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# Force

**Purpose:** The purpose of this lab is to calculate the force of a fan-cart while empty and full.

**Background:** Force can be calculated using the formula F=ma. F is force, m is the mass in kilograms of the object in motion and a is the acceleration. The force of an object in motion is represented by the unit Newtons. One Newton is equal to 1kg · meter/second^2. The mass of the fan cart was .5 kg, the mass of the weight was also .5 kg, the mass of the sail was 0.2 kg . Making the total weight of the cart 0.7 kg empty, and the weight of the cart full 1.2 kg. In each trial run we calculated the speed of the cart with and without a load while the fan was at high speed and low speed and on an inclined plane with low and high angles. To calculate the acceleration of the fan-cart while using the fan the formula (1/2a)t^2 is used. The value of a is half of the cart's acceleration. On the slope the acceleration is calculated by the formula Acceleration=gravity*sintheta.

## Materials:

- Fan Cart
- Computer with Logger Pro
- Sonic Ranger
- Ramp
- Weight (500 g)

## Procedure:

Step 1: First set up your laptop and sonic ranger to record using logger pro. Then set the sonic ranger about 2 meters from the fan cart. Make sure the surface is flat and the sail is set up straight with the ranger.
Step 2: Turn the fan on low and let it go towards the sonic ranger, at the same time press record in logger pro. Repeat this step with the 500g weight on the cart. Then repeat it with the cart on high, first without the weight and then add the weight.
Step 3: Now stet up the ramp at a low height and the sonic ranger at the bottom.
Step 4: Let the cart roll down making sure it doesn't hit the ranger and record its velocity, and acceleration.
Step 5: Now raise the ramp up higher and repeat step 4

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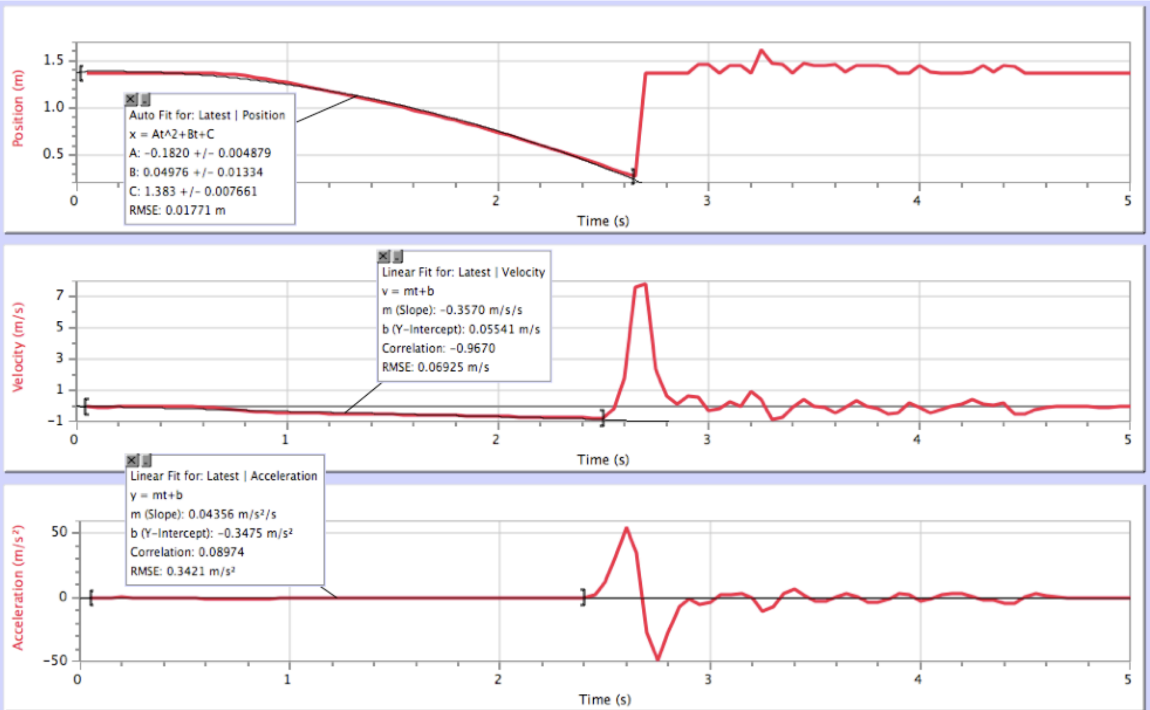
## Data:

