Phys 211 Lab 03 $\frac{93}{100}$

CM-03: Fan-cy Forces

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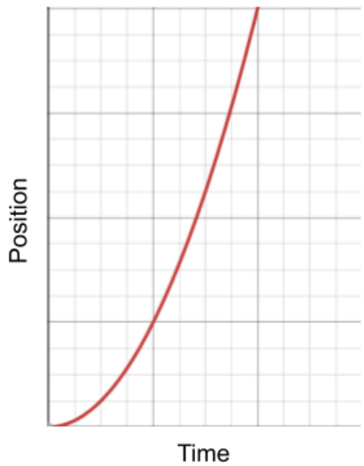
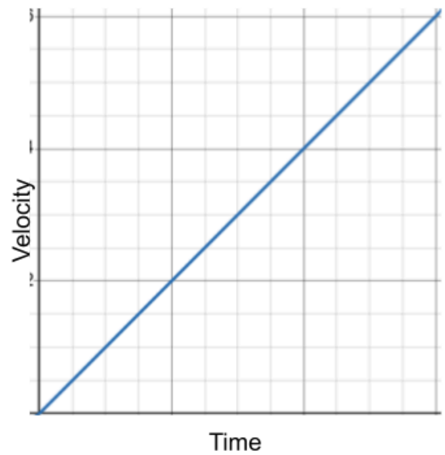
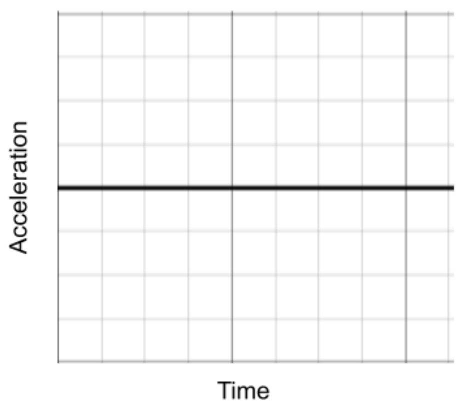
Task #1

A.







Because the fan cart will be undergoing a constant applied force, and will have a constant mass as it goes down the track, its acceleration should remain constant as Force/Mass = Acceleration. This means that the Acceleration vs. Time graph should end up as a horizontal straight line. A constant acceleration means that velocity will be increasing linearly ($v = at + v_o$) with the slope of the line being the acceleration, and v_o

being 0 as the cart starts at rest. This means the Velocity vs. Time graph will be a linearly increasing line starting at the origin. A constant acceleration means that the Position vs Time graph will be an exponential line as $x = \frac{1}{2} at^2 + v_0t + x_0$.

B.

