Projectile Mini Lab 1

AP Physics C

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0.1 Introduction

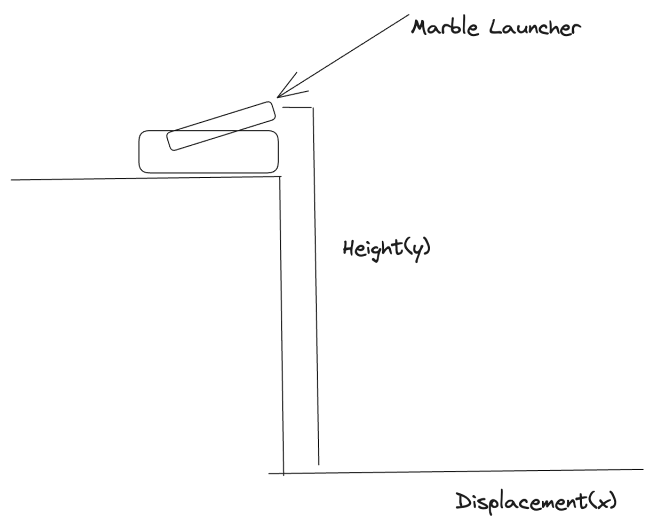
The goal of this lab is to determine where a marble will land given a 45 degree angle based on data from when the marble was launched at a 0 degree angle.
The materials that are used in this lab include measuring sticks, kinematic equations, a marble, and a marble launcher.

0.2 Procedure

The procedure for this lab is as follows:

1. First, we found the height of the launcher from the ground, and the displacement of the marble when being launched from 0 degrees.
2. We then perdicted where the marble would land if it was launched at a 45 degree angle.
3. Then, we launched the marble at a 45 degree angle, and measured the displacement of the marble from the launcher.

0.3 Diagram of the Procedure



0.4 Data

The data that we collected for the height of the launcher, and the displacement of the marble when being launched from 0 degrees is as follows:

Trial	Height of Launcher (m)	Displacement of Marble (m)
1	1.174	2.63
2	1.174	2.60
Avg.	1.174	2.615

0.5 Perdicting the Displacement of the Marble at 45 Degrees

To perdict the displacement of the marble at 45 degrees, we first found the velocity that the marble at 0 degrees was launched at.

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2(1.174m)}{9.8\frac{m}{s^2}}} = 0.49s$$

$$v = \frac{\Delta x}{t} = \frac{2.615m}{0.49s} = 5.34\frac{m}{s}$$

We then used the velocity to find the displacement of the marble at 45 degrees by first finding the x and y components of the velocity at 45 degrees to find the time that the marble is in the air to then find the marble's horizontal displacement.

$$v_{ix} = v_{iy} = v_i \cos\theta = 5.34\frac{m}{s}\cos 45 = 3.77\frac{m}{s}$$

$$\Delta y = v_{iy}t + \frac{1}{2}a_y t^2 \implies 3.77\frac{m}{s}t + \frac{1}{2}(-9.8\frac{m}{s^2})t^2 + 1.174m = 0$$

$$t = \frac{-3.77\frac{m}{s} \pm \sqrt{(3.77\frac{m}{s})^2 - 4(0.5)(-9.8\frac{m}{s^2})(1.174m)}}{2(0.5)(-9.8\frac{m}{s^2})} = 1.00725s$$

$$\Delta x_{\text{perdicted}} = v_{ix}t_{45} = 3.77\frac{m}{s}(1.00725s) = 3.80m$$

0.6 Experimental result

The experimental result of the displacement of the marble at 45 degrees is as follows:

$$\Delta x_{45} = 4.08m$$

0.7 Conclusion

0.7.1 Percent Error

$$\%Error = |\frac{\Delta x_{45} - \Delta x_{\text{perdicted}}}{\Delta x_{\text{perdicted}}}| \times 100\% = |\frac{4.08m - 3.80m}{3.80m}| \times 100\% = 7.37\%$$

0.7.2 Sources of Error

The sources of error in this lab include the marble not being launched at exactly 45 degrees, and the marble not being launched at the same velocity as the marble was launched at 0 degrees. If the marble was launched at an angle different from 45 degrees, it would be at a lower angle because the marble is launched above the ground would have a higher horizontal velocity and thus travel for a longer distance. And, if the marble wasn't launched at the same velocity as it was launched at 0 degrees, it would be launched a higher velocity. Lastly, factors such as spin and drag on the marble which we didn't account for could also lead to the error; however, those sources would likely slow the marble down.