Low No Weight

| | Time (s) | Position (m) | Velocity (m/s) |
|---|---|---|---|
| 1 | 0.05 | 1.367 | −0.012 |
| 2 | 0.10 | 1.368 | −0.026 |
| 3 | 0.15 | 1.364 | −0.022 |
| 4 | 0.20 | 1.364 | 0.000 |
| 5 | 0.25 | 1.364 | 0.022 |
| 6 | 0.30 | 1.367 | 0.023 |
| 7 | 0.35 | 1.367 | 0.007 |
| 8 | 0.40 | 1.367 | 0.004 |
| 9 | 0.45 | 1.368 | 0.003 |
| 10 | 0.50 | 1.368 | −0.001 |
| 11 | 0.55 | 1.368 | −0.010 |
| 12 | 0.60 | 1.368 | −0.038 |
| 13 | 0.65 | 1.365 | −0.086 |
| 14 | 0.70 | 1.359 | −0.137 |
| 15 | 0.75 | 1.351 | −0.189 |
| 16 | 0.80 | 1.341 | −0.264 |
| 17 | 0.85 | 1.324 | −0.332 |
| 18 | 0.90 | 1.306 | −0.365 |
| 19 | 0.95 | 1.287 | −0.386 |
| 20 | 1.00 | 1.268 | −0.403 |
| 21 | 1.05 | 1.247 | −0.419 |
| 22 | 1.10 | 1.226 | −0.428 |
| 23 | 1.15 | 1.204 | −0.441 |
| 24 | 1.20 | 1.182 | −0.457 |
| 25 | 1.25 | 1.159 | −0.472 |
| 26 | 1.30 | 1.135 | −0.492 |
| 27 | 1.35 | 1.110 | −0.510 |

