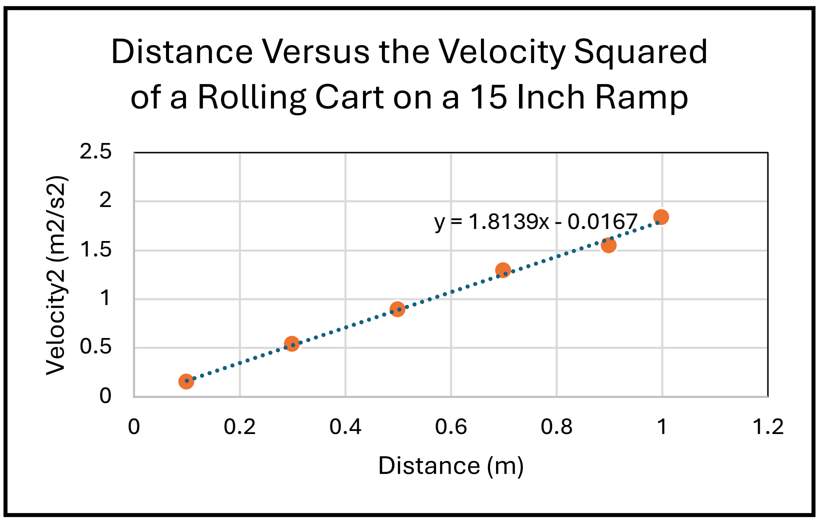
Analysis:

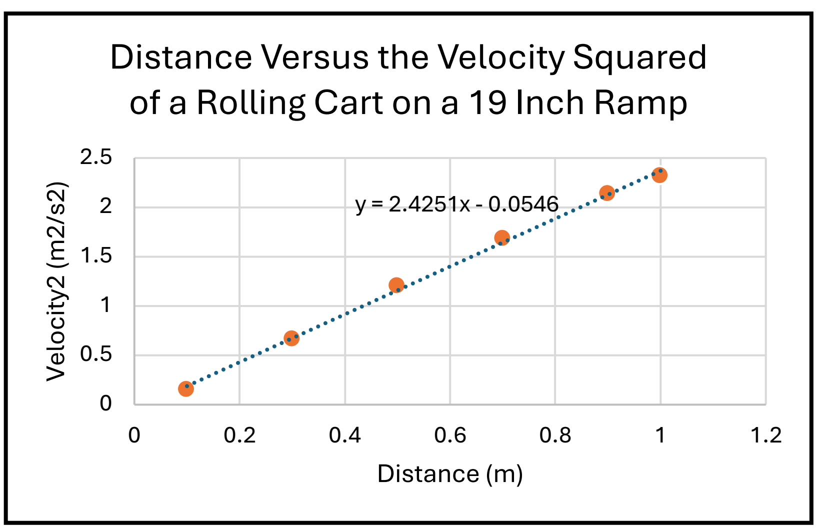
When creating the graph, I had the following equation in mind: $v^2 = v_0^2 + 2a\Delta x$.

Since the cart started from rest in our set up, $v_0 = 0, thus\ v_0^2 = 0$. And the equation simplifies to: $v^2 = 2a\Delta x$

Since I'm plotting the distance traveled versus velocity, The best way to make a linearized graph was to plot v^2 and Δx.

Thus, I chose to put Δx on the x axis as it is the independent variable and put v^2 on the y-axis as it's the dependent variable.





I used Excel Sheets to find the line of best fit.

The equation of the line of best fit for the 15-inch ramp, in terms of v and Δx, is:

$v^2 = 1.8139 * \Delta x - 0.0167$

The equation of the line of best fit for the 19-inch ramp, in terms of v and Δx, is:

$v^2 = 2.41251 * \Delta x - 0.0546$

We know that: $v^2 = 2a\Delta x$

For the 15-inch ramp,

$$1.8139 * \Delta x - 0.0167 = v^2$$

We can substitute in the previous equation, giving us:

$$2a\Delta x = 1.8139 * \Delta x - 0.0167$$

Since we plotted v^2 and Δx, 2a is the slope, or rather, 1.8139

Using a calculator to solve,

$$a = 0.90695$$

For the 19-inch ramp,

$$2.41251 * \Delta x - 0.0546 = v^2$$

We can substitute in the previous equation, giving us:

$$2a\Delta x = 2.41251 * \Delta x - 0.0546$$

Since we plotted v^2 and Δx, 2a is the slope, or rather, 2.41251

Using a calculator to solve,

$$a = 1.206255$$

Conclusion:

The experimental accelerations found by linearizing v^2 and Δx were about 0.907 $\frac{m}{s^2}$ and 1.206 $\frac{m}{s^2}$ for the 15- and 19-inch ramp respectively. These values are reasonable, and it makes sense that the acceleration for the 19-inch ramp was larger than for the 15-inch ramp since there is a steeper incline. Let's compare these values to the expected result for these ramp sizes. We are using the equation $a = g\ sin(\theta)$ for our expected result, where g is the magnitude of the acceleration due to gravity and theta is the angle that the inclined plane makes with the floor.

For the 15-inch ramp, the expected acceleration is equal to 9.8 $\frac{m}{s} * \frac{15}{100}$, which equals 1.47 $\frac{m}{s}$. Plugging in our theoretical and experimental values into the equation for percent error, we find that there is a percent error of about 38.367%.

For the 19-inch ramp, the expected acceleration is equal to 9.8 $\frac{m}{s} * \frac{19}{100}$, which equals 1.862 $\frac{m}{s}$. Plugging in our theoretical and experimental values into the equation for percent error, we find that there is a percent error of about 35.231%.

Possible sources of error in the experiment include friction of the cart on the rail, placing the cart at the wrong point on the ramp, leading to a miscalculation in Δx, or an error in the photo gate. The last two possibilities don't have a concrete effect on the result as they could skew the results either way, but friction leads to a lower experimental acceleration than expected, which is what I found in my own experiment. Since my result was too small, friction is a sensible source of error to identify. The measurement I have the least confidence in is our Δx, since I think it is very feasible that we placed the cart slightly off position since we were going so fast.

I made three key assumptions. The first and most obvious one is that the sensors on the ramp worked and were accurate. I relied on them heavily for the time measurements and the whole experiment would be inaccurate if the sensors weren't working properly. Second, I assumed that friction was negligible and didn't factor it into my equations at all. Clearly, it did have a substantial effect. Third, when calculating the acceleration from the slope of my graphs, I didn't account the constant on the right side of the equation, instead just dividing 2 with the coefficient of Δx.