Three Sample Lab Reports from Different Students

Grading Grid

	Satisfactory	Adequate	Poor
Addresses Content accurately and thoroughly			
Write to the appropriate Context or situation of assignment			
Addresses Audience appropriately			
Indicates clear Purpose for writing			
Organizes writing well			
Includes adequate Support (documentation and illustrations)			
Applies an appealing Design			
Uses clear Expression			

Comments:

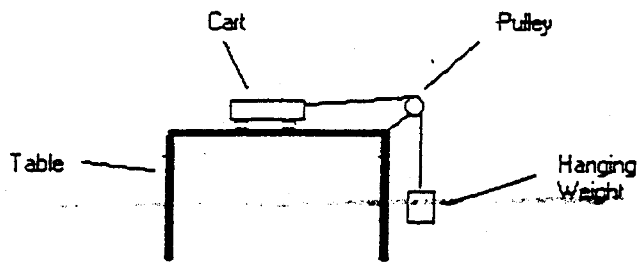
Grade: ____________________

Laboratory III-Frictional Force

#1

Statement of the Problem

The problem for this lab was to determine the frictional force on the cart as it is accelerated by a hanging weight and then allowed to decelerate after the weight hits the ground. For our lab we used a cart, a string with a weight attached to it, a pulley, a ramp, a meter stick, a stopwatch, a digital video camera, and a computer to which the camera sent its information. We set the friction screw on the cart so that it slowed the cart down enough to give us good results in our video analysis. It took us a few tries to get the friction set just right. We then put a 10-gram weight on to the 50-gram hanging weight. We measured out the distance the cart would be traveling from where we released it. We also measured out the distance the cart would be traveling after the hanging weight lands on the ground. We set up a marker next to the meter stick where the hanging weight hits the ground. This way, when we analyzed our video later we would be able to do two analyses. The first analysis is from when we release the cart to when the hanging weight hits the ground. The second analysis is from where the weight hits the ground to where the cart stops.



(Above is a picture of the lab setup)

After video taping the motion of the cart, we analyzed the video clip using the LabVIEW program on the Macintosh computer to study the horizontal motion and the velocity of the cart.

Prediction

Our group predicted the equation for the force of friction is F=(friction coefficient)(mass of cart)(acceleration of the cart). We also predicted that the cart would accelerate up until the point where the hanging weight hit the ground. After the weight hit the ground, the cart would then decelerate because of the friction caused by the screw. We also concluded that the graph horizontal position of the cart would be parabolic due to the carts accelerating and then decelerating. We determined that the equation for the position of the cart according to time is X (t)=x (o)+v (o) t+(1/2) at^2. This equation gave us a parabolic curve, which is what we predicted it should be. The equation for the horizontal velocity of the cart was V (t)=v (o)+a (t). We concluded that these equations would be the best and most accurate.

Data and Results

Using LabVIEW we were able to analyze the motion of the cart. In order to gather data for the whole motion of the cart, we had to analyze the video in two parts. The first part we analyzed was from the release of the cart to where the hanging weight hit the ground. The second part we analyzed was from where the hanging weight hit the ground to where the cart stopped. We marked off a 52 cm section on the meter stick and used that to calibrate our videos. After doing this we began to collect the data from the movie. We did this by clicking on the end of the cart in the video. Each time we clicked on the end of the cart the computer advanced to the next frame and it plotted a point on the graphs at the bottom of the screen. We continued clicking on the cart until it got to the marker marking where the hanging weight hit the ground. After doing this, we found equations that fit the plotted points. We found that the equation for the position was $X(t)=x(o)+v(o)t+(1/2)at^2$. When we put numbers into this equation we were able to make the graph fit the plotted points. We did this same analysis for the two videos. The equation we found for the motion of the cart is $X(t)=0.51+1.15t-0.33t^2$. This equation gave us a parabolic curve, which is what we predicted. The equation we received for the horizontal velocity was $V(t)=1.05-.50t$. This equation gave us a line with a negative slope, meaning the velocity was constantly decreasing.

