### Motion on a level track

I observed the cart's velocity remaining almost constant for the free-motion portion of the track. The relationship between position and time increased linearly. The general shapes of my descriptions compared to the capstone graphs were similar, with one slight difference, velocity in the free motion area was not constant, it was slightly decreasing over time. I predict that this is due to the friction of the cart on the track. My predictions were slightly off. The sign of the acceleration, which is +, does make sense. This is because the negative velocity is slightly decreasing over time, which would mean that the acceleration is positive. Capstone calculated the average velocity for both methods to be, d/Delta t, approximately 0.8m/s for both methods, specifically 0.815 m/s from the slope of the position graph and 0.799 m/s for the mean of the velocity. The two differ due to the areas the slope and averages were taken, with the velocity having slightly less area causing it to be slightly less than the mean of the position. The element that is not accounted for in the equations is friction. This means that the average velocity doesn't tell the whole story of how the cart moves on the track. One issue with the data collection is that it relies on a human to put in exact values for where to take the averages, which is prone to human error. This came up in the experiment with the two methods for getting average velocity being slightly different from each other, which can safely be assumed to be from human error. I came to the same conclusions when moving the cart away from the computer, but with the signs reversed. The two methods for calculating velocity were largely accurate with the slight differences being safely accounted for as human error.

### Motion moving down a sloped track

I predict that the position over time will exponentially increase, the velocity over time will linearly increase, and acceleration will remain constant. My general expectations were borne out in the data. This makes sense because the position over time exponentially increases, because as the cart goes down a sloping track it gradually covers more distance each second over time, think x^2. The derivative of that is 2x, which makes sense because the change in position over time is linearly increasing. The derivative of 2x gives you the acceleration, or change in velocity over time, which means that acceleration is constant. So given that the position over time prediction is correct, as long as the derivatives are taken correctly they necessarily have to be correct. The sign of the acceleration does make sense (+) because the change in distance over time gradually increases in the positive direction. One factor that is not accounted for in the equations, that doesn't change the overall shape of the graph is friction. Friction causes the velocity to decrease over time, but if velocity is linearly increasing it only decreases the rate at which it increases, meaning the slope is slightly decreased.

### Conclusion

My predictions in terms of the shapes of graphs were largely accurate, with the motion on a level track being slightly off due to not accounting for friction. The average velocities derived from the slope of the position graph and the average of the velocity graph were very similar, approximately 0.8 m/s, with slight differences between the two. The predictions for the motion on a sloping track experiment even without accounting for friction were accurate, this is due to friction being a constant meaning it doesn’t affect the shape of the graph.