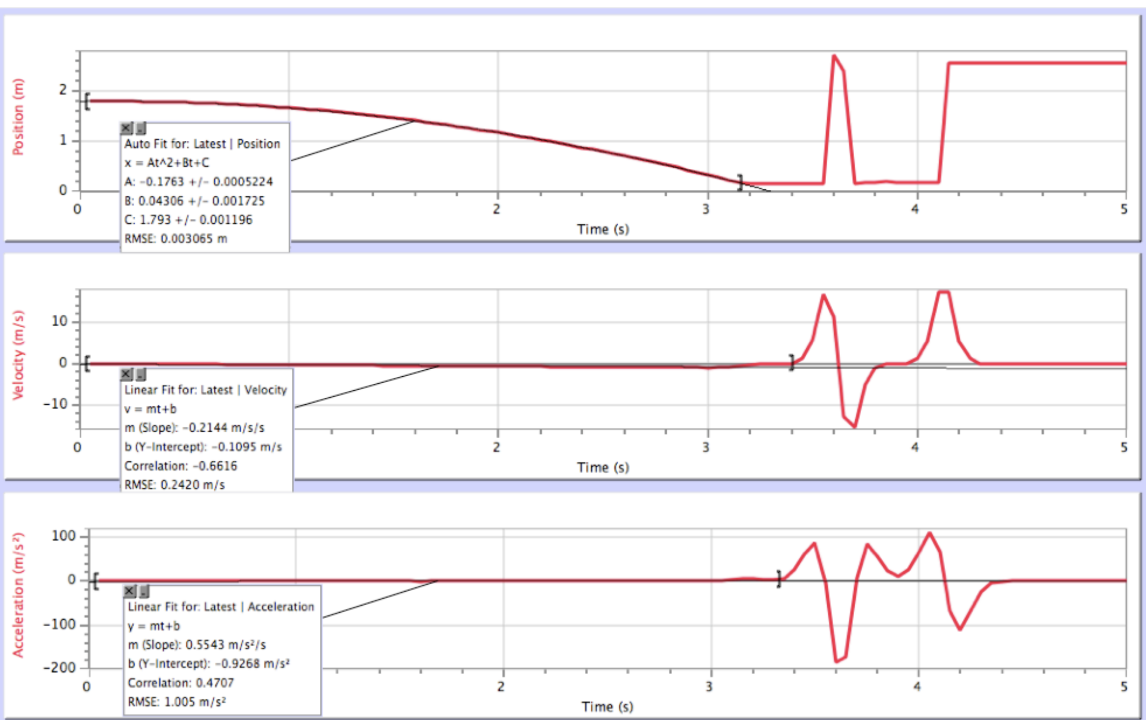
Position m




High No Weight

| | Time (s) | Position (m) | Velocity (m/s) |
|---|---|---|---|
| 1 | 0.05 | 1.792 | 0.004 |
| 2 | 0.10 | 1.792 | 0.002 |
| 3 | 0.15 | 1.792 | −0.004 |
| 4 | 0.20 | 1.792 | −0.018 |
| 5 | 0.25 | 1.791 | −0.038 |
| 6 | 0.30 | 1.788 | −0.058 |
| 7 | 0.35 | 1.785 | −0.076 |
| 8 | 0.40 | 1.780 | −0.093 |
| 9 | 0.45 | 1.775 | −0.109 |
| 10 | 0.50 | 1.770 | −0.125 |
| 11 | 0.55 | 1.763 | −0.142 |
| 12 | 0.60 | 1.756 | −0.161 |
| 13 | 0.65 | 1.747 | −0.186 |
| 14 | 0.70 | 1.736 | −0.196 |
| 15 | 0.75 | 1.728 | −0.214 |
| 16 | 0.80 | 1.715 | −0.239 |
| 17 | 0.85 | 1.703 | −0.250 |
| 18 | 0.90 | 1.690 | −0.265 |
| 19 | 0.95 | 1.676 | −0.275 |
| 20 | 1.00 | 1.663 | −0.294 |
| 21 | 1.05 | 1.648 | −0.323 |
| 22 | 1.10 | 1.631 | −0.348 |
| 23 | 1.15 | 1.612 | −0.368 |
| 24 | 1.20 | 1.594 | −0.383 |
| 25 | 1.25 | 1.574 | −0.400 |
| 26 | 1.30 | 1.554 | −0.417 |
| 27 | 1.35 | 1.533 | −0.435 |

Position m



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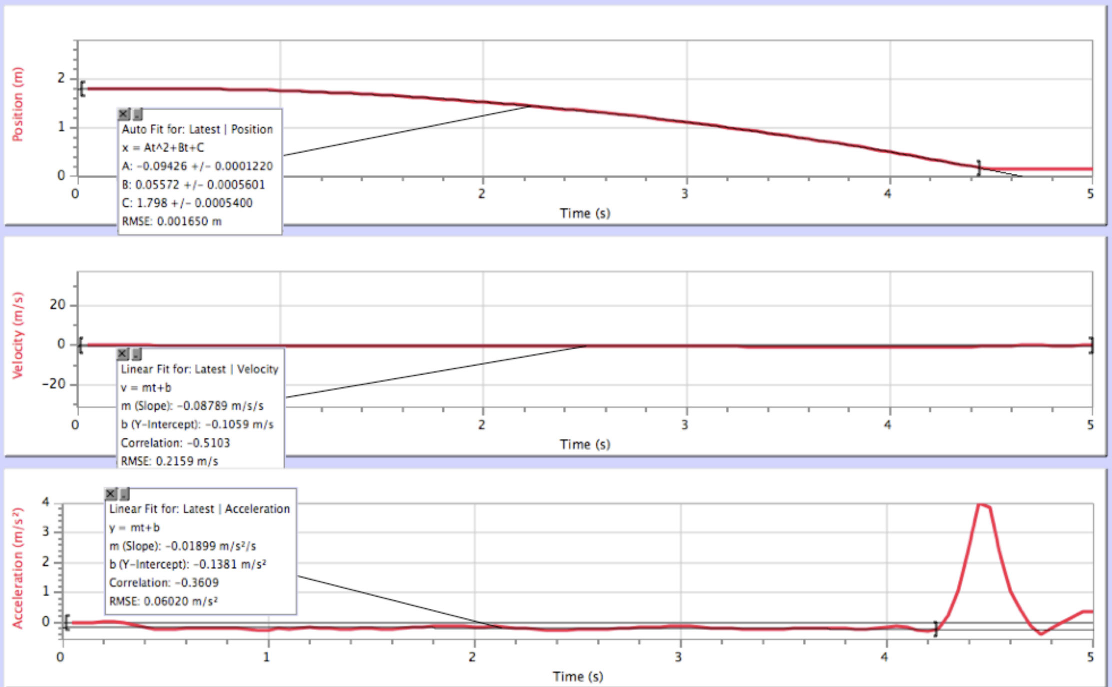
## Low With Weight