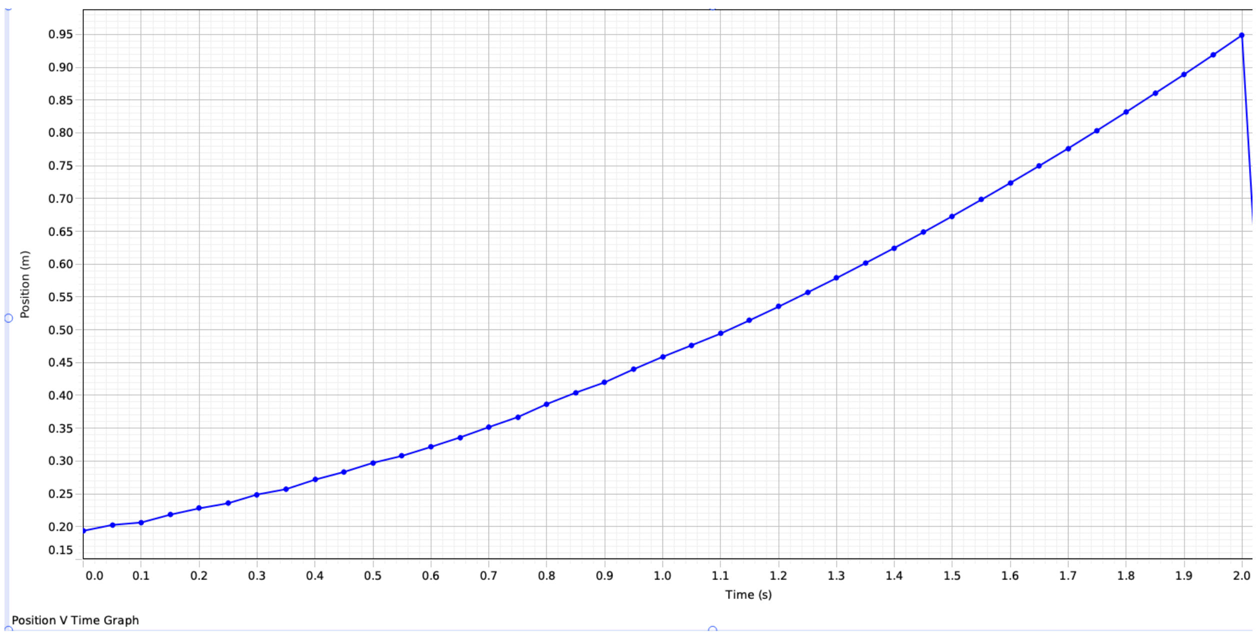
a. N/A

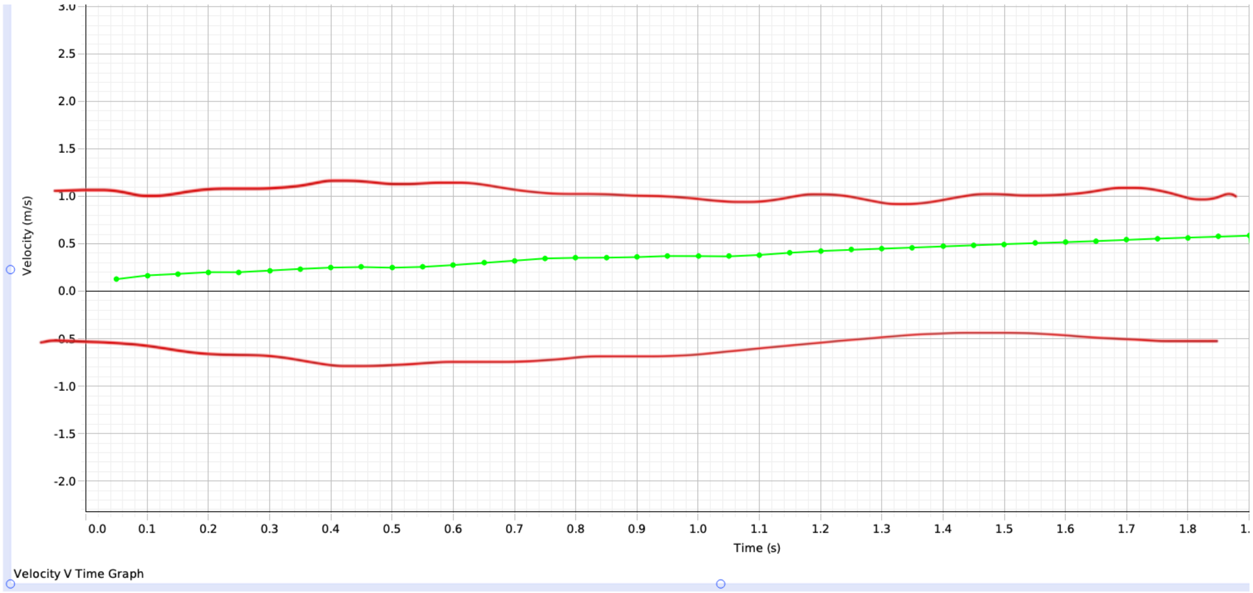
b. N/A

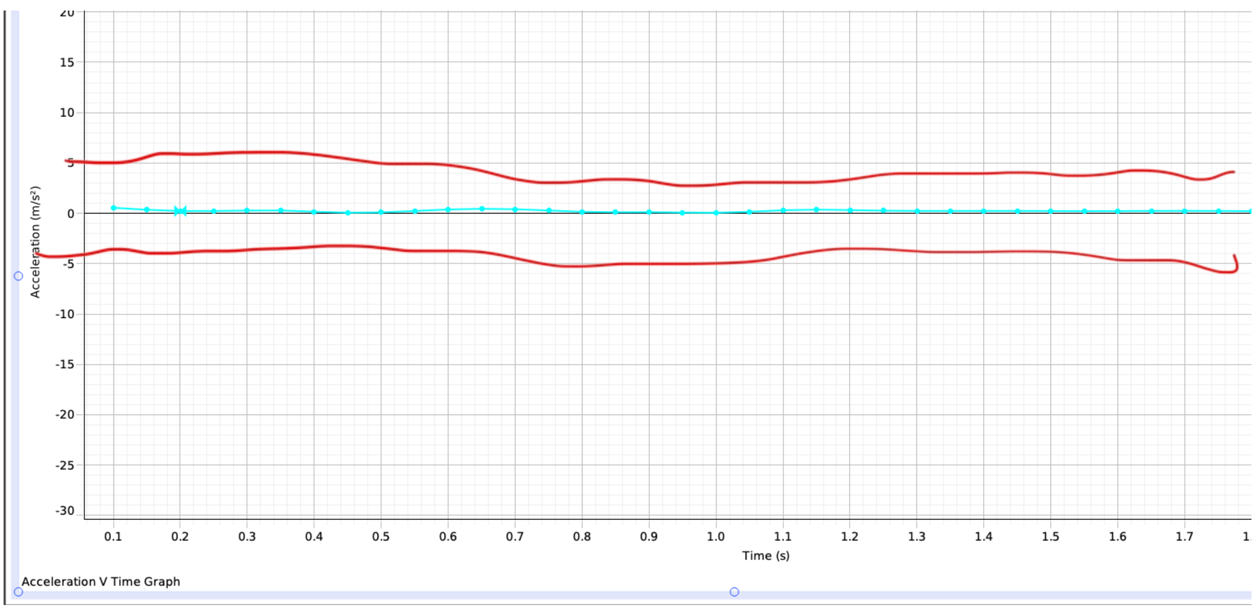
c. N/A

d. N/A

e. Graphs Pictured Below







Scale better -2 Data/results

C. The graphs match up accurately with our predictions from earlier. The capstone graphs are stretched