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Newton's Law

Purpose: to study Newtons law

Background: Anything that has mass acted on by force will move. The heavier the mass the more force need to move. We can manipulate force and mass and measure acceleration with formula F=Ma

Materials:

- Roller Cart
- Ramp
- Books
- Computer with logger pro
- Note card
- Tape
- Weight
- Fancart
- Go!motion radar with cable
- Digital scale

Procedure:

Part 1 Fan cart:

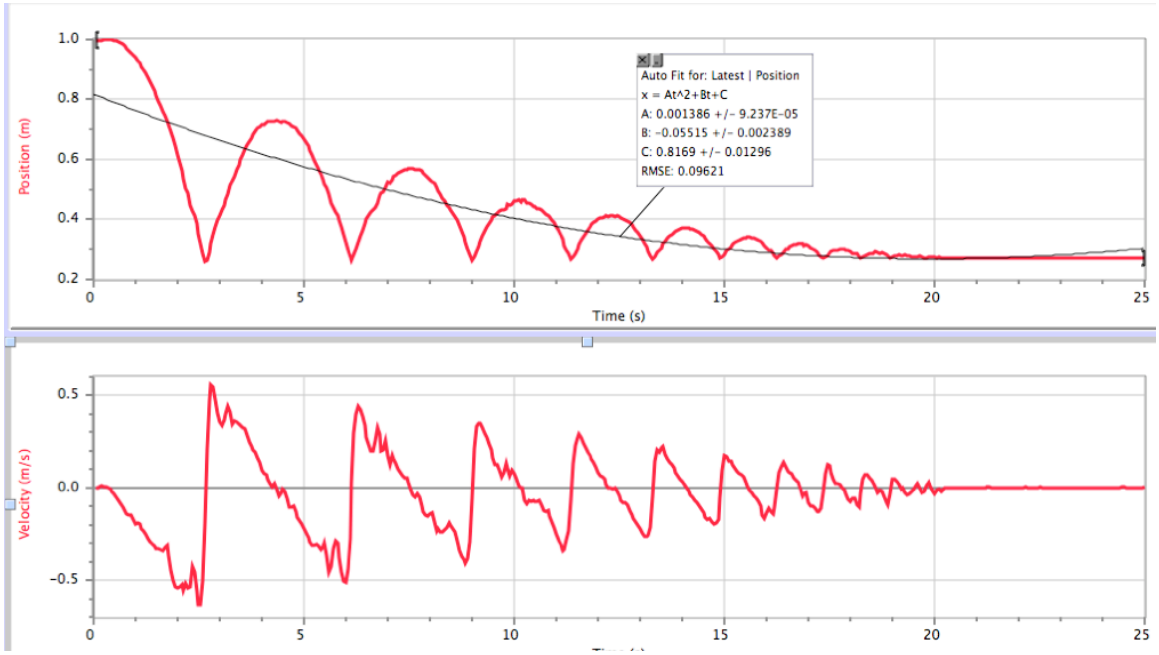
1. Setup the motion radar pointing directly at the fan cart's sail
2. Turn cart on low and hold at 150 cm away from bumper
3. Release cart
4. Record the data on logger pro
5. Auto scale graphs
6. repeat steps 1-5 with cart fan on high
7. now repeat steps 1-6 with a weight

Part 2 Roller cart

1. setup the ramp at 8cm high by using books
2. by using tape mount the note card on the roller cart
3. setup the motion radar facing ramp and roller cart
4. let the cart go at 100cm distance from the bumber
5. keep motion radar on while the cart bounces back and forth off bumper
6. record data on logger pro
7. now do this experiment again moving the height of the ramp up to 12 cm