| | Latest | | |
|---|---|---|---|
| | Time (s) | Position (m) | Velocity (m/s) |
| 1 | 0.05 | 1.803 | 0.001 |
| 2 | 0.10 | 1.803 | 0.001 |
| 3 | 0.15 | 1.803 | 0.000 |
| 4 | 0.20 | 1.803 | 0.000 |
| 5 | 0.25 | 1.803 | 0.002 |
| 6 | 0.30 | 1.803 | 0.003 |
| 7 | 0.35 | 1.804 | 0.001 |
| 8 | 0.40 | 1.804 | -0.006 |
| 9 | 0.45 | 1.803 | -0.017 |
| 10 | 0.50 | 1.802 | -0.030 |
| 11 | 0.55 | 1.800 | -0.041 |
| 12 | 0.60 | 1.798 | -0.050 |
| 13 | 0.65 | 1.795 | -0.061 |
| 14 | 0.70 | 1.792 | -0.071 |
| 15 | 0.75 | 1.788 | -0.079 |
| 16 | 0.80 | 1.784 | -0.087 |
| 17 | 0.85 | 1.779 | -0.097 |
| 18 | 0.90 | 1.774 | -0.107 |
| 19 | 0.95 | 1.769 | -0.118 |
| 20 | 1.00 | 1.763 | -0.140 |
| 21 | 1.05 | 1.754 | -0.145 |
| 22 | 1.10 | 1.749 | -0.153 |
| 23 | 1.15 | 1.739 | -0.170 |
| 24 | 1.20 | 1.731 | -0.175 |
| 25 | 1.25 | 1.722 | -0.183 |
| 26 | 1.30 | 1.713 | -0.192 |
| 27 | 1.35 | 1.703 | -0.203 |

