Homework

TA Orientation 2004 Name: ______________________

Homework #3: Solving Problems

Solve the following problems like you, as an instructor, would like see freshman solutions. That is, draw diagrams with a clear definition of symbols, clearly represent the symbolic forms of the fundamental concepts and principles you use, and show a logical, organized progression of steps in your solution.

1. **Traffic Accident Problem:** You have a summer job with an insurance company and are helping to investigate a tragic "accident." At the scene, you see a road running straight down a hill that is at 10° to the horizontal. At the bottom of the hill, the road widens into a small, level parking lot overlooking a cliff. The cliff has a vertical drop of 400 feet to the horizontal ground below where a car is wrecked 30 feet from the base of the cliff. A witness claims that the car was parked on the hill and began coasting down the road taking about 3 seconds to get down the hill. Your boss drops a stone from the edge of the cliff and, from the sound of it hitting the ground below, determines that it takes 5.0 seconds to fall to the bottom. You are told to calculate the car's average acceleration coming down the hill based on the statement of the witness and the other facts in the case. Obviously, your boss suspects foul play. (Remember you can only use the fundamental concepts listed below.)

Fundamental Concepts: $\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t}$, $\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t}$

Under Certain Conditions: $r_f = \frac{1}{2}a_r t^2 + v_{ro}t + r_o$,

2. **Ice Skating Problem:** You are taking care of two small children, Sarah and Rachel, who are twins. On a nice cold, clear day you decide to take them ice skating on Lake of the Isles. To travel across the frozen lake you have Sarah hold your hand and Rachel's hand. The three of you form a straight line as you skate, and the two children just glide. Sarah must reach up at an angle of 60 degrees to grasp your hand, but she grabs Rachel's hand horizontally. Since the children are twins, they are the same height and the same weight, 50 lbs. To get started you accelerate at 2.0 m/s^2. You are concerned about the force on the children's arms which might cause shoulder damage. So you calculate the force Sarah exerts on Rachel's arm, and the force you exert on Sarah's other arm. You assume that the frictional forces of the ice surface on the skates are negligible. (Remember you can only use the fundamental concepts listed below.)

Fundamental Concepts: $\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t}$, $\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t}$, $\vec{v} = \frac{d\vec{r}}{dt}$, $\vec{a} = \frac{d\vec{v}}{dt}$, $\Sigma\vec{F} = m\vec{a}$, $F_{12} = F_{21}$

Under Certain Conditions: $r_f = \frac{1}{2}a_r t^2 + v_{ro}t + r_o$, $F = \mu_{sliding}N$, $F \le \mu_{static}N$

3. **Safe Ride Problem:** A neighbor's child wants to go to a neighborhood carnival to experience the wild rides. The neighbor is worried about safety because one of the rides looks dangerous. She knows that you have taken physics and so asks your advice. The ride in question has a 10-lb. chair which hangs freely from a 30-ft long chain attached to a pivot on the top of a tall tower. When a child enters the ride, the chain is hanging straight down. The child is then attached to the chair with a seat belt and shoulder harness. When the ride starts up the chain rotates about the tower. Soon the chain reaches its maximum speed and remains rotating at that speed. It rotates about the tower once every 3.0 seconds. When you ask the operator, he says that the ride is perfectly safe. He demonstrates this by sitting in the stationary chair. The chain creaks but holds and he weighs 200 lbs. Has the operator shown that this ride safe for a 50-lb. child? (Remember you can only use the fundamental concepts listed below.)

Fundamental Concepts: $\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t}$, $\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t}$, $\vec{v} = \frac{d\vec{r}}{dt}$, $\vec{a} = \frac{d\vec{v}}{dt}$, $\Sigma\vec{F} = m\vec{a}$, $F_{12} = F_{21}$

Under Certain Conditions: $r_f = \frac{1}{2}a_r t^2 + v_{ro}t + r_o$, $a = \frac{v^2}{r}$, $F = \mu_{sliding}N$, $F \le \mu_{static}N$, $F = -k_s x$

4. **Fusion Problem:** You have a great summer job in a research laboratory with a group investigating the possibility of producing power from fusion. The device being designed confines a hot gas of positively charged ions, called plasma, in a very long cylinder with a radius of 2.0 cm. The charge density of the plasma in the cylinder is 6.0 x 10^{-5} C/m^3. Positively charged Tritium ions are to be injected into the plasma perpendicular to the axis of the cylinder in a direction toward the center of the cylinder. Your job is to determine the speed that a Tritium ion should have when it enters the plasma cylinder so that its velocity is zero when it reaches the axis of the cylinder. Tritium is an isotope of Hydrogen with one proton and two neutrons. You look up the charge of a proton and mass of the tritium in your trusty Physics text to be 1.6 x 10^{-19} C and 5.0 x 10^{-27} Kg.