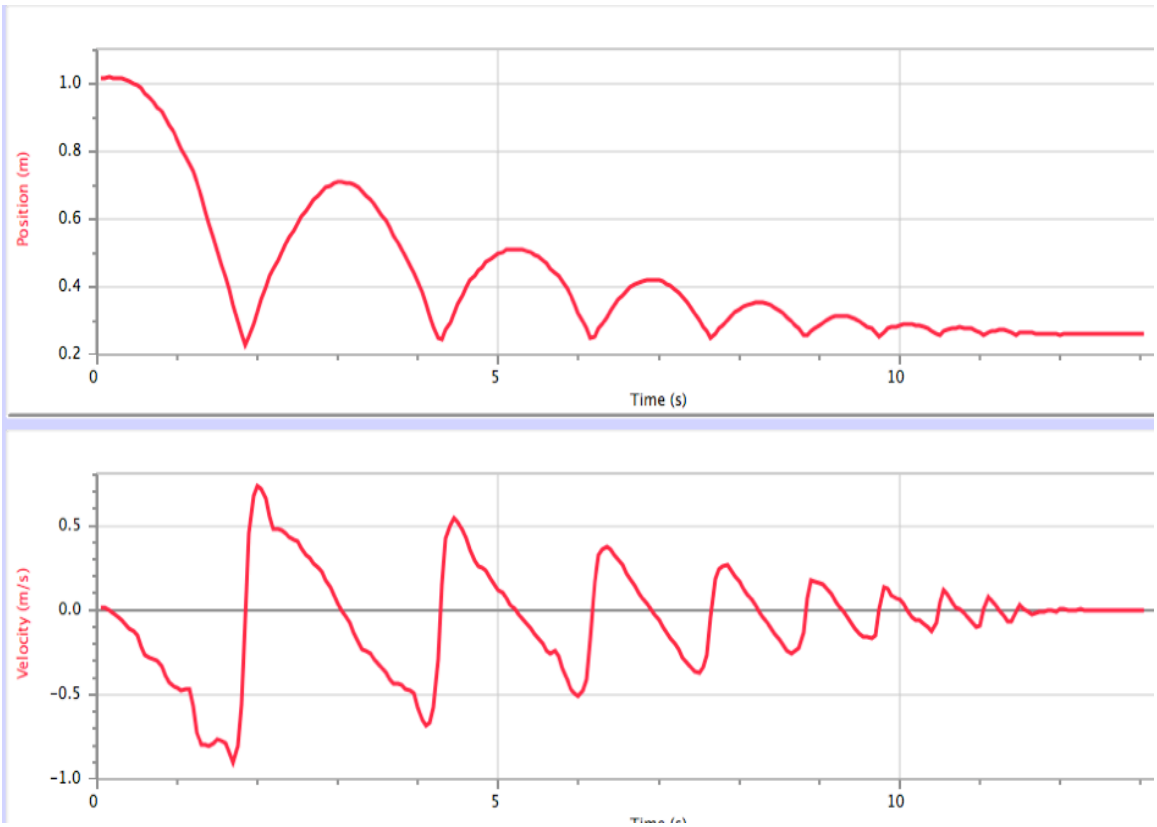
Data: Roller cart 8cm

	Latest		
	Time (s)	Position (m)	Velocity (m/s)
1	0.05	0.997	-0.003
2	0.10	0.997	0.001
3	0.15	0.997	0.006
4	0.20	0.998	0.009
5	0.25	0.998	0.007
6	0.30	0.998	0.003
7	0.35	0.998	0.000
8	0.40	0.999	-0.006
9	0.45	0.998	-0.020
10	0.50	0.997	-0.035
11	0.55	0.995	-0.050
12	0.60	0.992	-0.067
13	0.65	0.988	-0.084
14	0.70	0.983	-0.102
15	0.75	0.978	-0.128
16	0.80	0.970	-0.144
17	0.85	0.963	-0.147
18	0.90	0.955	-0.150
19	0.95	0.949	-0.173
20	1.00	0.938	-0.196
21	1.05	0.928	-0.193
22	1.10	0.919	-0.198
23	1.15	0.909	-0.217
24	1.20	0.897	-0.229
25	1.25	0.886	-0.248