Conclusion

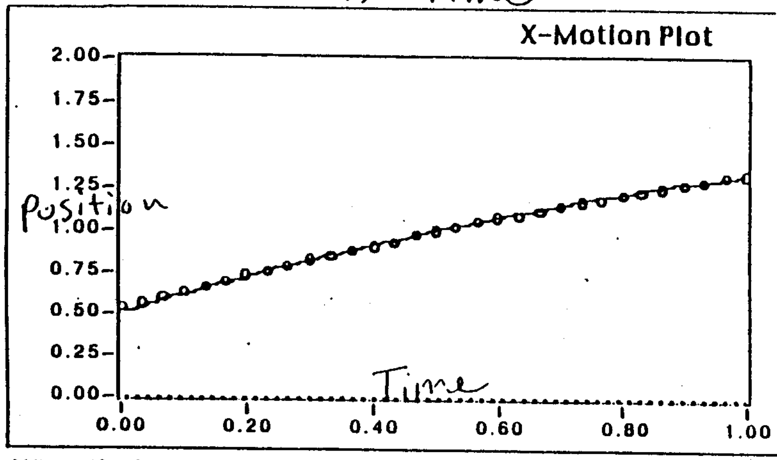
Our prediction for the equation for friction was wrong. We predicted that the equation for the force of friction would be F=(coefficient of friction)(mass of cart)(acceleration of cart). Our prediction of the graph of the position being parabolic was correct, however. What we did wrong for the frictional force equation was, we forgot to figure in the mass and the acceleration of the hanging weight. If we ~~had done this~~ we ~~would~~ have ~~had the correct equation.~~

According to the results received from our graphs, the position was always positive, but it didn't increase at a constant rate. The velocity of the cart stayed constant throughout the motion of the cart. From the results we received in our lab we can now answer the original question given to us. The question was, "Is the frictional force on an object larger when that object speeds up than when it coasts?". Using the correct equation for the force of friction, we can tell that as an object speeds up, the frictional force gets larger. Therefore, an object with a greater acceleration will have a greater force of friction acting on it than an object with a lesser acceleration.

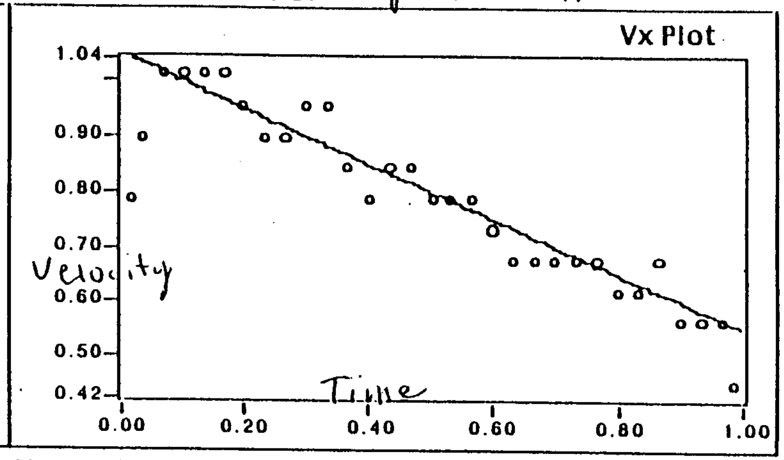
Movie Name: "k-dog2"
Data Taken: Wednesday, October 14, 1998, 6:15 PM

Your Graph Title Goes Here!