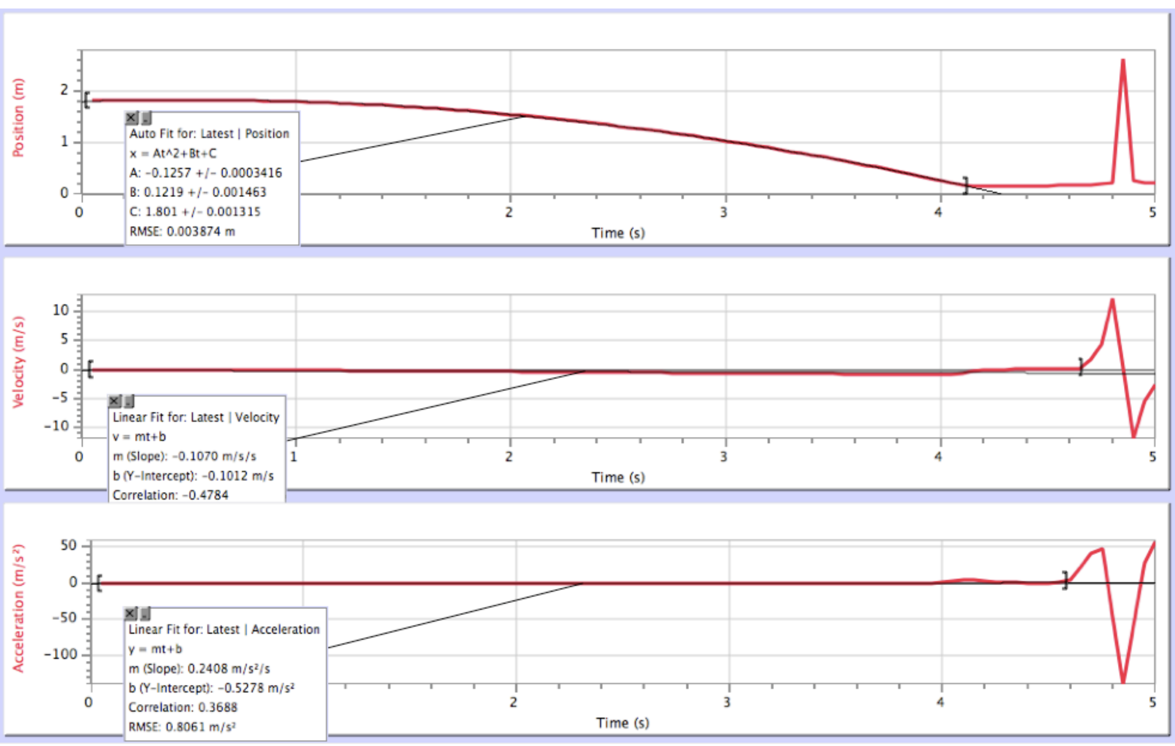
Position m




## High With Weight

| | Latest | | |
|---|---|---|---|
| | Time (s) | Position (m) | Velocity (m/s) |
| 1 | 0.05 | 1.826 | -0.004 |
| 2 | 0.10 | 1.825 | -0.001 |
| 3 | 0.15 | 1.826 | 0.003 |
| 4 | 0.20 | 1.826 | 0.003 |
| 5 | 0.25 | 1.826 | 0.000 |
| 6 | 0.30 | 1.826 | -0.001 |
| 7 | 0.35 | 1.826 | 0.001 |
| 8 | 0.40 | 1.826 | -0.001 |
| 9 | 0.45 | 1.826 | -0.003 |
| 10 | 0.50 | 1.826 | -0.006 |
| 11 | 0.55 | 1.825 | -0.013 |
| 12 | 0.60 | 1.825 | -0.025 |
| 13 | 0.65 | 1.823 | -0.038 |
| 14 | 0.70 | 1.821 | -0.049 |
| 15 | 0.75 | 1.818 | -0.065 |
| 16 | 0.80 | 1.814 | -0.080 |
| 17 | 0.85 | 1.810 | -0.093 |
| 18 | 0.90 | 1.805 | -0.104 |
| 19 | 0.95 | 1.800 | -0.117 |
| 20 | 1.00 | 1.793 | -0.128 |
| 21 | 1.05 | 1.787 | -0.136 |
| 22 | 1.10 | 1.780 | -0.146 |
| 23 | 1.15 | 1.772 | -0.160 |
| 24 | 1.20 | 1.764 | -0.174 |
| 25 | 1.25 | 1.755 | -0.187 |
| 26 | 1.30 | 1.745 | -0.200 |
| 27 | 1.35 | 1.735 | -0.214 |