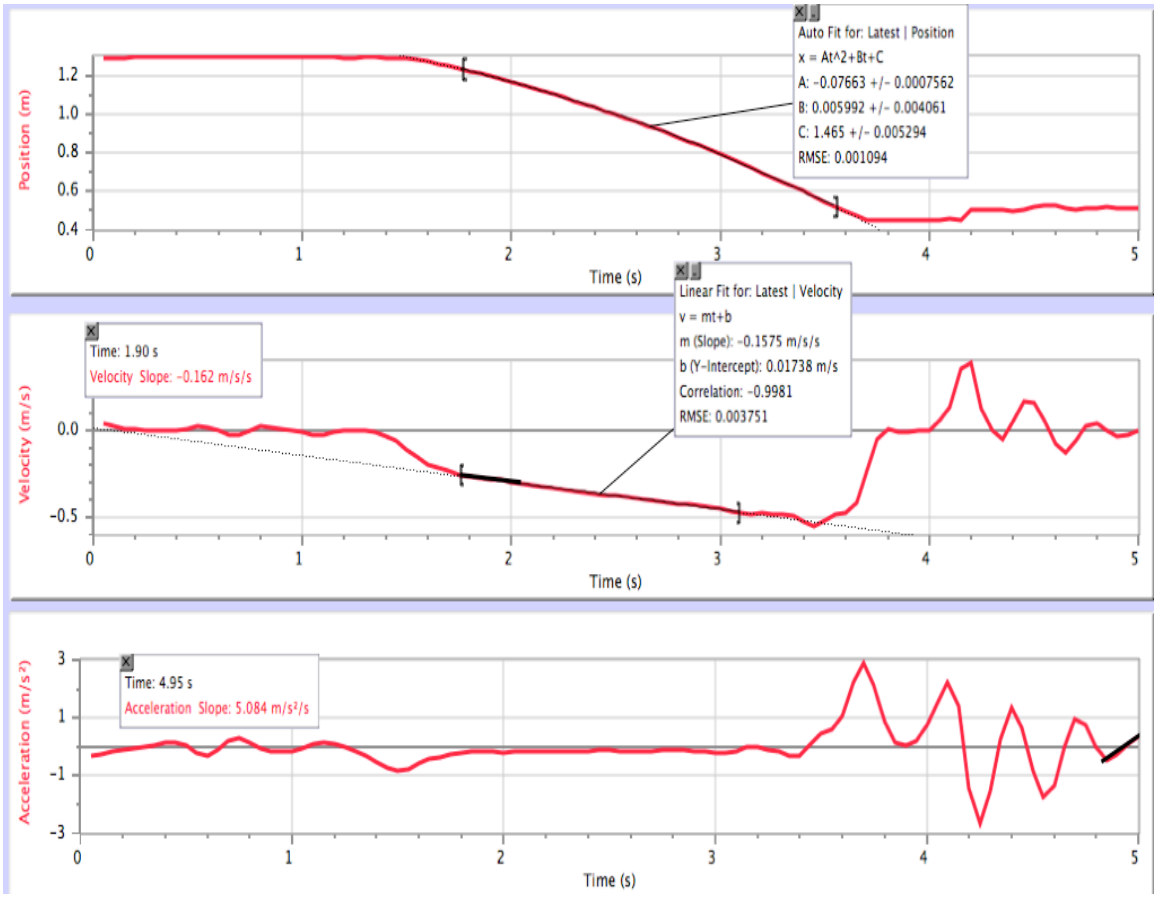
Roller car at 12 cm:

	Latest		
	Time (s)	Position (m)	Velocity (m/s)
1	0.05	1.019	0.010
2	0.10	1.020	0.012
3	0.15	1.022	-0.002
4	0.20	1.020	-0.019
5	0.25	1.020	-0.035
6	0.30	1.016	-0.060
7	0.35	1.014	-0.081
8	0.40	1.009	-0.106
9	0.45	1.002	-0.123
10	0.50	0.996	-0.148
11	0.55	0.990	-0.212
12	0.60	0.974	-0.263
13	0.65	0.962	-0.277
14	0.70	0.947	-0.292
15	0.75	0.932	-0.297
16	0.80	0.919	-0.328
17	0.85	0.900	-0.383
18	0.90	0.880	-0.426
19	0.95	0.857	-0.451
20	1.00	0.834	-0.464
21	1.05	0.811	-0.475
22	1.10	0.785	-0.471
23	1.15	0.763	-0.471
24	1.20	0.743	-0.566
25	1.25	0.710	-0.724