Position vs. Time



Velocity vs. Time



X Prediction

x(t) = 0.00 + 0.00t

X Fit

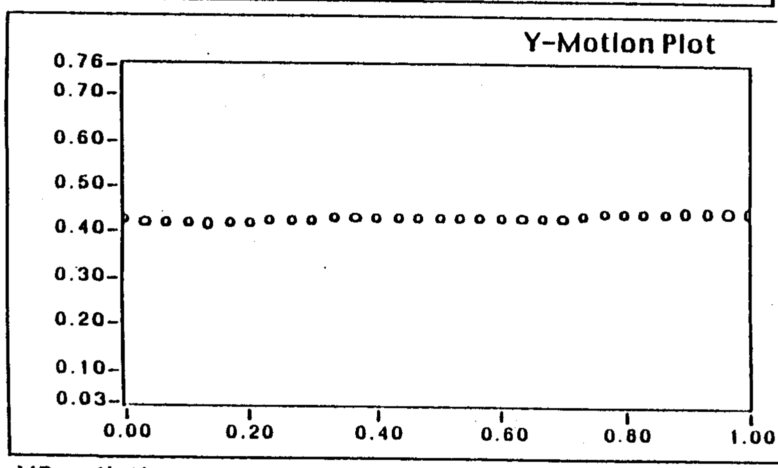
x(t) = 0.51 + 1.15t + -0.33t^2

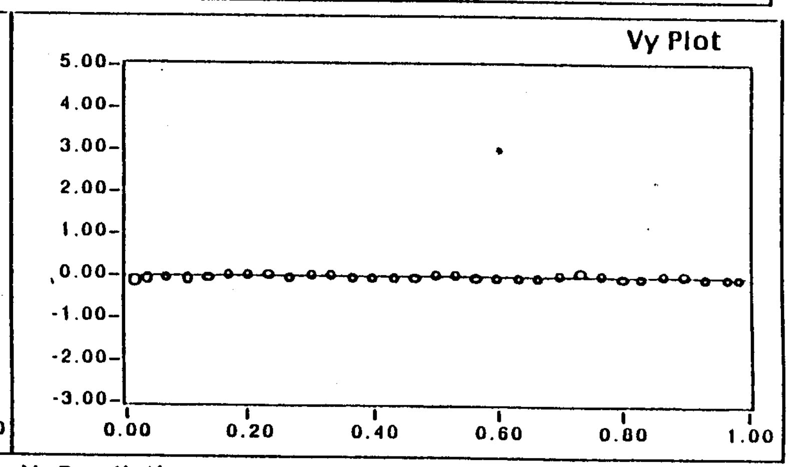
Vx Prediction

Vx(t) = 0.00 + 0.00t

Vx Fit

Vx(t) = 1.05 + -0.50t





Y Prediction

y(t) = 0.00 + 0.00t

Y Fit

y(t) = 0.00 + 0.00t

Vy Prediction

Vy(t) = 0.00 + 0.00t

Vy Fit

Vy(t) = 0.00 + 0.00t

Grading Grid

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#2

LAB #1, PROBLEM #3

STATEMENT OF THE PROBLEM

The problem was to determine the acceleration of an object moving up and down a ramp at all times during its motion. We pushed a cart up an air track from rest and observed its motion up the track and then on the way down after it reversed direction at the top of the inclined plane.

We made numerous movies of the cart moving up and down the track, but settled on just one video that accurately portrayed the velocity and acceleration of the cart throughout the cycle. We analyzed the movie through the use of the LabVIEW program provided to us by the physics department. Because the only motion we analyzed was in the x direction, the y portion of LabVIEW can be neglected.

PREDICTION

We were asked to predict the graph produced for the acceleration-versus-time graph for a given initial velocity up the inclined plane. We thought the acceleration would be the same at the beginning of the run as near the end of the run. At the top of the inclined plane we thought the acceleration would slow and then go to O m/s^2. After the reversal in direction, we thought again that it would increase its acceleration all the way down the inclined plane. So we reasoned from this that the equation needed to interpret the data correctly would be the following:

$$Y= A + Bt + Ct^2$$

Because of the initial deceleration into a reversal of direction and the subsequent acceleration down the ramp, we hypothesized a parabolic shape. We had a problem coming up with the correct position of the shape however, and as a result our prediction graph is not even remotely close to the final data results. For the predictions that I made on the position-versus-time graph, you can look to the lab journal report included in the packet. For the group's LabVIEW prediction, take a look at the computer printout of the final results.

DATA AND RESULTS

We used a woodblock to set up the inclined plane. It lifted one end of the air track about 10.14cm in the air. The other end rested on the table creating an angle of 3.30 degrees with it. We set up a couple of markers along the track to help us determine the speed of the cart. We set one at 126 and one at 7.5 near the end of the track. The 7.5 indication mark is where the cart reversed direction. The 126 marker is where we started the timing of the cart. This information is included at the top of the lab journal entry.

The actual data collection consisted of several minutes of pushing the cart up the ramp to get the desired video for the analysis. Next we entered our movie into the LabVIEW program to be analyzed. We used the black plastic at either end of the cart to calibrate the distance of the movie measurements. A portion of the LabVIEW program was also dedicated to predicting the velocity-vs. -time graph. This can also be found on the copy of the lab journal entry.

UNCERTAINTIES

Much of the uncertainties lie in the method in which the initial speed and the average speed were calculated. We calculated the average velocity for the entire round trip, from the bottom to the top and back down to the bottom. We should have calculated the average speed up the ramp, and then an average speed going down the ramp. Although it is not possible to get the exact same trial twice, so the only way to determine this would be the through the video made. I believe that our reasoning for finding initial velocity was off as well. Which would have made our predictions off in the first couple of graphs.

CONCLUSIONS

From our analysis and the graphs produced from the analysis, we determined that the acceleration acting on the cart is equal throughout the entire trial is the same. So even though the cart is slowing on the way up and speeding up on the way down, the acceleration is the same.