Fundamental Concepts:

$\vec{v}_{av} = \dfrac{\Delta\vec{r}}{\Delta t}$	$\vec{a}_{av} = \dfrac{\Delta\vec{v}}{\Delta t}$	$\vec{v} = \dfrac{d\vec{r}}{dt}$	$\vec{a} = \dfrac{d\vec{v}}{dt}$	$\sum\vec{F} = m\vec{a}$
$F_{12} = F_{21}$	$W = \int_{path} \vec{F} \bullet d\vec{\ell}$	$KE = \dfrac{1}{2}mv^2$	$E_f - E_i = \Delta E_{transfer}$	$\vec{E} = \dfrac{F_e}{q}$
$\oint\!\!\oint \vec{E} \bullet dA = \dfrac{Q}{\varepsilon_o}$	$\iint_{surface} \vec{E} \bullet dA = \Phi$			

Under Certain Conditions:

$F = k_e \dfrac{q_1 q_2}{r^2}$	$\vec{E} = k_e \dfrac{q}{r^2}$	$U = k_e \dfrac{q_1 q_2}{r}$	$\Delta V = \dfrac{\Delta U}{q}$	$\Delta V = IR$

 Name: ________________________________
Homework #6

Initial Evaluation of Example Student Laboratory Reports

Before you start this homework, read the article by S. Allie, A. Buffler, L. Kunda, and M. Inglis, Writing Intensive Physics Laboratory Reports: Tasks and Assessment (Selected Readings). In this homework you will you will go through 2 examples of student laboratory reports and evaluate their quality.

Homework Tasks:

1. Come up with words and characteristics that describe what you consider to be "good" and "bad" writing.

2. Using the descriptions that you came up with in step 1, evaluate the following 2 example student laboratory reports.

3. Mark down any and all comments on the example student laboratory reports, and indicate whether it is "good" or "bad" based on your description.

Note: This homework is to elicit your initial ideas on how to evaluate student laboratory reports. In class we will discuss, model, and coach grading lab reports.

Defining “Good” & “Bad” Writing

What words or characteristics come to mind when trying to define “good” writing?

What words or characteristics come to mind when trying to define “bad” writing?

Example #1

Lab Report 2 – Lab 3, Problem 1

Statement of the problem:

I am a volunteer in the city's children's summer program. One suggested activity is for the children to build and race model cars along a level surface. To ensure that each car has a fair start, my co-worker recommends a special launcher be built. The launcher uses a string attached to the car at one end and, after passing over a pulley, the other end of the string is tied to a block hanging straight down. The car starts from rest and the block is allowed to fall, launching the car along the track. After the block hits the ground, the string no longer exerts a force on the car and the car continues moving along the track. I want to know how the launch speed of the car depends on the parameters of the system that you can adjust. I decide to calculate how the launch velocity of the car depends on the mass of the car, the mass of the block, and the distance the block falls. My ultimate goal was to find the answer to the question – "What is the velocity of the car after being pulled for a known distance?"

Prediction:

I predicted that, using the equation $V=\sqrt{(2M_agh)/(M_a+M_c)}$

and with the data collected during setup, that the velocity at the time the block hit the floor would be 60.5cm/s. (Prediction graphs are attached.)

Procedure:

First, we gathered supplies. We used a cart, a flat track with a pulley attached, a mass hanger with a mass set to simulate the wooden block, string, and a video camera attached to a computer with video analysis software. We massed the cart and the block, and began to set up the experiment. We placed the cart on the track, and ran the string through the pulley. We hooked our mass onto the end of the string, and held it to a height that we measured and marked. We began recording video and let the mass go. We made 3 runs like this to obtain the best video. When we were satisfied we analyzed the video and came up with a good measurement of the cart's velocity. We printed our graphs and made conclusions based on our data.

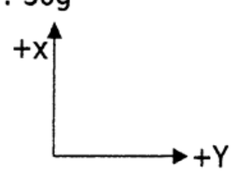
Data and Results:

Mass of Cart (Mc): 753.8g

Mass of Block (Ma): 50g

Height (H): 30cm

Coordinate Axis:



(Graphs of data analysis are attached)

Discussion:

The results from the lab were pretty close to the prediction made by plugging the masses of the cart and block and the height of the drop into the equation I wrote in my lab journal.

