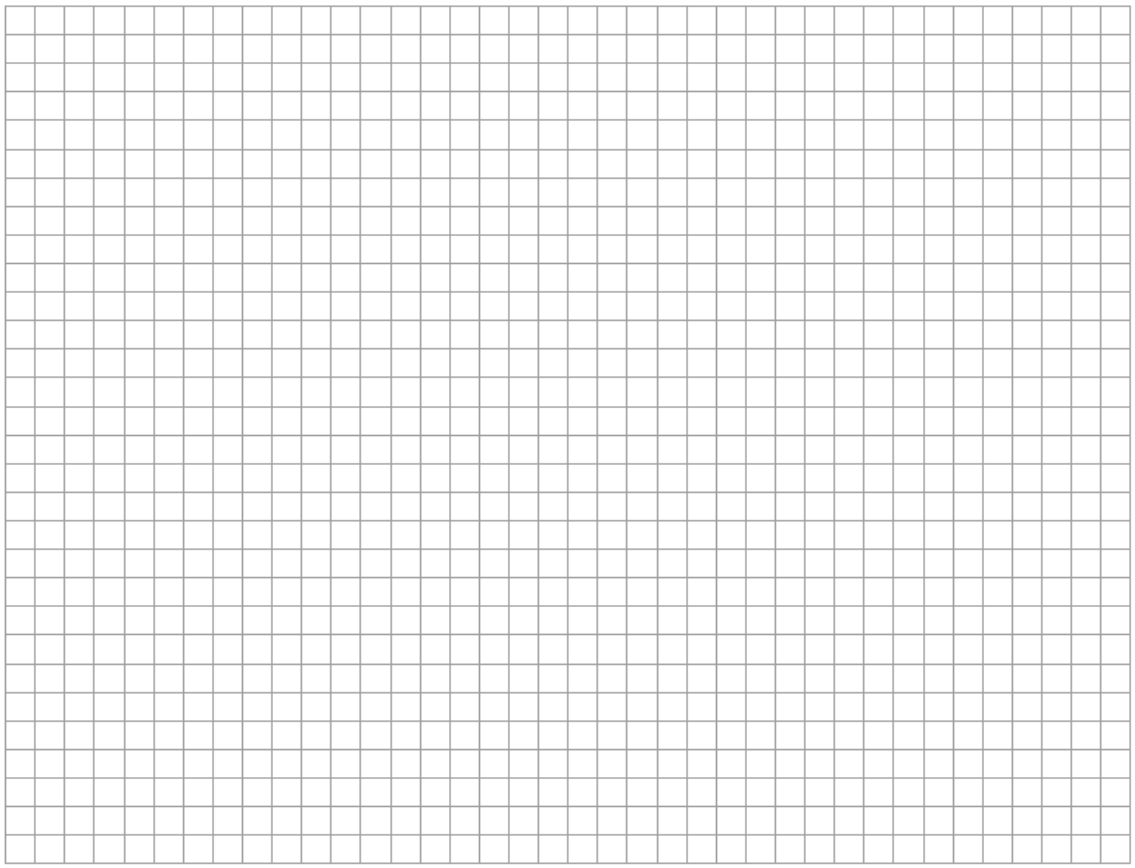
C. Why is the range less for angles larger or smaller than the angle corresponding to the maximum range?

Report Sheet 7

Table 7: Measured Horizontal Range

Angle	Trial 1 (meters)	Trial 2 (meters)	Trial 3 (meters)	Average Range (meters)
15°				
30°				
45°				
60°				
75°				
90°				

Graph of Avg. Range vs. Launch Angle



Questions

1. Look at your data. How close to your predicted location can you expect the marble to land? Write your answer in this format: The marble consistently lands within +/- _____ centimeters of my predicted location.

2. Suppose the marble launcher is set to 62 degrees. Using your graph, predict how far the marble will go. Express your prediction as a “plus-or-minus” range.

3. Express the error in your prediction as a percent.

4. Launch a marble at 62 degrees and measure the range. How accurate is your prediction? Calculate your percent error.

5. How could you make your prediction even more accurate?

6. Three marbles are launched at 15 degrees, 45 degrees, and 75 degrees. Which launch will provide the greatest range?