Our prediction for the results of the position vs. time were right in assuming that it would be a parabola, however the positioning was incorrect. The final equation for our graph is

Y=. 84t + .2t^2

On the other hand, our predictions for the graph of the velocity-time-time graph were dead on. The graph of our prediction and the final results can be found in the analysis sheet in the packet. The line's equation was

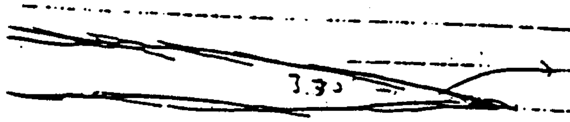
Y= .841 - .4t

Lab 1 Problem 3

D: Traveled 126 - 7.5 = 118 m   26.33 cm/s or .2633 m/s

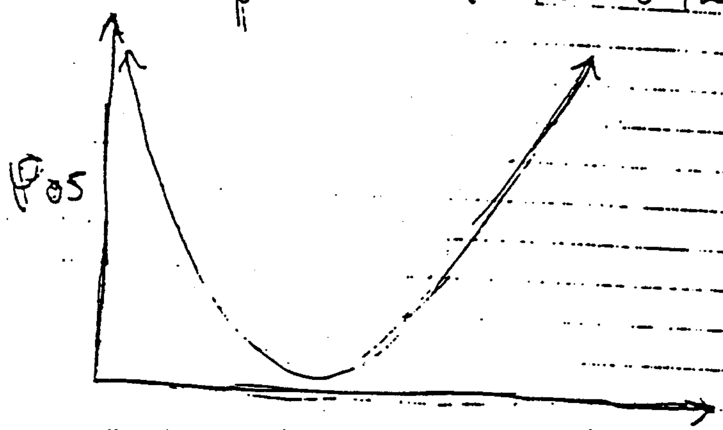
T - It took 4.50 seconds

$x_f = x_0 + v_0 \Delta t + \frac{1}{2} a t^2$



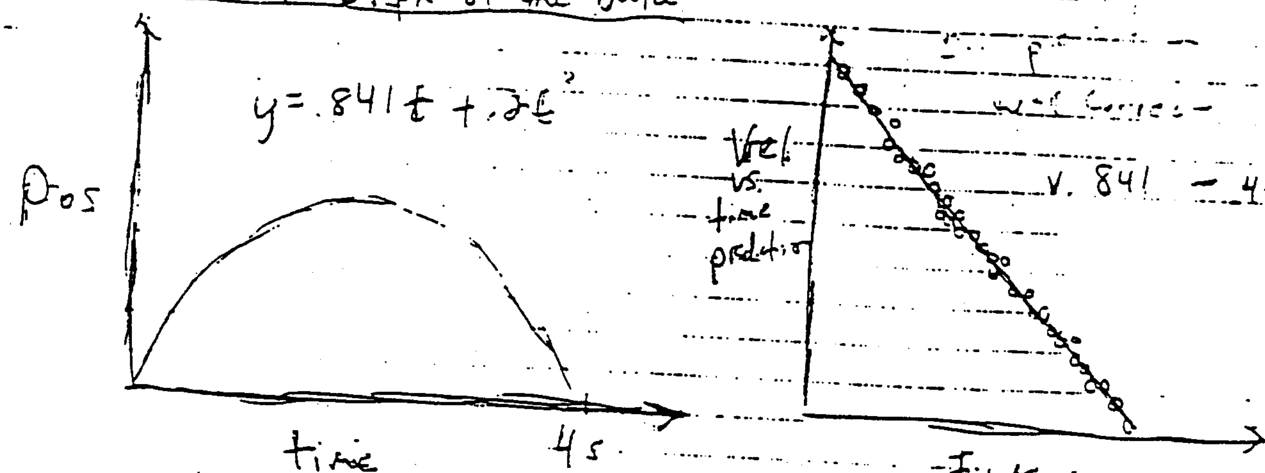
$V_0 =$

Our prediction of the Data



I interpreted this as a deceleration and then the vertex is the point where it turned around and then the acc goes back up again.

