Worksheet for Lab 2: Graphing Motion

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Section: 14
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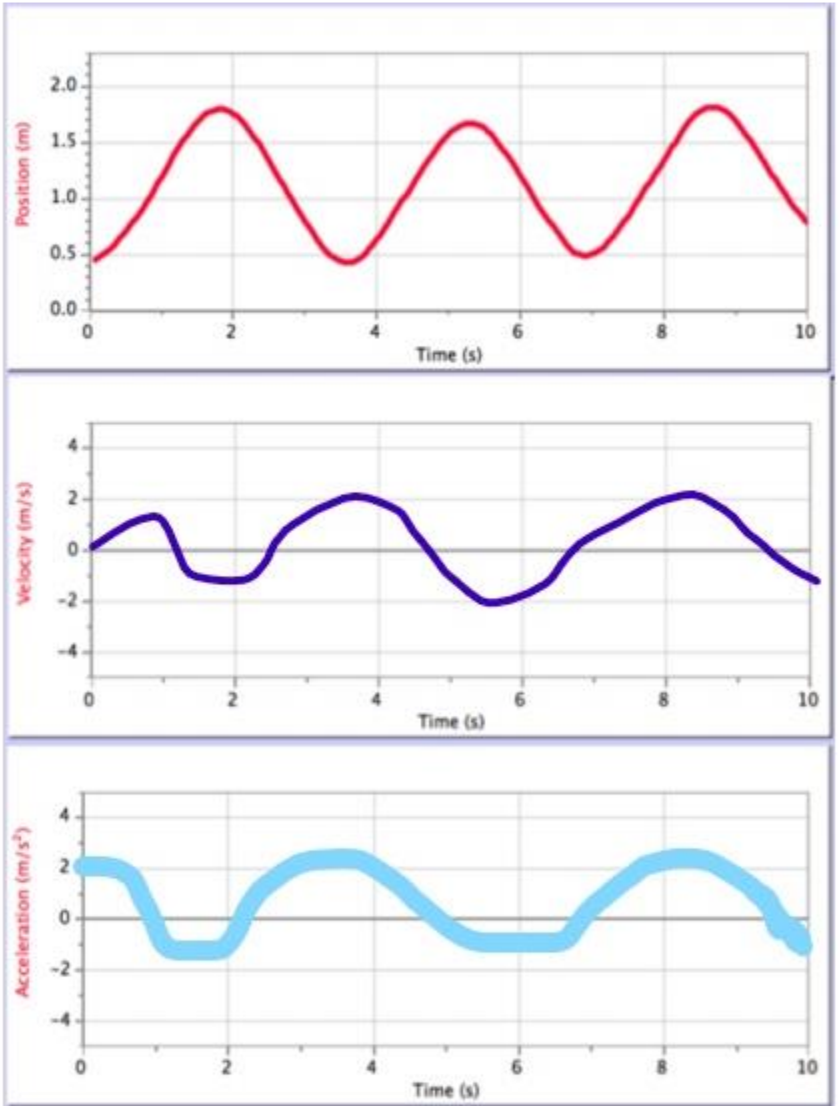
Use this sheet to enter and submit your answers to the questions asked in the gray boxes on the Lab Instructions document. When you have completed this worksheet, save this file as a .pdf and upload the pdf to the canvas assignment associated with this lab. If you have any trouble converting to a pdf, please ask you Lab Instructor or Lab Assistant.

Remember to use complete sentences and that these text boxes will increase in size as you add more content.

1)

The trigonometric graph depicts the car moving forward and backwards repeatedly in the given time.

2) Sketch the v(t) and a(t) graphs you would expect to get for this motion using the Insert Shape > Scribble command.



3)

Our predictions for the graphs are similar to the actual logger pro graphs. The position vs time graph imitates a -cosine graph. The velocity vs time graph is the derivative of the position vs time graph so it would be a positive sine graph. The acceleration vs time graph is the derivative of the velocity vs time graph so it would be positive cosine graph. The shape of our graphs were very similar to that pf the actual graphs because we stared the car in the same direction (it is traveling towards the sensor). The zeros of our graphs compared to the zeros of the actual graphs are at the same points. The slopes of the curves of our graphs were different as were drawing without precision.

4) Moving towards the motion detector at a constant velocity.

The position vs time graph would be a positive linear graph, the velocity would be a positive horizontal line, and the acceleration would be zero.