In the lab, there were a few sources of obvious error. The first major source was the method of getting data. The computer software is a bit inaccurate in measuring the velocity with the method of selecting points in the video frames. The camera we used has a curved lens, which distorts the video. This all leads to data that is off from the expected return. Another possible source of error is the equipment. The set-up we used was not entirely perfect in the fact that we were not taking friction into account, yet there was most likely friction in the cart's wheels. This would matter most during the time after the block has hit the ground, which is the situation we are modeling.

We could have made a few improvements. The main improvement would be to more accurately analyze the data within the computer software to compensate for any distortion in the video. We also could have made sure the cart was properly lubricated before performing the experiment.

Conclusions:

In our lab, we discovered the velocity of the car after being pulled a known distance was around 55cm/s. This was close to our initial prediction, so we were satisfied with our results.

The launch velocity of the car does depend on its mass, as well as the mass of the block and the distance the block falls. This is due to the fact that they all affect the forces acting on the car. There are some instances where the mass would not really affect the launch velocity. If the distance dropped were very close to zero, the launch velocity would be near zero no matter what the mass of the block was.

If the same block falls the same distance, the force exerted by the block on the cart would not change, no matter the mass of the cart. The force of the block on the cart is always equal to the block's weight.

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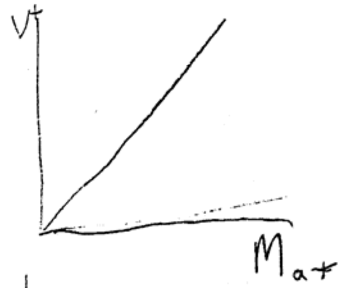
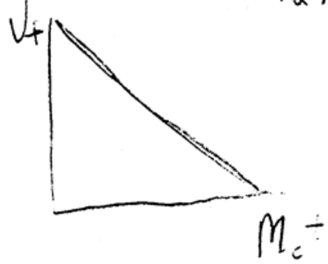
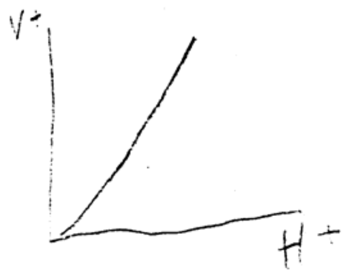
Prediction graphs







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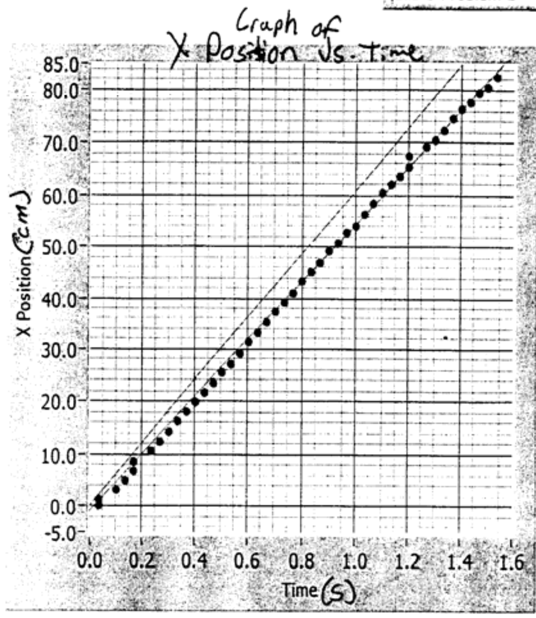
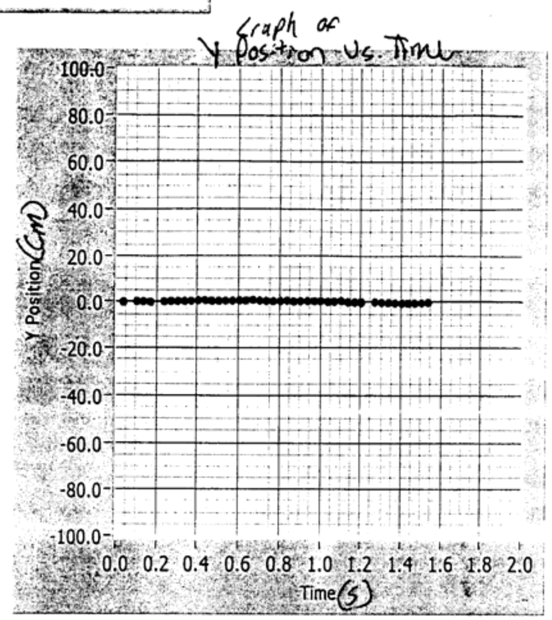
Graph Title