Position m



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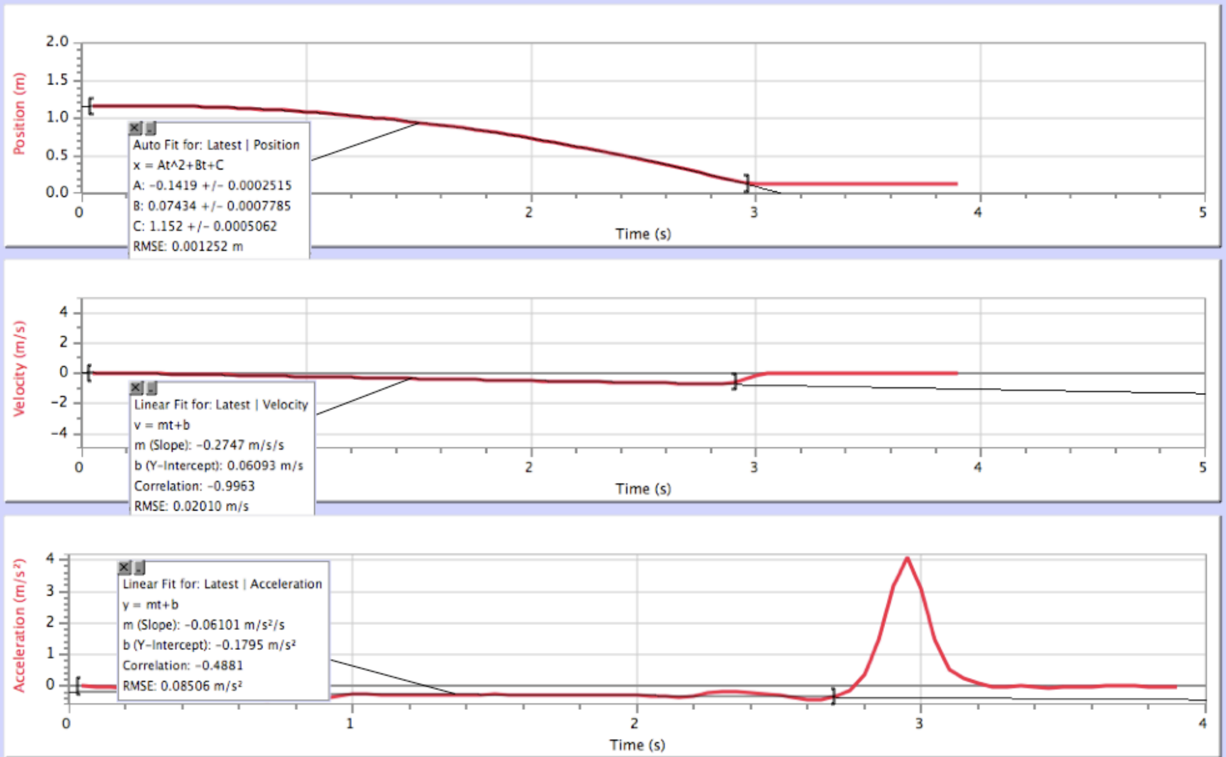
## Low Incline 5cm

| | Latest | | |
|---|---|---|---|
| | Time (s) | Position (m) | Velocity (m/s) |
| 1 | 0.05 | 1.160 | 0.000 |
| 2 | 0.10 | 1.159 | 0.001 |
| 3 | 0.15 | 1.160 | 0.000 |
| 4 | 0.20 | 1.160 | -0.003 |
| 5 | 0.25 | 1.159 | -0.003 |
| 6 | 0.30 | 1.160 | -0.011 |
| 7 | 0.35 | 1.159 | -0.025 |
| 8 | 0.40 | 1.157 | -0.035 |
| 9 | 0.45 | 1.155 | -0.045 |
| 10 | 0.50 | 1.152 | -0.059 |
| 11 | 0.55 | 1.149 | -0.072 |
| 12 | 0.60 | 1.145 | -0.084 |
| 13 | 0.65 | 1.141 | -0.099 |
| 14 | 0.70 | 1.136 | -0.123 |
| 15 | 0.75 | 1.129 | -0.152 |
| 16 | 0.80 | 1.119 | -0.158 |
| 17 | 0.85 | 1.112 | -0.150 |
| 18 | 0.90 | 1.106 | -0.179 |
| 19 | 0.95 | 1.094 | -0.206 |
| 20 | 1.00 | 1.084 | -0.210 |
| 21 | 1.05 | 1.074 | -0.223 |
| 22 | 1.10 | 1.062 | -0.238 |
| 23 | 1.15 | 1.050 | -0.253 |
| 24 | 1.20 | 1.037 | -0.267 |
| 25 | 1.25 | 1.023 | -0.281 |
| 26 | 1.30 | 1.009 | -0.295 |
| 27 | 1.35 | 0.994 | -0.308 |

