Acceleration on an Inclined Plane: Physics Lab Report #1

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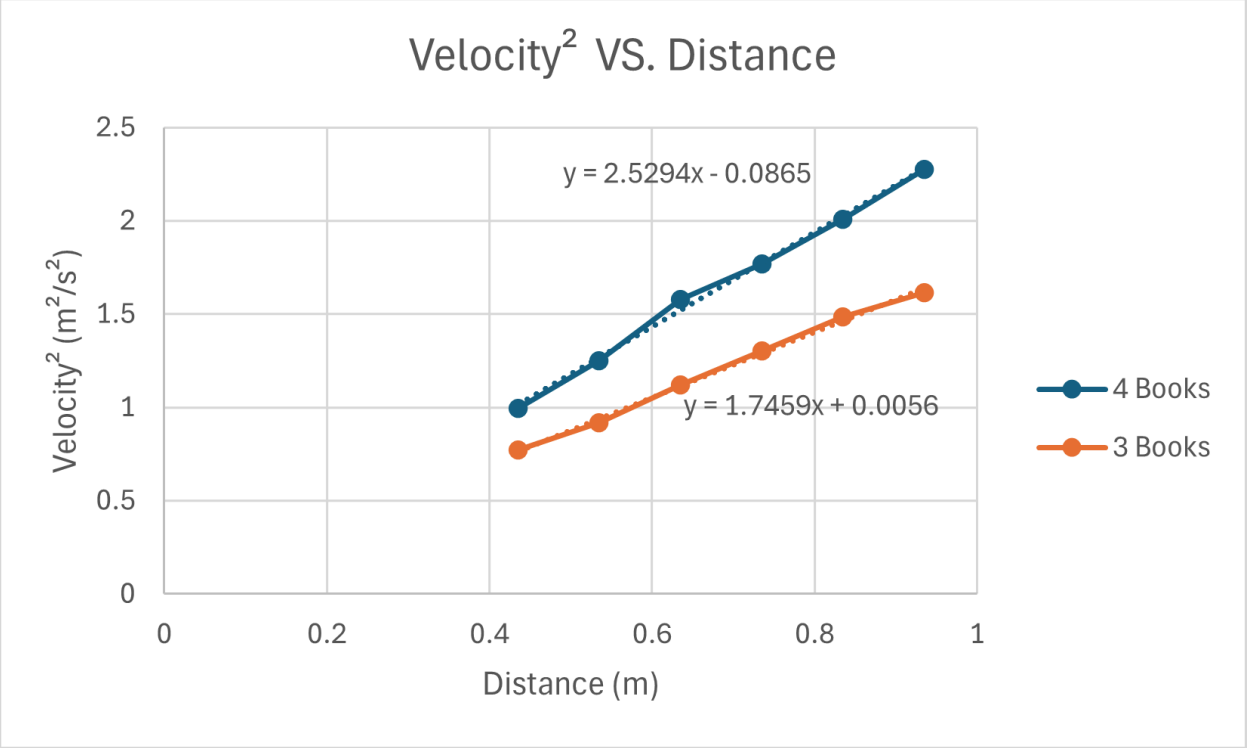
9/12/2025

Analysis:



The above graph shows a linearized model of the data found using our data. On the x-axis we can see the distance in meters. This variable was changed throughout the course of the experiment and therefore is the independent variable. Based on the changes in distance, the velocity had changed. Velocity² in meters²/seconds² can be seen on the y-axis due to its dependent nature. Two trendlines are shown where each represents the data when the inclined plane was rested on a stack of 4 books and a stack of 3 books.

The above trend lines show that when an inclined plane is rested on a stack of 4 books the relationship between velocity and distance is the following:

$$v^2 = 2.5294\Delta x - 0.0865 \rightarrow v = \sqrt{(2.5294\Delta x - 0.0865)}$$

Similarly the inclined plane rested on 3 books will have the equation:

$$v^2 = 1.7459\Delta x + 0.0056 \rightarrow v = \sqrt{1.7459\Delta x + 0.0056)}$$

Using this we can find the acceleration of the carts:

4 books -

$$v^2 = {v_0}^2 + 2a\Delta x$$

$$2.5294\Delta x - 0.0865 = {v_0}^2 + 2a\Delta x$$

I substituted in the equation of the line to find the acceleration

$$2.5294\Delta x - 0.0865 = 2a\Delta x - 0.0865$$

We can substitute the y intercept as v_0. This is possible since the v_0 value is the y intercept of the original formula when it is graphed

$$2a = 2.5294$$

$$a = 1.2647\ m/s^2$$

Expected value -

$$g\ sin\theta = a$$

We have already measured the lengths of the hypotenuse and opposite sides. Therefore those can be substituted instead of $sin\theta$.

$$9.8\ (0.152/1.22) \approx 1.2209\ m/s^2$$

Percent error -

$$\frac{1.2647 - 1.2209}{1.2209} = 0.0358$$

3.58% error

This attests that the method of calculation and experimentation are accurate.

3 books - using the exact same methods as above

$$v^2 = {v_0}^2 + 2a\Delta x$$

$$1.7459\Delta x + 0.0056 = {v_0}^2 + 2a\Delta x$$

$1.7459\Delta x + 0.0056 = 2a\Delta x + 0.0056$

$2a = 1.7459$

$a = 0.87295\ m/s^2$

Expected value -

$g\ sin\theta = a$

$9.8\ (0.115/1.22) \approx 0.924\ m/s^2$

Percent error -

$\frac{0.87295 - 0.924}{0.924} = 0.0552$

5.52% error

This is still a very low error rate meaning results are accurate.

Conclusions:

In the end, the results of this experiment shows that as distance increases velocity increases. This proves the idea of gravity's constant force accelerating things towards the earth's core. A steeper plane is linked to a higher acceleration. The plane was resting on 4 textbooks, it's acceleration rate was $1.2647\ m/s^2$. This value had a 3.58% error when compared to the theoretical value of about 1.2209 m/s^2. Similarly, the plane resting on 3 textbooks had an acceleration of $0.87295 m/s^2$ a 5.52% error when compared to the theoretical value of 0.924 m/s^2

These error rates may have been caused by factors such as friction, air resistance, and human error. Human error includes factors such as accidentally giving the cart some initial velocity, slight movement of the photogate, and more. Friction or air resistance will decrease the

velocity which would affect our acceleration calculations. Accidentally giving the cart some initial velocity could cause increased overall velocity which would misrepresent the data. If the hotogate had been moved slightly, the velocity reading would have happened at a slightly different distance.

All things considered, this experiment provides great insight into how gravity related acceleration works on incline planes and deepens our understanding on key kinematics concepts.