5) Moving away from the motion detector with continuously increasing velocity.

The position vs time graph would be half a positive parabolic/exponential curve, the velocity would be a constant negative linear line (diagonal), and the acceleration would be negative horizontal line.

6) Moving towards, then away from, the motion detector (looking only at the turning point).

The position vs time graph would be positive a parabolic/exponential curve, the velocity would be constantly decreasing, starting from the positive y-direction then crossing the x-axis then ending in the negative y-direction at a constant rate. The acceleration would be negative horizontal line.

Results

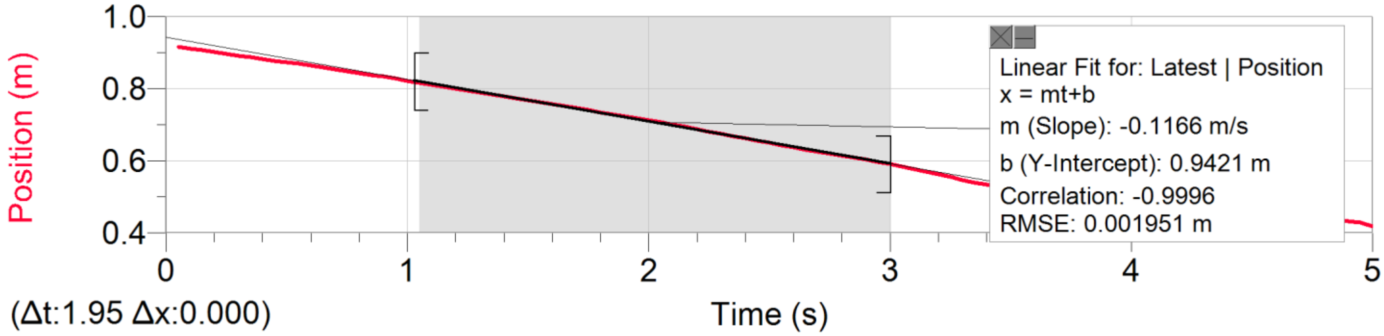


Figure 1: Above is an approximate position vs time graph for when the car moved towards the motion detector at a constant velocity. Our prediction differed from our resulting graph as we predicted the velocity would be a constant positive linear graph. This is because of the motion sensor; as the car moves toward the sensor it measured the distance away from the car instead of the distance traveled. The linear slope of the position vs time graph is -0.1166 m/s ± .01 which is equivalent to the mean of the velocity vs time graph. As a result the difference is not significant.

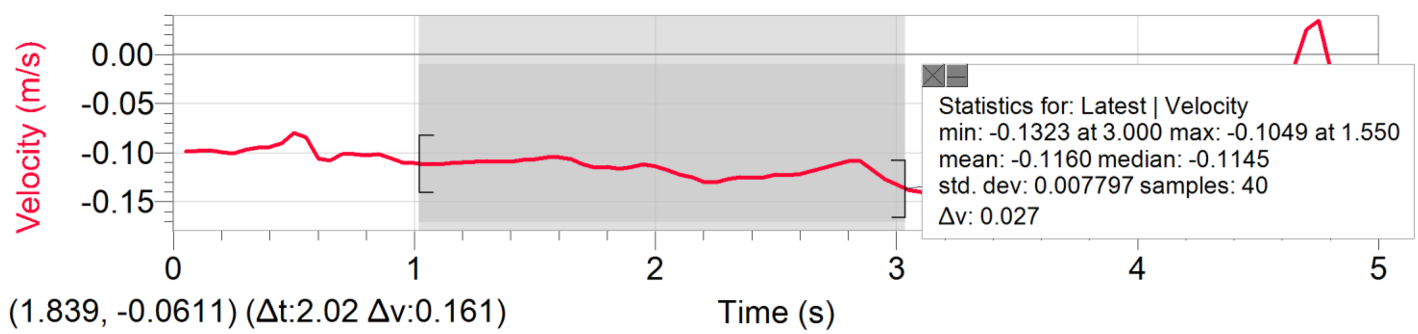


Figure 2: Above is an approximate velocity vs time graph for when the car moved towards the motion detector at a constant velocity. The velocity vs time graph differed from our prediction, as it is negative instead of positive. We also predicted that the graph would be horizontal, but the resulting graph is not stagnant, instead it fluctuates.