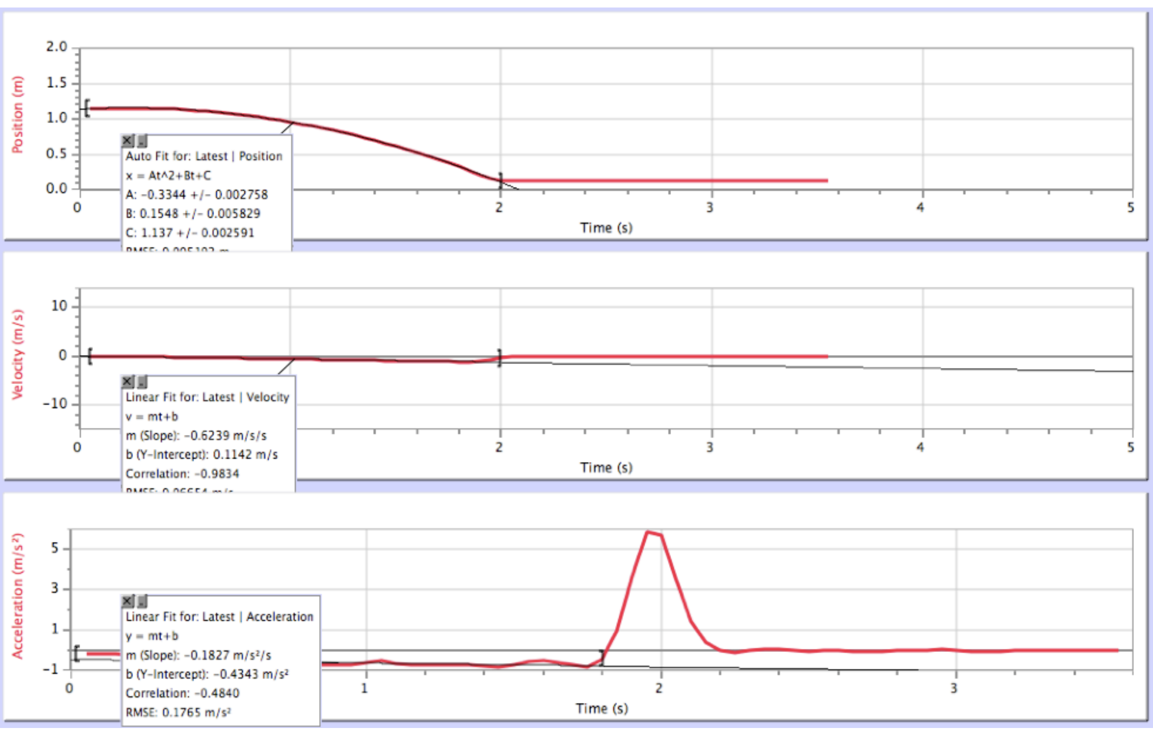
Position m




## High Incline 11cm

| | Latest | | |
|---|---|---|---|
| | Time (s) | Position (m) | Velocity (m/s) |
| 1 | 0.05 | 1.150 | 0.018 |
| 2 | 0.10 | 1.152 | 0.009 |
| 3 | 0.15 | 1.151 | 0.001 |
| 4 | 0.20 | 1.151 | -0.004 |
| 5 | 0.25 | 1.151 | -0.015 |
| 6 | 0.30 | 1.150 | -0.034 |
| 7 | 0.35 | 1.148 | -0.063 |
| 8 | 0.40 | 1.144 | -0.098 |
| 9 | 0.45 | 1.139 | -0.137 |
| 10 | 0.50 | 1.131 | -0.187 |
| 11 | 0.55 | 1.119 | -0.218 |
| 12 | 0.60 | 1.108 | -0.223 |
| 13 | 0.65 | 1.098 | -0.254 |
| 14 | 0.70 | 1.084 | -0.303 |
| 15 | 0.75 | 1.067 | -0.343 |
| 16 | 0.80 | 1.049 | -0.380 |
| 17 | 0.85 | 1.029 | -0.417 |
| 18 | 0.90 | 1.007 | -0.452 |
| 19 | 0.95 | 0.984 | -0.488 |
| 20 | 1.00 | 0.959 | -0.529 |
| 21 | 1.05 | 0.930 | -0.546 |
| 22 | 1.10 | 0.904 | -0.567 |
| 23 | 1.15 | 0.874 | -0.611 |
| 24 | 1.20 | 0.843 | -0.647 |
| 25 | 1.25 | 0.810 | -0.682 |
| 26 | 1.30 | 0.775 | -0.717 |
| 27 | 1.35 | 0.738 | -0.752 |

Position m



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**Observations:** The Fan Cart seemed to move the fastest when there was no load on it. While on high the fan cart moved the fastest. When the fan cart looked like it was going the fastest when the incline was highest.

**Analysis:** The process of finding the force of the Fan cart was successful. Though the cart always seemed to merge the right, which could've affected our results. But when the cart was on the ramp there was no problem with the Fan Cart merging off course.

By using the formula F=ma the force of the fan cart on low with no weight is 0.2548 Newtons. 0.2548 N= .7 kg*(0.182*2).

By using the formula F=ma the force of the fan cart on high with no weight is 0.24682 Newtons. 0.24682 N= .7 kg*(0.1763*2).

By using the formula F=ma the force of the fan cart on low with weight is 0.226224 Newtons. 0.226224 N= 1.2 kg*(0.09426*2).

