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Physics

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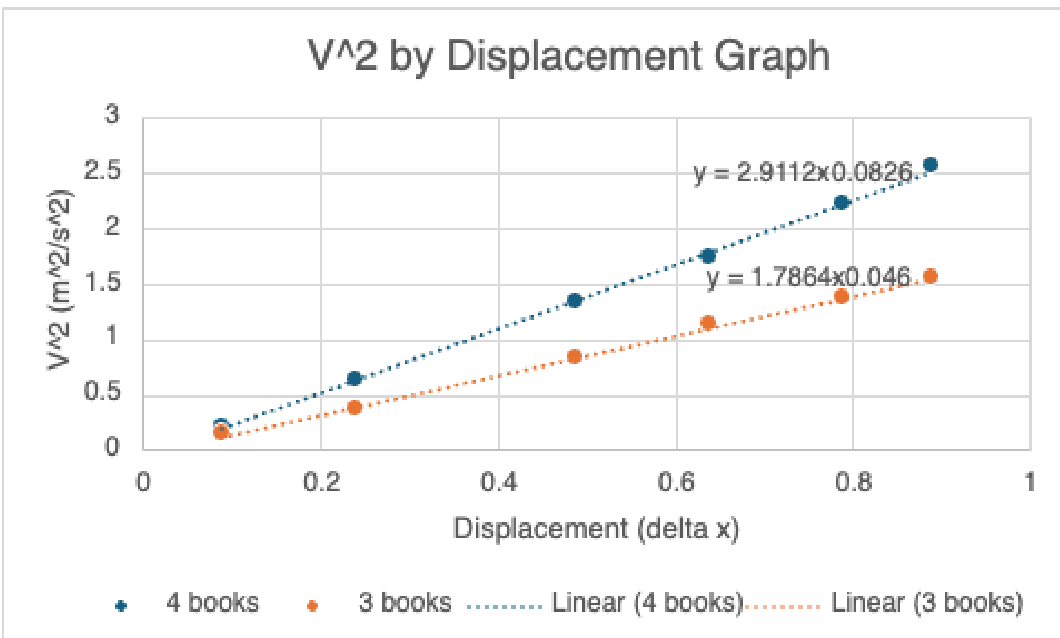
Acceleration on an Inclined Plane Lab- Ashley Li

In this lab, we recorded the final velocity of a cart that is rolling down an inclined plane, doing trials with different distances. There were two angles of inclined planes, one at 9.2 degrees and one at 7.9 degrees. For each distance, we took 3 trials and averaged the data. The location on the inclined plane that the cart was released at stayed the same for both angles.



The data collected was in units representing velocity and displacement. In order to achieve a linear graph, the y-axis should be in terms of v^2, due to the kinematic equation v^2=v_0^2+2aΔx. This is because when we plug in the knowns into the equation we get,

v^2=0^2+2aΔx

$v^2=2a\Delta x$

In this form, it is oriented the same way as a linear, slope-intercept equation ($y=mx+b$). In this case, y is represented by v^2, m by 2a, and Δx is the same as x in this scenario. From here, we are also able to use the equations to solve for acceleration. As mentioned earlier, m, the slope, is equivalent to 2a (2 x acceleration). This means that we can determine the value of a simply by dividing the slope of the line by 2. The acceleration of the cart on the plane angled at 9.2 degrees is 1.4556m/s^2, and 0.8932m/s^2 for the plane at 7.9 degrees.

In order to find the expected value of acceleration, we can follow the equation below:

$$a = g \sin(\theta)$$

In the equation above, a represents the acceleration, g the acceleration due to gravity (9.8m/s^2), and θ the degree at which the plane is angled. Beginning with the plane angled at 9.2 degrees,

$$a= (9.8)(\sin(9.2))$$

$$a= (9.8)(0.1702)$$

$$a=1.668 m/s^2$$

To calculate percent error, we subtract the calculated by the expected, then divide that by the expected:

$$(a_{calculated}-a_{expected})/a_{expected}$$

the answer is a decimal representation of a percent

To apply this to the 9.2 degree plane:

$$(1.4556-1.668)/2$$

$$(-0.2124)/2$$

$$-0.1062$$

-10.62% error

The calculated was 10.62% less than the actual acceleration

The above process will be repeated to calculate percent error in the plane with a 7.9 degree slant.

a= (9.8)(sin(7.9))

a= (9.8)(0.1374)

a=1.34m/s^2

(0.8923-1.34)/2

(-0.4477)/2

-0.22385

-22.385% error

The calculated was 22.385% less than the actual acceleration

A source of error in the experiment could have derived from friction on the track and wheels of the cart. Friction may slow down the movement of the cart, resulting in an inaccurate representation of the acceleration. If this is true, it explains why the calculated acceleration with the slope is so much lower than the actual acceleration. The “actual” acceleration does not account for friction whatsoever, though the graph is likely influenced by friction.

Another reason data could have been inaccurate is an error in the velocity sensor. There are many reasons that the velocity sensor could have given an incorrect velocity, some examples including poor connection with the device, old sensors, blocked/unclear sensors, etc. If a sensor is blocked or not as sensitive anymore, velocity could be inaccurately documented as it cannot properly track the cart and movement anymore. It is unclear whether this would cause a larger or smaller acceleration as it depends on what sensor was impacted and to what extent.