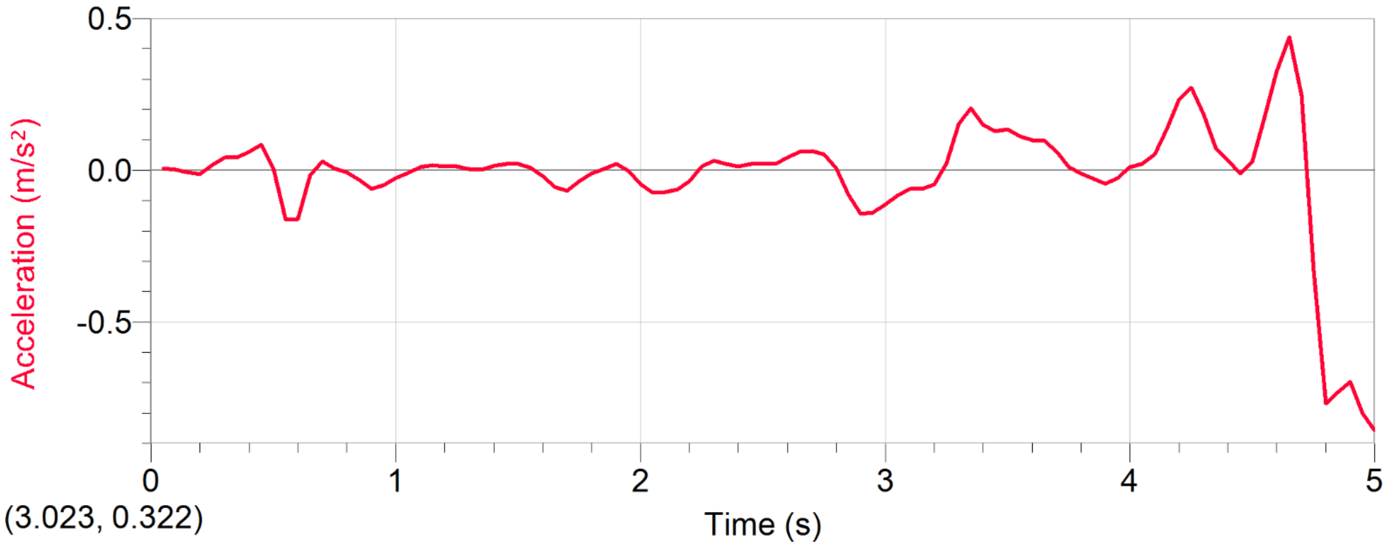


Figure 3: Above is an approximate acceleration vs time graph for when the car moved towards the motion detector at a constant velocity. We predicted the acceleration vs time graph would be zero. Our resulting graph fluctuates around zero and is not a constant horizontal line. Some of our values are zero in the graph, but it is not exactly zero at all times. In a real-world application, the acceleration is probably not exactly zero, but the acceleration values are very close to zero so it can be rounded to zero.

