Range of a Projectile Lab 09/25/2023

Purpose of the lab:

The purpose of the Range of a Projectile Lab is to determine if angles have Ranges close to the Ranges of their complementary angle.

Materials

- Marble Launcher
- Marble
- Plain White Paper
- Carbon Paper
- Masking Tape
- Meter Stick(s)

Procedure

Setting up the Lab:

First, set up the marble launcher on a flat surface while aiming towards somewhere with a long hallway where nothing could obstruct the marble from launching and landing. You would want to tape where the launcher is sitting so you can see where the default shooting position is. You should put tape on every meter starting from the barrel of the marble launcher. For every test run for shooting the marble, You should only put 1-3 notches for the spring; you would also want someone to catch the marble after you launch it.

Finding the V initial:

First, you would set up the Marble Launcher on a higher platform at a 0-degree angle and see the height on the ground to the launcher. You can do 2-3 test shots before taping the carbon paper and plain paper on top of each other on the floor where the marbles usually land. After that, you would shoot the marbles many times until you can get five precise measurements within a 10cm range. You can use the Meter stick starting from each of the tapes on the ground to measure the range of the marble traveled, which would be printed on the paper below the carbon paper. After finding the averages of the five precise measurements, you can find the velocity-initial using the formula $v_o = \frac{Range}{\sqrt{\frac{2\,(Height)}{-g}}}$

Finding the Ranges of 5 different angles:

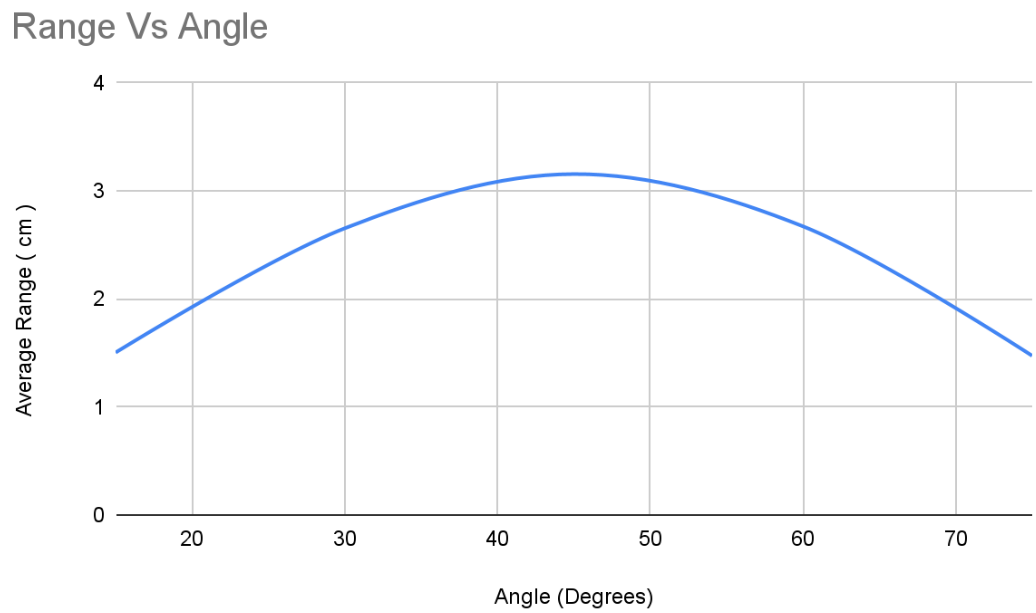
First, you need to set up the Marble Launcher on the same level as the marble would be landing on. You can do 2-3 test shots for each angle before taping the carbon paper and plain paper on top of each other on the ground where the marbles usually land. For five different angles, you have to do multiple trials before you get five precise measurements between 10cm of range by using the meter sticks on meter tapes we put down earlier. After that, you could find the averages and plot them on the graph to get a downward parabola curve.

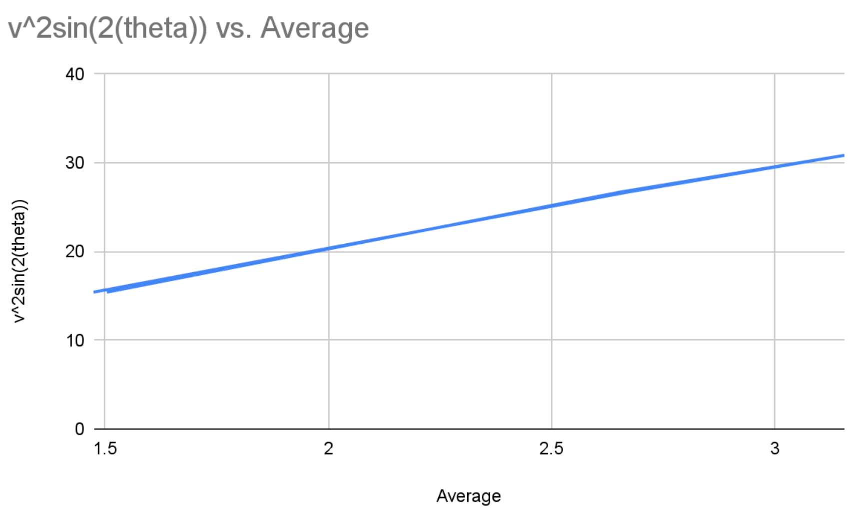
Five Readings of Initial Velocity:

	Velocity for v_o (m/s)	Ranges (m)
Trial 1	5.545 m/s	2.53
Trial 2	5.589 m/s	2.55
Trial 3	5.721 m/s	2.61
Trial 4	5.414 m/s	2.47
Trial 5	5.501 m/s	2.51
Averages of Trials	5.554 m/s	2.534

Data Table:

	15 deg (m)	30 deg (m)	45 deg (m)	60 deg (m)	75 deg (m)
Trial 1	1.52	2.59	3.23	2.64	1.45
Trial 2	1.56	2.64	3.17	2.67	1.46
Trial 3	1.49	2.71	3.11	2.68	1.49
Trial 4	1.47	2.63	3.12	2.69	1.49
Trial 5	1.48	2.7	3.15	2.68	1.48
Average	1.504	2.654	3.156	2.672	1.474
$v_o^2 sin(2\theta)$ (m^2 / s^2)	15.423	26.714	30.847	26.714	15.423





Regression Equation:

$$g = \frac{v_o^2 \sin(2\theta)}{R}$$

Error Analysis:

The two most plausible errors encountered in this experiment are that the launchers are not perfectly symmetrical to the landing place. Non-symmetrical motion can cause the data to fluctuate a little. Another cause of the error is the marble launcher's inability to shoot accurately and precisely over a short period; we combat this by doing rigorous testing. Another less plausible error cause is the air resistance, which we should ignore air resistance.

Conclusion:

Throughout this experiment, we are testing to prove that the symmetrical motion will have the same Ranges of shooting angles from its complementary angles. The range of initial velocities is narrow because we consistently used the same notch setting to launch the marbles with a consistent force. The Range Equation is $R = \frac{v_o^{\ 2} sin(2\theta)}{g}$, which can give us an excellent accurate distance for the Range for each of the angles used in the lab. The slope of the second graph is g because if we changed the range equation from $R = \frac{v_o^{\ 2} sin(2\theta)}{g}$ to $g = \frac{v_o^{\ 2} sin(2\theta)}{R}$ by flipping R and g, we essentially created the making the slope of the graph to be $\frac{v_o^2 sin(2\theta)}{R}$.