Actual Graph of the Data



Analysis

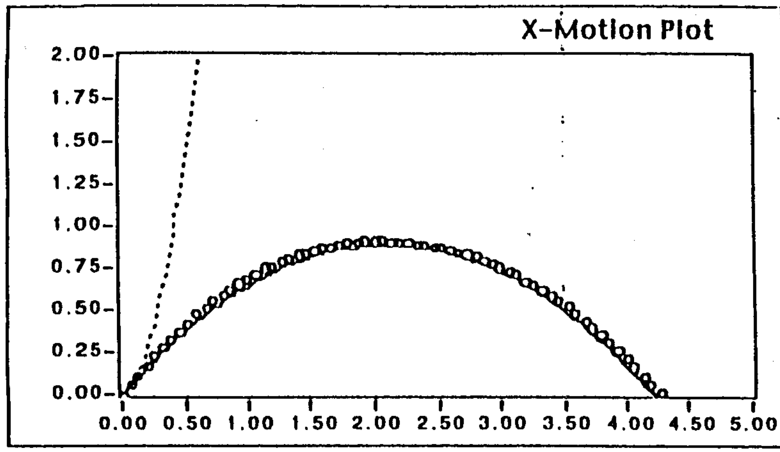
$f(t) = .84t - .2t^2$

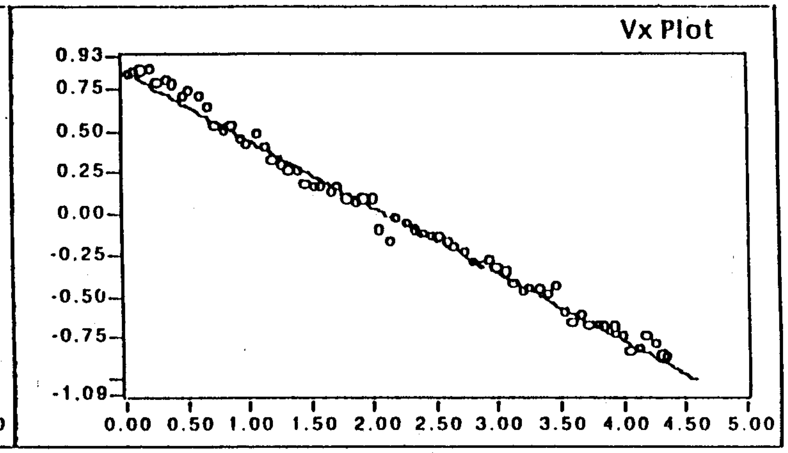
$V = .84 - .4t$

The acceleration is constant. The slope of the V vs t. graph is constant.

Movie Name:"movie2"
Data Taken: Wednesday, September 23, 1998, 5:08 PM

Graph 1-3





XPrediction

x(t) = 0.00 + 0.45t + 4.50t^2

XFit

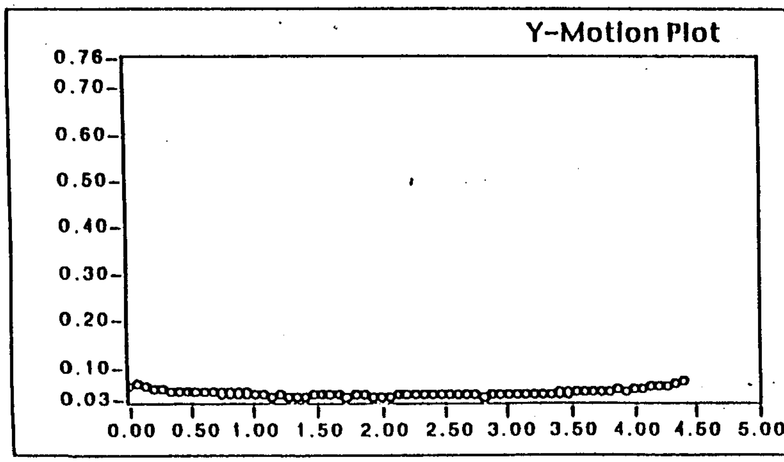
x(t) = 0.00 + 0.84t + -0.20t^2

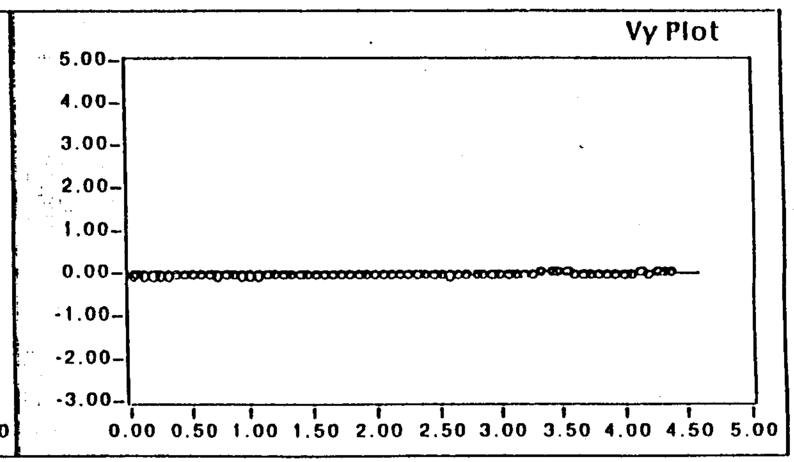
VxPrediction

Vx(t) = 0.84 + -0.40t

VxFit

Vx(t) = 0.84 + -0.40t





YPrediction

y(t) = 0.00 + 0.00t

YFit

y(t) = 0.00 + 0.00t

VyPrediction

Vy(t) = 0.00 + 0.00t

VyFit

Vy(t) = 0.00 + 0.00t

Grading Grid

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Comments:

Grade: ____________________

#3

PROBLEM #3

FRICTIONAL FORCE

STATEMENT OF PROBLEM

The problem was to study the behavior of frictional force on a cart. Is the frictional force larger when the cart is gaining speed do to an applied force than when it coasts and slows down because of friction? We used the following equipment in our experiment: meter stick, stopwatch, video camera, computer with video analysis software, track, cart and weights. The experimental setup is illustrated in appendix one.