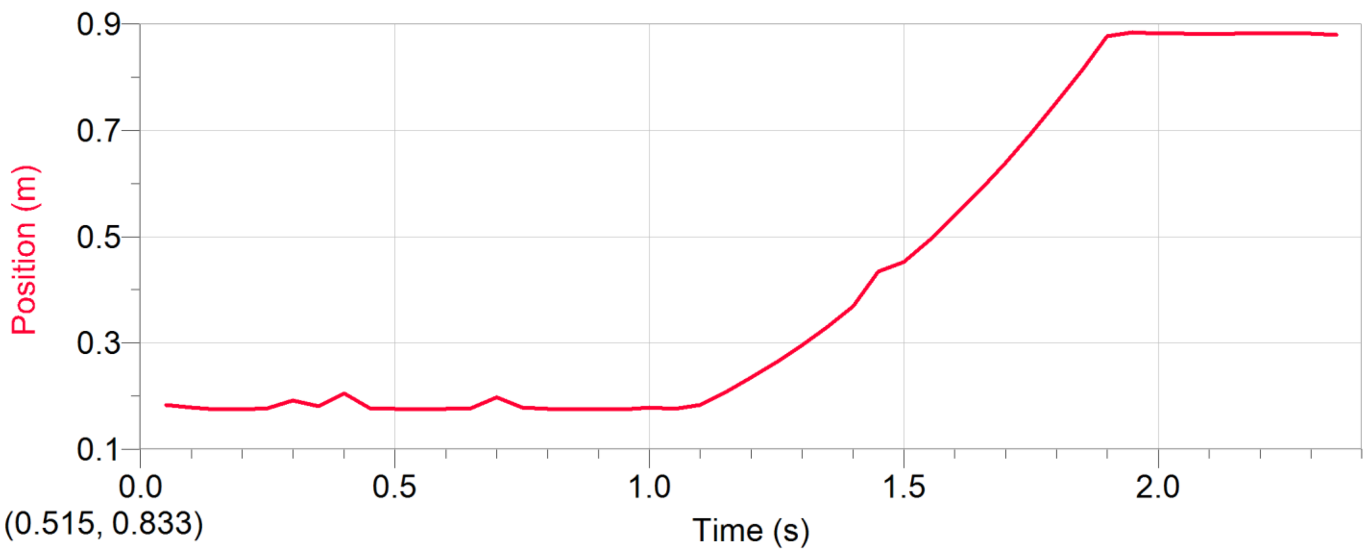


Figure 4: Above is an approximate position vs time graph for when the car moved away from the motion detector with continuously increasing velocity. We predicted that the acceleration vs time graph would be a positive exponential curve upwards. Our prediction partly matches our results. We predicted more of a curve, but we were accurate in our assumption that the curve would be positive.

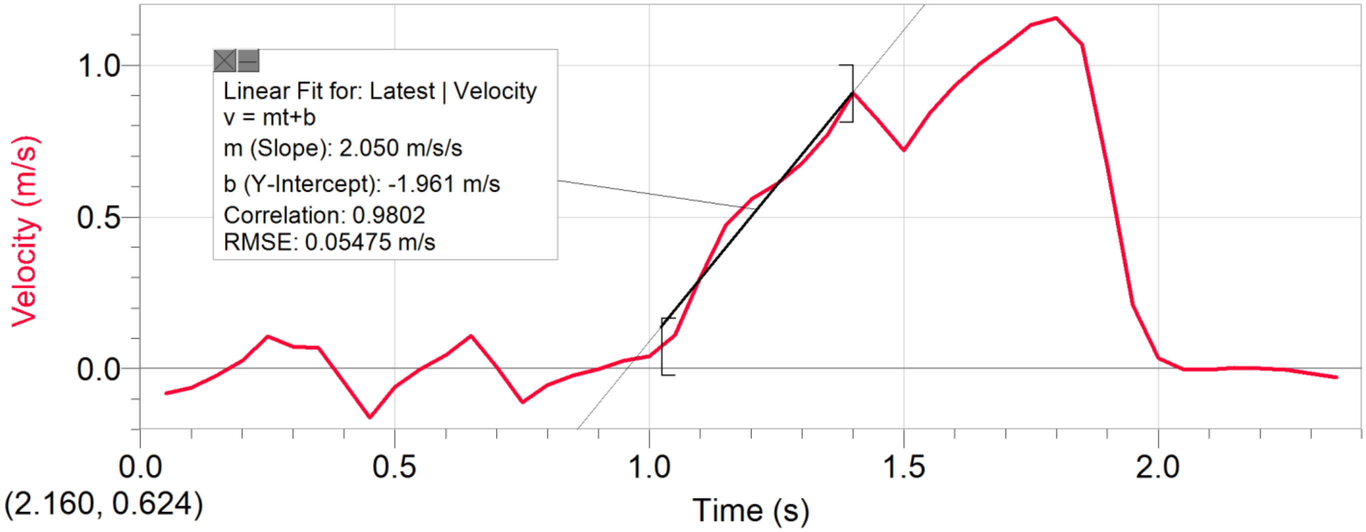


Figure 5: Above is an approximate velocity vs time graph for when the car moved away from the motion detector with continuously increasing velocity. We predicted that the velocity vs time graph would a negative diagonal line, but instead the graph is a positive and increasing some-what linearly. This again is due to the directionality that the sensor detects. The slope of the velocity vs time graph is 2.05 m/s/s and the mean of the acceleration vs time graph is 1.818, making the difference .232 ± .01. This difference is not significant, as the value is close to zero.