horizontally but our predictions about their slopes hold true. There are small deviations on the real graph which could be due to a number of outside factors such as friction, air, or small issues in the measurement device.

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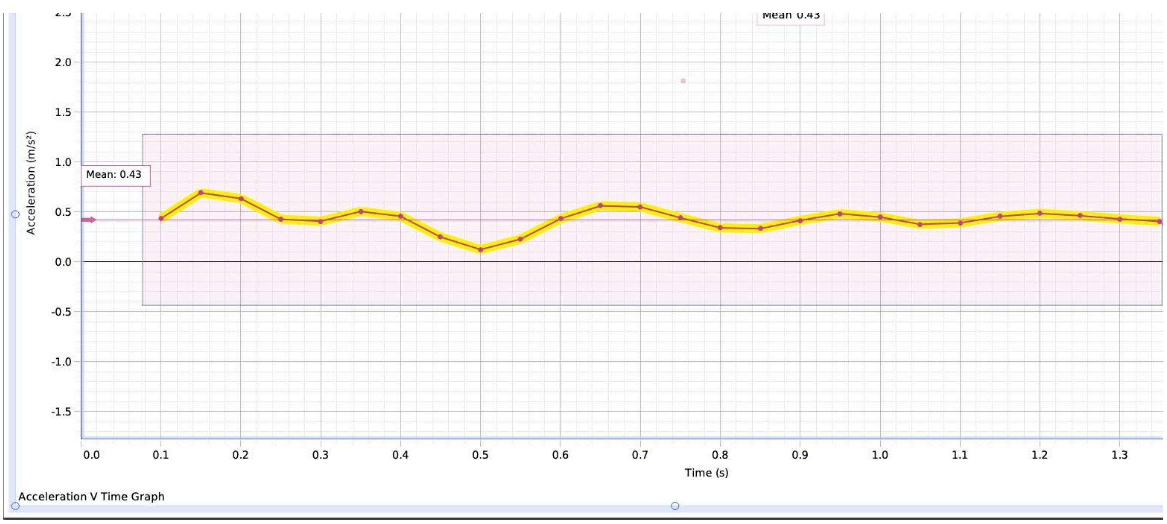
Task #2