Lab 3 Problem 1





X - Prediction Equation

u(t) = 0.000 + 60.500t

X - Fit Equation

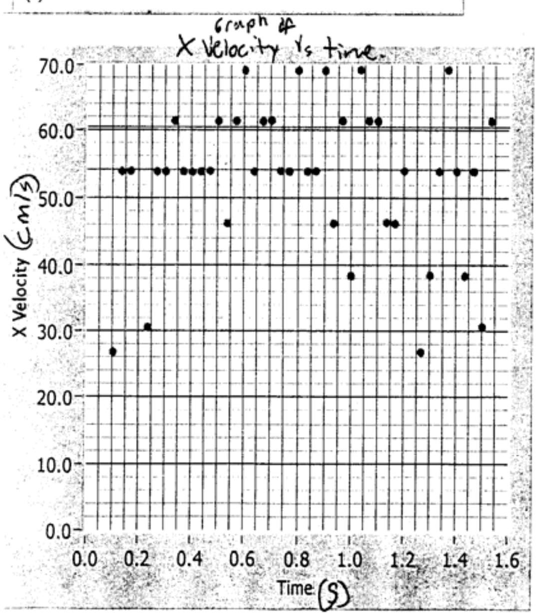
u(t) = -1.000 + 55.000t

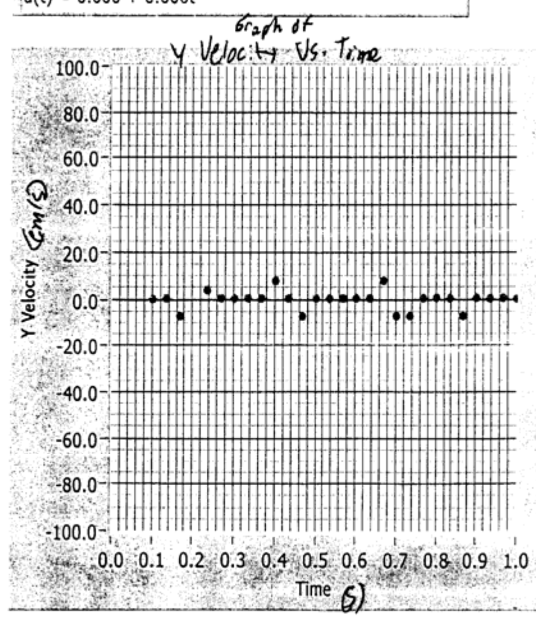
Y - Prediction Equation

u(t) = 0.000 + 0.000t

Y - Fit Equation

u(t) = 0.000 + 0.000t





Vx - Prediction Equation

u(t) = 60.500 + 0.000t

Vx - Fit Equation

u(t) = 54.000 + 0.000t

Vy - Prediction Equation

u(t) = 0.000 + 0.000t

Vy - Fit Equation

u(t) = 0.000 + 0.000t

Example #2

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002

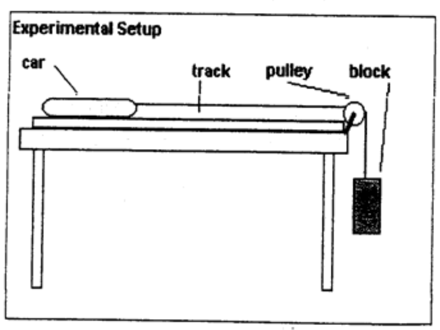
Lab III Problem 1: Force and Motion

1. Statement of the Problem -- According to the lab manual, my group members and I were asked to test the velocity of a toy car launched down a track. The car is attached to a string at the end of the track, which goes over a pulley and is then attached to a block. When the block is released, the string pulls the car down the track. After the block hits the ground, the car is no longer pulled but keeps going. We were asked to find how the cars speed after the block hits the ground depends on the mass of the car, the mass of the block, and the distance the block falls before hitting the ground. The question we answered in this lab is:

What is the velocity of the car after being pulled a known distance?

We used a toy car with a string attached to it, a block, a pulley, and a track to conduct our experiment. We recorded the motion of the car and the block using a video analysis application written in LabVIEW™, then analyzed the video to find the position, velocity and acceleration of the car while it was being pulled by the falling block and after the black reached the ground.