PREDICTION

In order to help answer the problem we needed to find the value of the frictional force when the force was applied and when there was no applied force. We calculated the frictional force in terms of the mass of Object A, the mass of the cart and the acceleration of the cart. These are known or measurable values.

For the situation where the cart was being pulled by Object A the equation was derived using "Newton's Second Law of Motion."

Sum of the forces on Object A:

$$\Sigma F_A = m_A a$$

$$m_A a = W_A - T$$

$$m_A a = m_A g - T$$

Sum of the forces on the cart:

$$\Sigma F_C = m_C a$$

$$m_C a = T - f_k$$

The force of tension in both of the above equations has the same magnitude. Thus, the two equations can be combined using substitution for T.

$$f_k = m_A g - a(m_A + m_C) \qquad (1)$$

This is the equation for the force of friction in the first situation.

For the second situation where no force is being applied and the cart was slowing down do to friction the following equation was derived using "Newton's Second Law of Notion."

$$\Sigma F_C = m_C a$$

$$f_k = m_C a \qquad (2)$$

From these equations our group decided that there should be no difference in the value of the frictional from situation one to situation two. Kinetic frictional does not act like static friction. When the force applied on the object increases the kinetic friction does not increase with it, it stays fairly constant as long as the object is still kinetic.

DATA AND RESULTS

To minimize the time of the lab we did not make two different videos for the two situations. Instead we marked the spot on the track that corresponded to Object A hitting the ground. This way the analysis could be done in two parts on the same video. We also found the spot on the track that corresponded to when Object A was hanging from its designated height of 0.50 meters (50 cm). This way we had a repeatable experiment given the designated starting point. The meter stick was laid horizontally to measure the horizontal distance of the second situation. We also timed the entire motion of the cart to help us make our predictions.

We made four runs to determine a good time for the entire trip of the cart. The timed trip is 1.66 seconds with an uncertainty of ± 0.04 seconds. To find the value of the frictional force we needed to know the mass of Object A, the mass of the cart and the acceleration of the cart in both of the situations. For the mass of object we took a 50 g mass and added 50 g weight to it making a total of 100 g. We weighed the mass of the cart on the triple beam balance and obtained a mass of 509.2 g because the precision of the balance is unknown and we got a consistent result for the mass when we weighed it again we assigned no uncertainty to this measurement. To determine the acceleration of the cart we needed to analyze our video and obtain graphs of the carts motion. The graphs of the results from the video analysis are displayed in appendix two.

Using kinematics and the equations from our video analysis the acceleration in both situations can be found easily.

Position formula: $x = x_0 - v_0t + 0.5at^2$

Results for situation one:

$$x(t) = 0 + 0.3t + 0.49t^2$$

From the model of the position formula we found the acceleration for situation one to be 0.98 m/s^2.

Results for situation two:

$$x(t) = 0.51 + 1.15t - 0.329t^2$$

Using the position formula as the model the acceleration for situation two is 0.658 m/s^2.

If we take equations 1 and 2 and plug all our measurements into their respective spots the values of the kinetic frictional force can be obtained for both situations. For situation one let $\mathbf{m_A}$ be the mass of Object A (in kilograms), let $\mathbf{m_C}$ be the mass of the cart (in kilograms), let **a** be the acceleration of the cart (in m/s^2) and let **g** be the acceleration due to gravity. When the measurements are plugged in, kinetic frictional force for situation one is computed to be 0.383 newtons. For situation two let $\mathbf{m_C}$ be the mass of the cart and let a be the acceleration of the cart. In situation two the value for kinetic frictional force came out to be 0.335 newtons.

The calculated values for the kinetic frictional force are only within tenths of each other. The reason for this is probably due to the quality of our video and the fact that we put the two situations on just one video. If the video wasn't at the exact point where Object A hit the ground our acceleration results could have been slightly different. Other than that the results should speak for themselves.