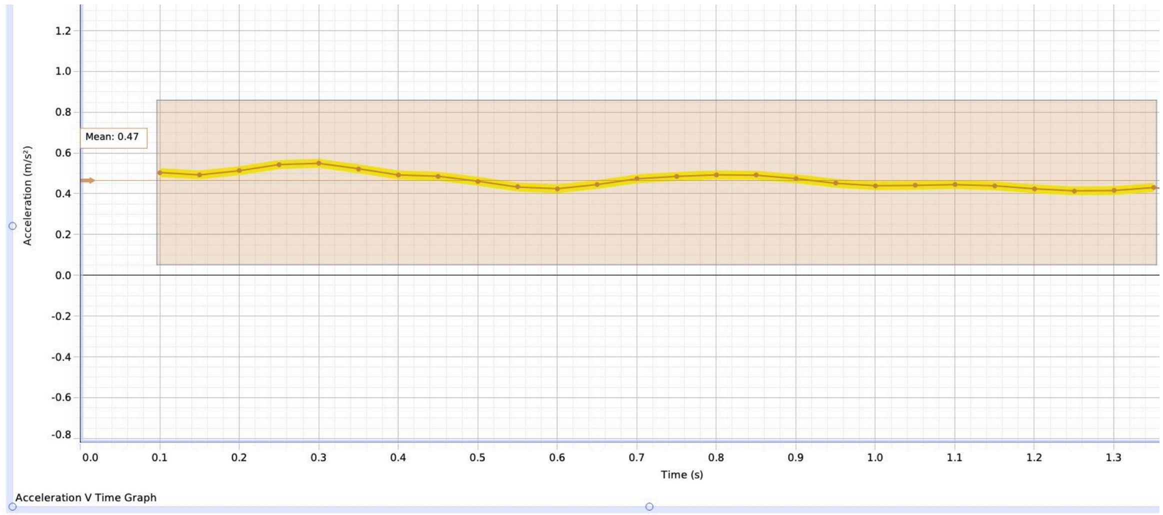
A.

Accel 1 m/s^2	Accel 2 m/2^2	Avg Accel m/s^2	Mass g
0.43	0.41	0.42	532.9
0.3	0.33	0.315	723.9
0.24	0.22	0.23	1032.9
0.18	0.18	0.18	1282.9
0.16	0.16	0.16	1532.9

B. To find the a_{avg}, we would run two experimental runs of the cart along the track measured in capstone. We would then take the mean of the acceleration of two separate runs, before then finding the mean of those two values. That would give us our a_{avg} which we would record along with the average accelerations of both experimental runs and the mass of the cart in these experiments.

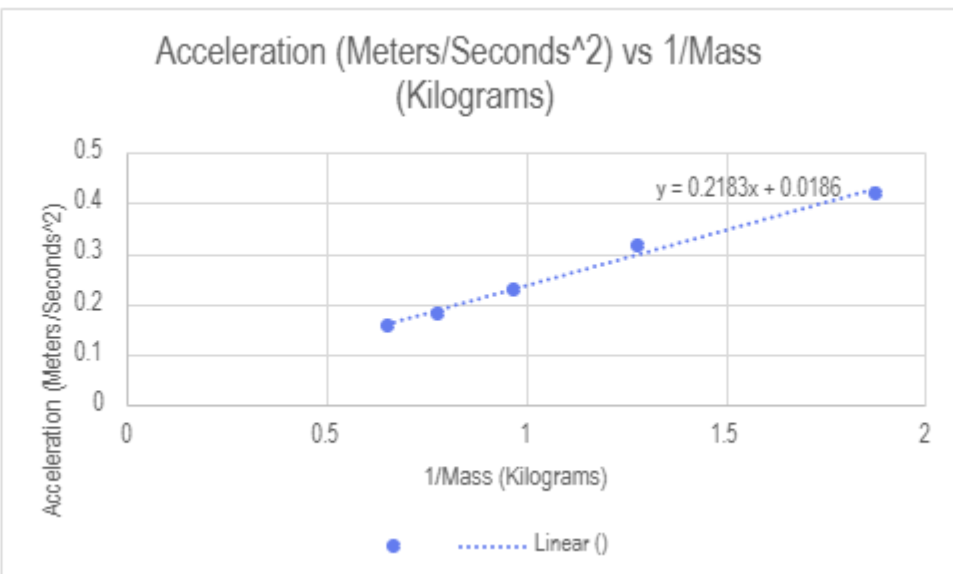
C.





D. We added a 250 gram mass to the fan cart and recorded the acceleration of the cart. We then did that one more time and found the average acceleration of the cart with the added mass.

E.



F. Shown in the graph above.

G. When force is constant, mass and acceleration have an inverse relation where mass decreasing causes an increase in acceleration (F/M = A). This equation makes sense as when 1/mass increases, mass decreases, and therefore acceleration increases, so 1/mass and acceleration have a direct relationship, as shown in the graph. This makes sense in the context of the experiment as when we would add mass to the cart, the average acceleration would decrease.