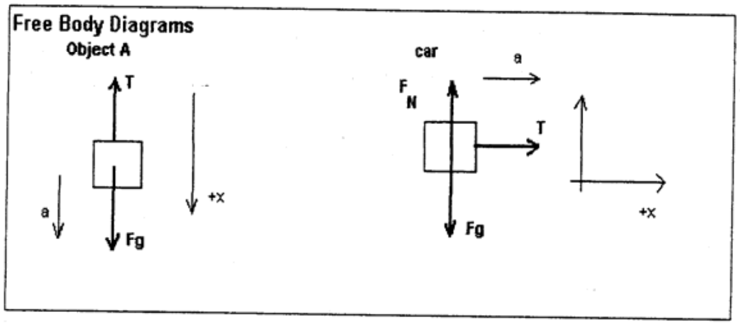
The block (called object A) has a significantly shorter distance to fall than the car has to travel along its track. In this experiment, we ignored the friction between the car and the track and between the pulley and the string. We also ignored the mass of the string.



2. Prediction --

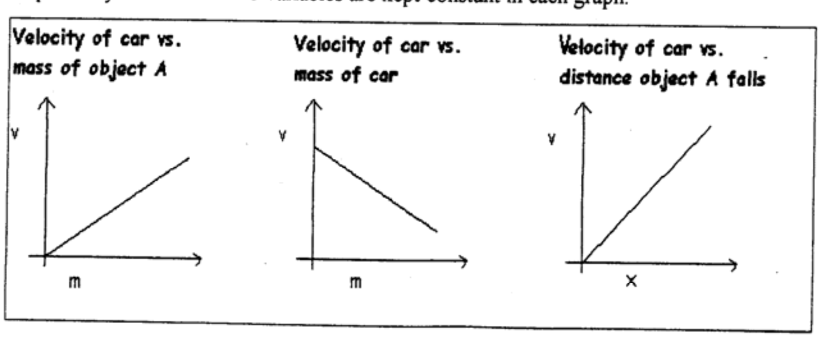
The first question asked me to calculate the cart's velocity after the block had hit the ground. I predicted that $\mathbf{v_c = \sqrt{2xg[m_a/(m_c + m_a)]}}$. I solved the first kinematics equation, $\mathbf{x_c = x_{0c} + v_{0c}t + 1/2at^2}$ **for t**, assuming that x_0 =O, v_0 =0 and $a_c = a_A$, and that the magnitude of the car's displacement was the same as the magnitude of the block's, (since the string did not stretch), yielding $\mathbf{t = 2x/a}$. Since v= at, $\mathbf{v = a\sqrt{(2x/a)}}$ and $v^2 = 2ax$. Solving for a gives $\mathbf{a = v^2/2x}$.

Variables	
x	position
xo	initial position
v	velocity
vo	initial velocity
a	acceleration
t	time
m	mass of object A
m	mass of car
F	Force
g	gravity
N	Normal Force
T	tension force



Since the objects are attached to the same string, the tension forces acting upon them are equal to each other. The sum of the forces acting on Object A in the x direction is $\mathbf{\Sigma F_A = Fg - T}$. The sum of the forces acting on the car in the x direction is $\mathbf{\Sigma F_c = T}$. Since F= ma, $\mathbf{M_A a = M_A g - T}$ and $\mathbf{M_c a = T}$. Using $\mathbf{a = v^2/2x}$, $\mathbf{M_A(v^2/2x) = M_A g - T}$, and $\mathbf{M_c(v^2/2x) = T}$. Combining these equations gives $\mathbf{M_A(v^2/2x) = M_A g - M_c(v^2/2x)}$, and solving for v gives $\mathbf{v_c = \sqrt{2xg[m_a/(m_c + m_a)]}}$.

The next three prediction problems asked us to draw a graph of the car's velocity vs. time as a function of the mass of object A, mass of the car, and distance object A falls, respectively. The other two variables are kept constant in each graph.



The velocity would increase as the mass of object A or the distance object A falls increased, and would decrease as the mass of the car increased. The velocity would increase at a greater rate with the increase in distance than it would with the increase in mass of object A. Another way this could be said is that the graph of velocity vs. distance would have a greater slope than the graph of velocity vs. mass of object A.