Position (m)
1.0
0.8
0.6
0.4
0.2
0
5
10
Time (s)
Velocity (m/s)
0.5
0.0
-0.5
-1.0
0
5
10

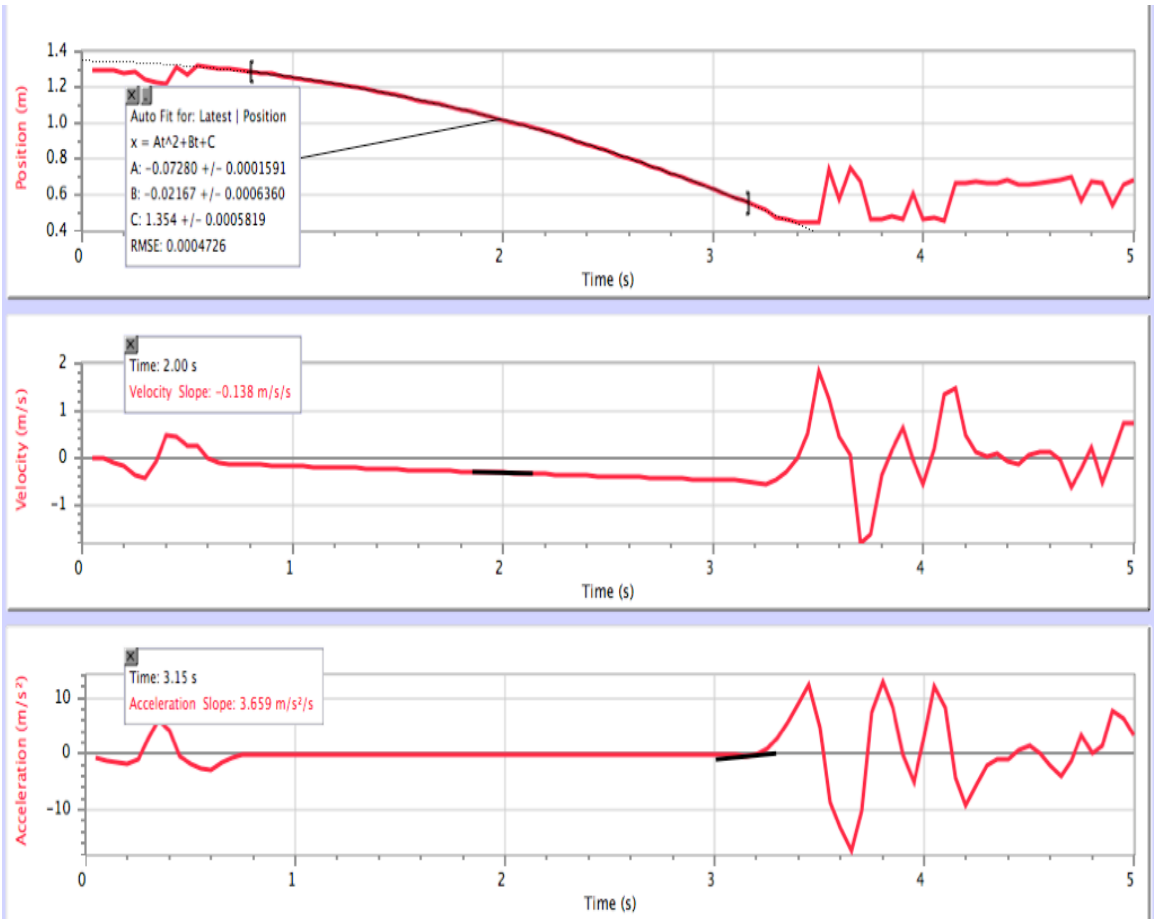
Low fan without weight:

	Latest		
	Time (s)	Position (m)	Velocity (m/s)
21	1.05	1.299	-0.023
22	1.10	1.296	-0.023
23	1.15	1.296	-0.010
24	1.20	1.295	-0.003
25	1.25	1.295	0.002
26	1.30	1.296	0.000
27	1.35	1.296	-0.011
28	1.40	1.295	-0.030
29	1.45	1.293	-0.063
30	1.50	1.289	-0.109
31	1.55	1.283	-0.156
32	1.60	1.273	-0.196
33	1.65	1.262	-0.214
34	1.70	1.252	-0.232
35	1.75	1.239	-0.254
36	1.80	1.226	-0.262
37	1.85	1.213	-0.270
38	1.90	1.199	-0.278
39	1.95	1.185	-0.285
40	2.00	1.171	-0.296
41	2.05	1.155	-0.306
42	2.10	1.140	-0.314
43	2.15	1.124	-0.323
44	2.20	1.107	-0.331
45	2.25	1.091	-0.342


Auto Fit for: Latest | Position
x = At^2+Bt+C
A: -0.07663 +/- 0.0007562
B: 0.005992 +/- 0.004061
C: 1.465 +/- 0.005294
RMSE: 0.001094
Position (m)
Time (s)
Linear Fit for: Latest | Velocity
v = mt+b
m (Slope): -0.1575 m/s/s
b (Y-Intercept): 0.01738 m/s
Correlation: -0.9981
RMSE: 0.003751
Time: 1.90 s
Velocity Slope: -0.162 m/s/s
Velocity (m/s)
Time (s)
Time: 4.95 s
Acceleration Slope: 5.084 m/s²/s
Acceleration (m/s²)
Time (s)

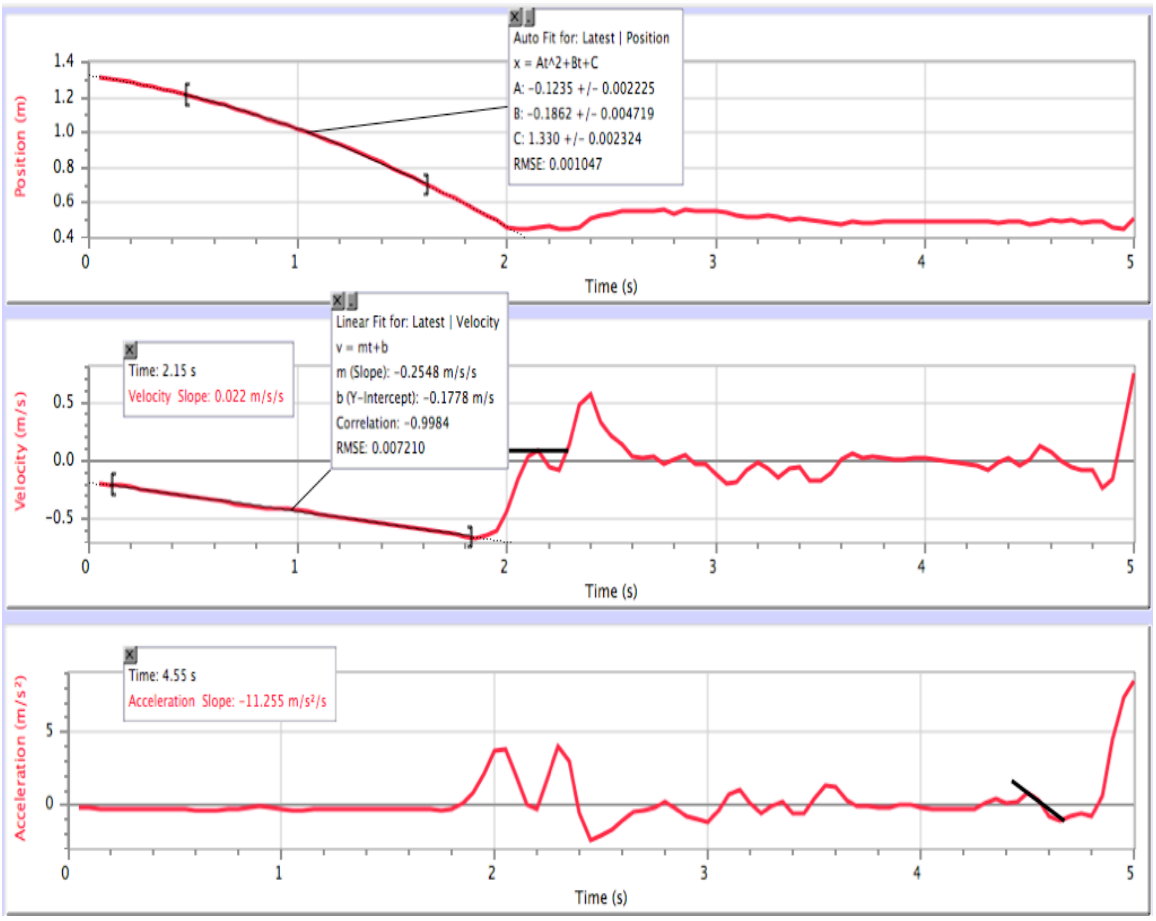
Low fan with weight:

	Latest		
	Time (s)	Position (m)	Velocity (m/s)
1	0.05	1.295	0.004
2	0.10	1.296	-0.022
3	0.15	1.297	-0.105
4	0.20	1.284	-0.158
5	0.25	1.290	-0.351
6	0.30	1.245	-0.414
7	0.35	1.225	-0.077
8	0.40	1.224	0.486
9	0.45	1.310	0.439
10	0.50	1.272	0.266
11	0.55	1.323	0.267
12	0.60	1.316	-0.021
13	0.65	1.310	-0.098
14	0.70	1.304	-0.134
15	0.75	1.297	-0.136
16	0.80	1.290	-0.137
17	0.85	1.283	-0.143
18	0.90	1.276	-0.157
19	0.95	1.267	-0.170
20	1.00	1.259	-0.172
21	1.05	1.250	-0.176
22	1.10	1.241	-0.185
23	1.15	1.232	-0.191
24	1.20	1.222	-0.188
25	1.25	1.213	-0.196


Position (m)
Auto Fit for: Latest | Position
x = At^2+Bt+C
A: -0.07280 +/- 0.0001591
B: -0.02167 +/- 0.0006360
C: 1.354 +/- 0.0005819
RMSE: 0.0004726
Time (s)
Velocity (m/s)
Time: 2.00 s
Velocity Slope: -0.138 m/s/s
Time (s)
Acceleration (m/s²)
Time: 3.15 s
Acceleration Slope: 3.659 m/s²/s
Time (s)