H. If force decreases but mass stays the same (F=ma), the only thing that would change would be that the acceleration would be lower. This would in turn cause the time it takes for the cart to get to the other side to increase, making the graph's time axis longer than it would be otherwise.

I. A smaller mass and the same force applied would mean that the acceleration would be greater, which would shrink the time axis of the graph.

Task #3

A. If both fans were turned on high, the carts would most likely not go anywhere as the forces are equal. The same result would occur if both fans were turned on low. If one fan was set on high and the other on low then the cart would move in the direction that the high fan is pushing towards, but slower than just by itself due to the opposing force that the low fan is causing.

B.

   a. N/A

   b. N/A

   c. The average acceleration when only the blue cart was running was 0.18m/s^2. It was the same when only the red cart was running except it was -0.18m/s^2 because it was running in the opposite direction back towards the scanner.

C. The new acceleration values are less than what we recorded in task #1 because there are now two carts attached together which means there is more mass and therefore acceleration decreases.

D. First we turned both of the fans on high and set the carts in the middle and recorded the result. We then set both to low and did the same thing, and we ended with setting one on high and one on low and recording the average acceleration using the sensor.

E. The results we found match up with our predictions very accurately. We predicted that the carts would not move (have an acceleration of 0 m/s^2) if both of the fans were set to high or low at the same time; the same thing occurred when we set them both to the same speed. When we then set the fans to one high and one low, we recorded an average acceleration of 0.16m/s^2, which is slightly slower than when we recorded just one fan running on high, which matches up with our prediction that opposing forces would result in a smaller net force and therefore smaller acceleration than otherwise.

F. When both fans were turned on, one being on high and one being on low, the recorded average acceleration was 0.02 m/s^2 lower than what we recorded when only one fan was running, which was 0.18 m/s^2. It came out slower because when both fans were running, the high fan had a negative force pushing against due to the low fan blowing at the same time. When only one fan is running it moves faster because there are no negative forces pushing on it at the same time.

G. The average acceleration is directly correlated to the net force for a constant acceleration, (F_{net} = mass * a_{avg}). Our data supports this as when the F_{net} decreases but the mass stays the same the acceleration also decreases. Such as when an opposing force (fan) is used to decrease the F_{net} the acceleration was smaller than when no opposing force was used so the F_{net} was higher.

Data for task 3? -> Data/results

Accuracy

Any slight issue in position measurement created huge dips and jumps in the acceleration graphs. Multiple times during our measurements we had to move the motion sensor to make sure to reduce errors in our measurements as otherwise it would occasionally measure past the fan and cart. Measuring the carts we found that they were not the exact same weight so in the future we would want to even them out before hand. Some of the weights we were given were not exactly as specific in the lab, which could have also created issues in the force we calculated. In the future having more precise weights could improve our measurements. While the track was roughly level, more precise instruments could help us understand if it was truly level. The friction between the wheels and the cart may not have been perfectly equal, especially between both carts, so in the future finding a way to make sure that they are equal could also help us in getting more precise measurements.

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Implications

In part one of the lab, we predicted how a cart with a fan on top would move across the track then recorded the acceleration, displacement, and velocity as a function of time as the cart moved across the track. We did this by using the sensor and capstone to graph the data. We care about finding this data because this can have real world applications, such as needing to find the amount of power it takes to move a vehicle across an area in a certain amount of time. In part two, we added weights to the cart then recorded the average acceleration as the cart moved across the track. We found the more weights we added, the stronger the force would be needed to increase the acceleration; this relates to the equation F=ma. This connects to earlier with the real world application because it can help demonstrate how much power would be needed to move a cart or vehicle that could be loaded up with cargo. Finally, during part three, we added a second cart with a second fan that would blow at a different force in the opposite direction. We found the average acceleration of this to be lower due to the negative force being applied. We care about this because this could connect to another real world scenario such as freight trains pushing multiple carts. The locomotives would be the positive force while the freight cars would be the negative force. Engineers need to know how powerful to make the locomotives if they are hauling more cargo otherwise the main power source would not be powerful enough to pull more cars.

Formatting/Layout	15/15
Completeness	15/15
Data/Results	23/30
Physics Concepts/Understanding	20/20
Accuracy and Implications	20/20