By using the formula F=ma the force of the fan cart on high with weight is 0.30168 Newtons. 0.30168 N= 1.2 kg*(0.1257*2).

By using the formula F=ma the force of the fan cart on a low incline of 2° is 0.2394 Newtons. 0.2394 N= .7 kg*(0.342). The acceleration is 0.342=(9.8)*sin(2).

By using the formula F=ma the force of the fan cart on a high incline of 5° is 0.5978 Newtons. 0.5978 N= .7 kg*(0.854). The acceleration is 0.854=(9.8)*sin(5).

**Conclusion:** From these results we found that the cart accelerated the fastest and had more force when empty on an incline of 5°. The cart was the slowest when full and with the fan on low. If I could change anything I would have probably done the fan portion of the lab on the ramp at 0° so that the cart would stay on course.

## Questions:

How was the acceleration of the inclined cart related to g? How should it be related?

The acceleration was greater when the cart was at a greater angle. G affected the acceleration because G provided a force that allowed the cart to accelerate down the ramp.

Determine the force from the fan on low and high speeds.

The force of the fan cart on low with no weight is 0.2548 Newtons. 0.2548 N= .7 kg*(0.182*2). The force of the fan cart on high with no weight is 0.24682 Newtons. 0.24682 N= .7 kg*(0.1763*2). The force of the fan cart on low with weight is 0.226224

Newtons. 0.226224 N= 1.2 kg*(0.09426*2). The force of the fan cart on high with weight is 0.30168 Newtons. 0.30168 N= 1.2 kg*(0.1257*2).

<u>If you allowed the ramp to bounce, what would the v/t graph look like and why?</u>

If the ramp was allowed to bounce then the v/t graph would be wavy because the cart would be accelerating and decelerating constantly.

<u>If the fan cart had another identical cart hooked to it, what would this do to the three curves: x/t v/t a/t?</u>

The x/t graph would be longer because of the added weight. The v/t graph would stay constantly at 0. The a/t graph would probably look the same as the high with weight graph.