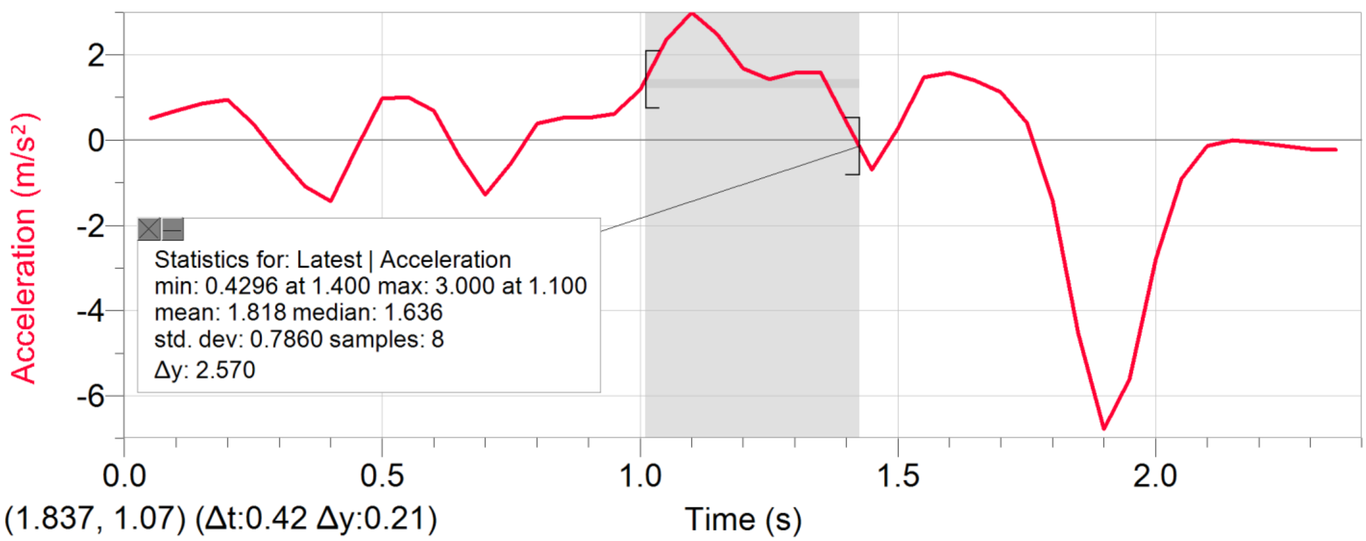


Figure 6: Above is an approximate acceleration vs time graph for when the car moved away from the motion detector with continuously increasing velocity. We predicted that the acceleration vs time graph would be a negative horizontal line, instead the graph is positive. This graph is accurate in accordance to the velocity vs time graph above. The spike in the acceleration differs from our prediction and is the result of the car hitting the barrier.

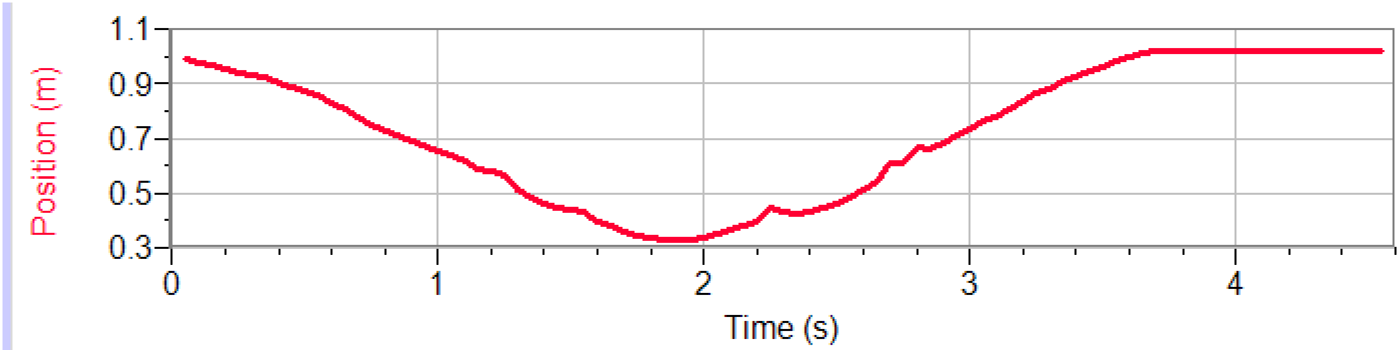


Figure 7: Above is an approximate position vs time graph for when the car moved toward then away from the motion detector. The predicted position vs time graph does not match the one seen above. Both of them are parabolic curves, but we predicted the curve to be negative instead of positive.