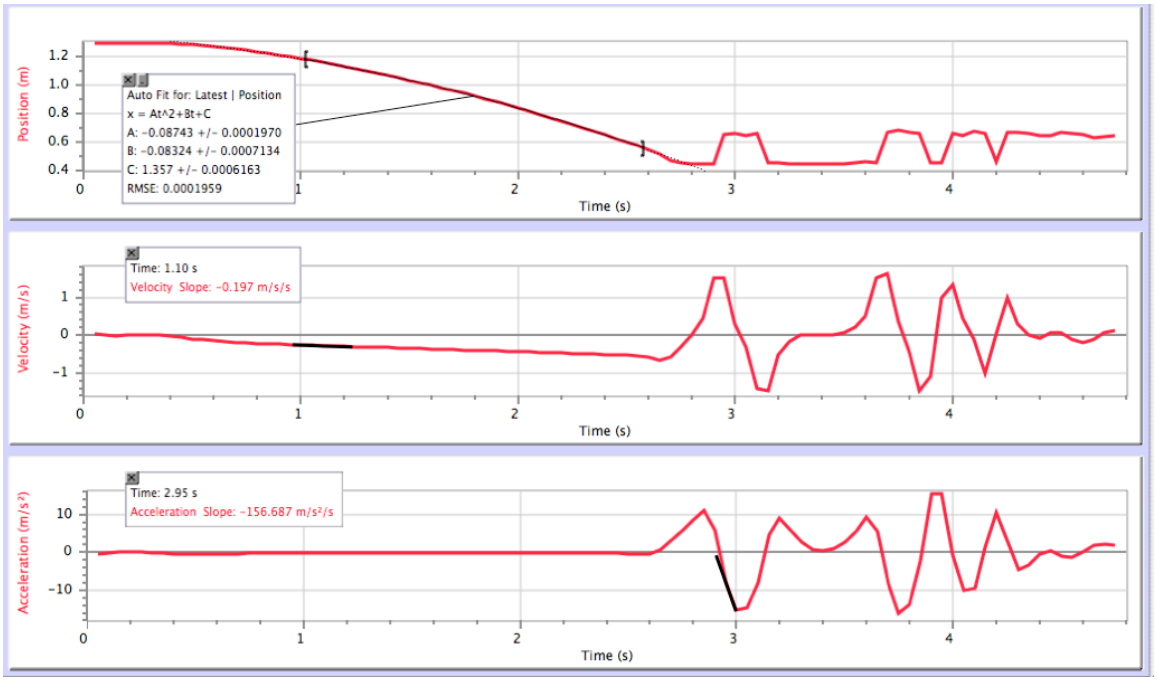
High fan without weight:

	Latest		
	Time (s)	Position (m)	Velocity (m/s)
12	0.60	1.175	-0.331
13	0.65	1.158	-0.348
14	0.70	1.140	-0.373
15	0.75	1.120	-0.379
16	0.80	1.103	-0.392
17	0.85	1.081	-0.412
18	0.90	1.060	-0.406
19	0.95	1.041	-0.407
20	1.00	1.020	-0.415
21	1.05	1.000	-0.433
22	1.10	0.977	-0.455
23	1.15	0.954	-0.471
24	1.20	0.930	-0.484
25	1.25	0.906	-0.497
26	1.30	0.880	-0.511
27	1.35	0.854	-0.523
28	1.40	0.828	-0.536
29	1.45	0.801	-0.550
30	1.50	0.773	-0.561
31	1.55	0.744	-0.571
32	1.60	0.716	-0.581
33	1.65	0.687	-0.595
34	1.70	0.656	-0.609
35	1.75	0.626	-0.622
36	1.80	0.595	-0.645



High fan with weight:

	Latest		
	Time (s)	Position (m)	Velocity (m/s)
1	0.05	1.289	0.025
2	0.10	1.292	0.000
3	0.15	1.289	-0.012
4	0.20	1.289	-0.003
5	0.25	1.289	0.001
6	0.30	1.289	0.002
7	0.35	1.290	-0.010
8	0.40	1.289	-0.038
9	0.45	1.286	-0.062
10	0.50	1.284	-0.101
11	0.55	1.275	-0.125
12	0.60	1.270	-0.129
13	0.65	1.264	-0.162
14	0.70	1.254	-0.191
15	0.75	1.244	-0.207
16	0.80	1.233	-0.220
17	0.85	1.222	-0.229
18	0.90	1.210	-0.236
19	0.95	1.198	-0.243
20	1.00	1.186	-0.252
21	1.05	1.173	-0.265
22	1.10	1.159	-0.277
23	1.15	1.145	-0.285
24	1.20	1.131	-0.291
25	1.25	1.116	-0.303



Observations: We realized that if the motion sensor got to close to the cart fan or the roller cart that it did not read correctly so we had to position it at a perfect distance in order to get a realistic graph.

Analysis: We used Newtons second law F=MA to setup the lab. To find the acceleration we derived the coefficent from the quadratic curve fit of the graphs using the S=1/2ab^2 and then double checked our answer using the linear equation y=mx+b with m being the acceleration

Conclusion: we determined that this lab was a good example of newtons law. Are data was pretty concise and realistic. We could have been even more precise if we had he exact measurements and a quicker data system. But overall both the roller cart and the fan cart worked extremely well on the ramp.