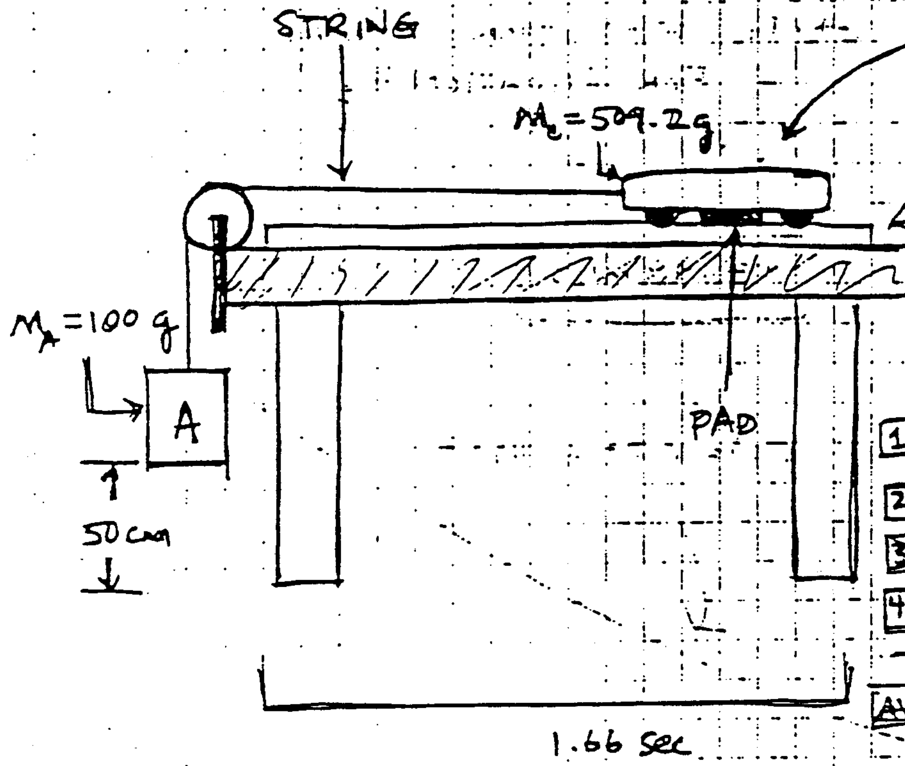
CONCLUSION

According to our results the predictions that we made were correct. The frictional force is not greater when a force is applied and the cart speeds up than when no force is applied and the cart slows down due to gravity. Unlike static friction, kinetic friction does not change in magnitude depending on the force applied.

There were no major problems in the process of our experiment. The only improvements that can be made are in the analysis of our video. Uncertainty to exactly where the cart was relative to the falling Object A created confusion on where to stop analysis of situation one and where to begin situation two. This experiment involved a lot more calculations and was challenging. Overall we feel we did an excellent job in performing this lab.

LAB 3 / PROBLEM 3 | APPENDIX ONE

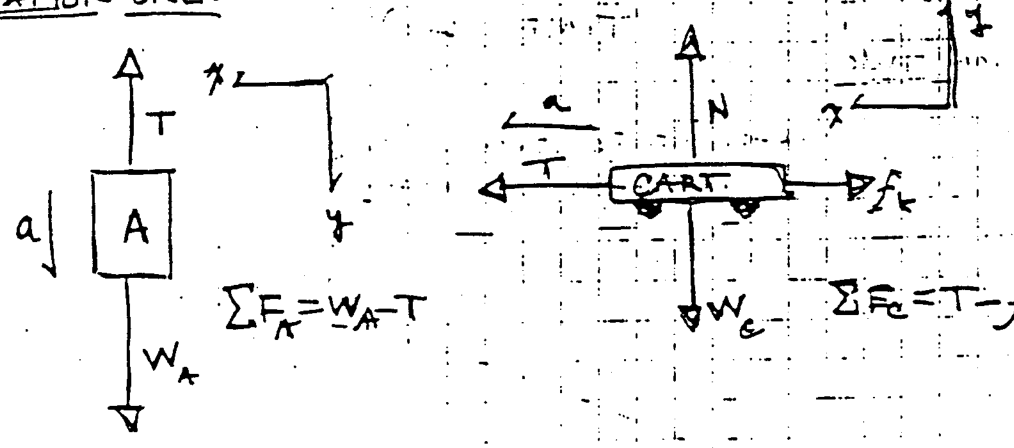
EXPERIMENTAL SETUP



	TIME(S)	DEVIATION
1	1.61	0.05
2	1.71	0.05
3	1.64	0.02
4	1.69	0.03
AVE	1.66 s	0.04

1.66 sec ± 0.04 sec

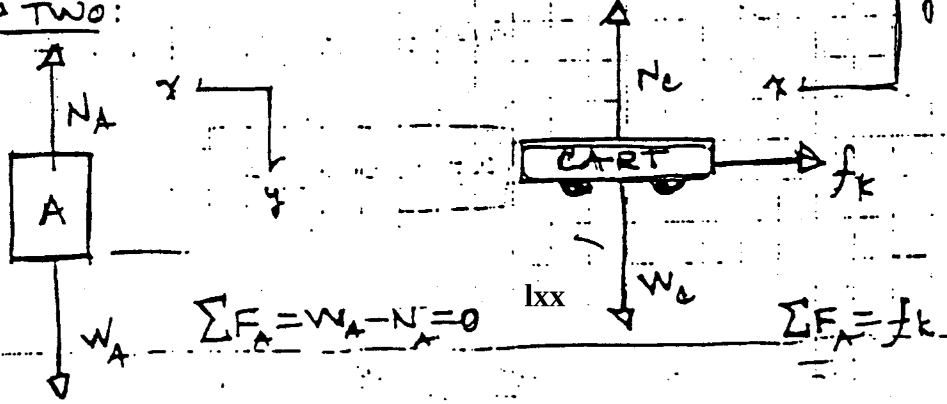
SITUATION ONE:



$\sum F_A = W_A - T$

$\sum F_c = T - f_k$

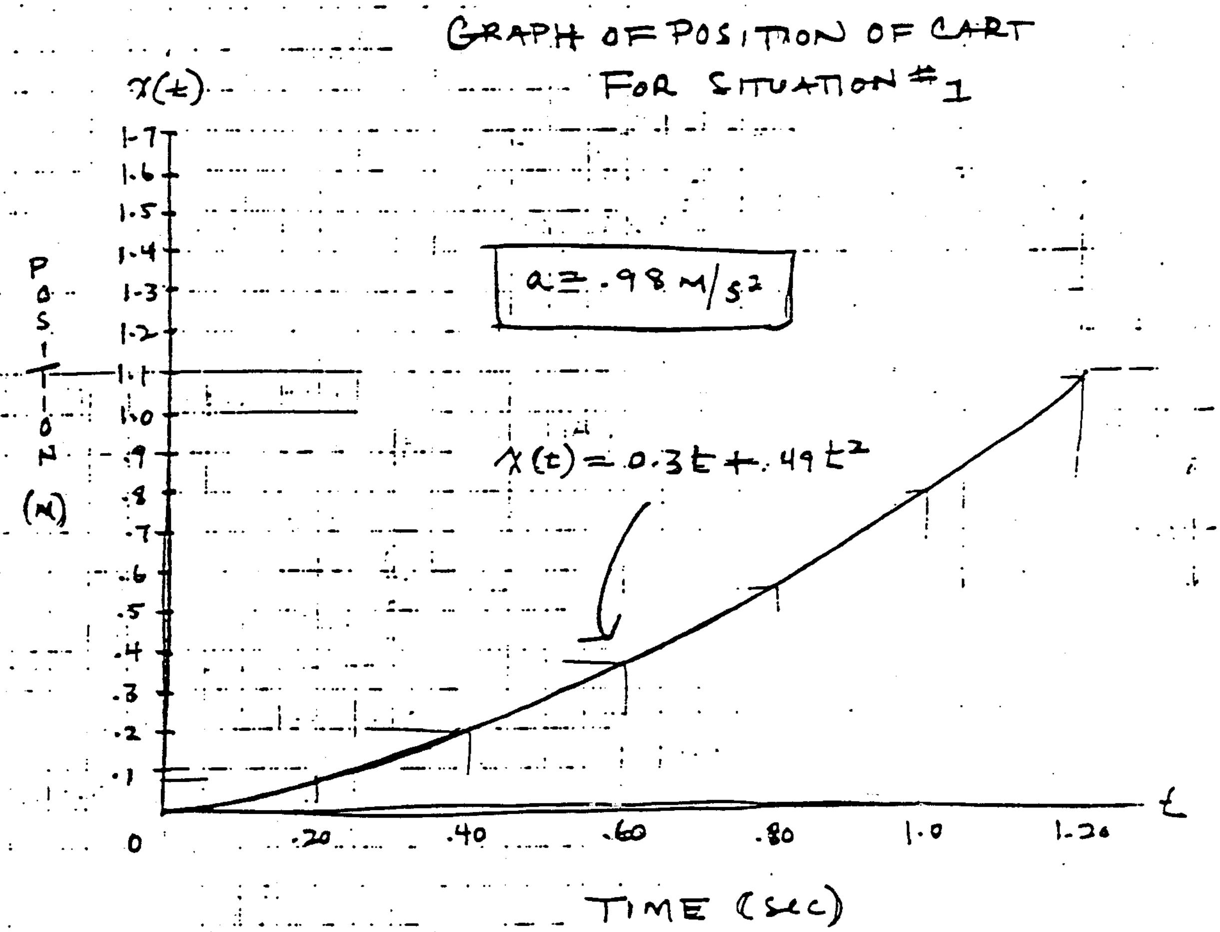
SITUATION TWO:



$\sum F_A = W_A - N_A = 0$

$\sum F_A = f_k$

SITUATION ONE



SITUATION TWO