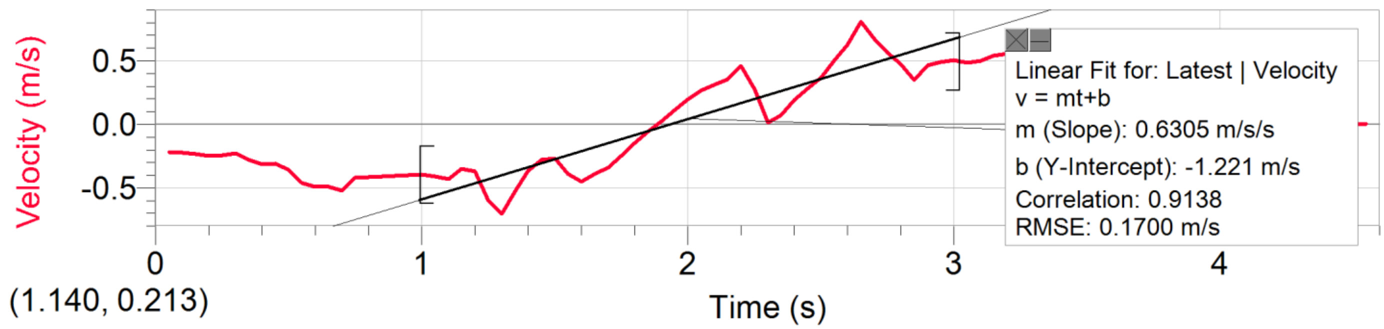


Figure 8: Above is an approximate velocity vs time graph for when the car moved toward then away from the motion detector. The graph above differs from our velocity vs time graph. The actual velocity vs time graph above seems somewhat positive and linear, whereas our prediction resembled a constant negative linear graph. This again is due to the method the motion sensor collects data. The slope of the velocity vs time graph is .6305 m/s/s and the mean of the acceleration vs time graph is .4507, making the difference equal to .1798 ± .01. This value is not significant, as it is very close to zero.

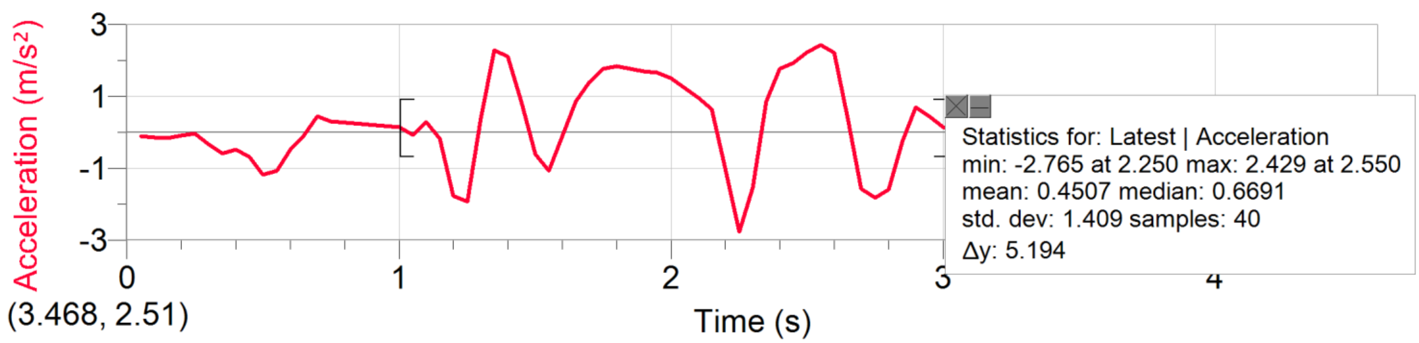


Figure 9: Above is an approximate acceleration vs time graph for when the car moved toward then away from the motion detector. We predicted that the acceleration vs time graph would be a constant negative horizontal line. This was inaccurate, as the graph above fluctuates around zero.

Experimental Method

- Proper car placement on the tracks, keeping our fingers away from the sensor, and making sure the track was level improved the readability of our graphs.
- Scaling the graphs helped us accurately depict the movement of the car in relation to the sensor; this emphasized the shape of the graph, making it easier to compare between graphs.
- We had to secure our sensor and place it a fair distance away from the car to reduce error in our data, resulting in the creation of more accurate graphs.