3. Procedure – We set up the experiment according to the experimental setup picture above. The mass of the car we used was 252 g, and the mass of object A was 50 g. The distance form object A to the ground was 0.41m and the total distance the car was able to travel was 1m. There was 0.59m for the car to travel after object A hit the ground. We placed the camera about 1.5m away from the table holding the track so that the entire length of the track could be seen as well as object A. We recorded the car's motion and then analyze it in LabVIEW™. We divided the motion of the car into two parts -- motion before object A hit the ground and motion after object A hit the ground -- and analyzed each part separately. We predicted the equations for the position vs. time graphs, plotted data points of both the horizontal and vertical motion of the graphs, and then found the best-fit equations for them. We did the same for the car's velocities.

4. Data and Results – SEE ATTACHED GRAPHS

We predicted that there would be no motion, and hence no velocity, in the y direction for any of the graphs, and our prediction was correct.

Before object A hit the ground --When we predicted the equation for the x position vs. time of the car before object A hit the ground, we didn't really know what we were doing. We should have used the equation $x = x_0 + v_0t + 1/2at^2$ to make our prediction. The values for x_0 and v_0t would both have been equal to zero and we could have predicted the acceleration using $a = v^2/2x$: $(\sqrt{2xg[m_a/(m_c + m_a)]})^2/2x = [m_a/(m_c + m_a)]g = a$. This would have given us an acceleration of 1.49 m/s*s, and a predicted equation of $x = 0 + 0(t) + 0.75\text{m/s*s}(t^2)$. The value of 0.897 m/s*s in the best-fit equation is reasonably close to this. Since the slope of a velocity vs. time graph is equal to the acceleration and since 0.897 m/s*s was equal to ½ a, we predicted that the slope of the acceleration vs. time graph would be equal to 1.80 m/s*s, and our prediction fit the actual value of 1.70 m/s*s well.

After object A hit the ground—We predicted that the car would have zero acceleration during this portion of its motion and that its velocity would be equal to its final velocity, just as object A hit the ground. Again, we used the equation $x = x_0 + v_0t +$

$1/2at^2$ to describe the predicted motion, with x_0 and a both equal to zero. We predicted the velocity to be $v = \sqrt{2xg[m_a/(m_c+m_a)]}$, or 1.167m/s. This prediction was very close to the actual value. We predicted that for the velocity vs. time graph, the velocity would stay constant at 0.167m/s, and our prediction was very close to the actual best-fit line equation.

5. Discussion--

Results- The acceleration of the car in the experiment is dependant on the block falling. Before the block hits the ground, the car accelerates because of the falling block. The acceleration of the block and the car is the same because the same tension force acts them upon. Their accelerations are equal to $[m_a/(m_c+m_a)]g$, where m_a is the mass of object a (the block), m_c is the mass of the car, and g is the acceleration due to gravity, 9.8m/s*s. The velocity of the car and of object a at the time when object a hits the ground is equal to $\sqrt{2xg[m_a/(m_c+m_a)]}$.

After the block hit the ground there would no longer be any tension in the string and the sum of the forces on the car would be equal, (since T=0 and $F_g = -F_N$). Because F=ma, the car would have no acceleration. Its velocity would continue to be equal to $\sqrt{2xg[m_a/(m_c+m_a)]}$.

Error- Error resulted from our collection of data points again. It is difficult to click on exactly the same point of the car each time and to click on the same y value along the track each time as well. This results in distortion of the position measurements and velocities calculated. There is not much that can be done about this, except that we should try to be very precise in future collection of data points. Also, the camera could have caused a slight distortion of the collected data values. In this experiment, we neglected the friction between the car and the track and between the pulley and the string. This made the calculations a lot easier, but it caused our predicted value for the acceleration of the car and the block to be different than the actual value.

Improvements- It would be optimal to do many trials of this experiment, using different values for m_c, m_a and x, to check that the equations really fit, but time is an issue. With more precise data collection, we could have eliminated some of the movement and velocity seen along the y-axis.

6. Conclusions-- Using physics principles and equations, we predicted that the velocity of car pulled a known distance by a falling object would be equal to $\sqrt{2xg[m_a/(m_c+m_a)]}$, where x is equal to the distance the object falls, g is equal to gravity (9.8m/s*s), m_a is the mass of the object falling and m_c is equal to the mass of the car being pulled. Since the tension forces on each object are the same, they have the same acceleration and this can be predicted using Newton's second law and kinematics equations. The results of our experiment confirmed this.

In each case but one, the predicted values for the components of the equations of the graphs were the same or close to the actual ones. When we predicted the value for acceleration of the car before the block hit the ground, we didn't figure any friction into the calculations. We based all of our future predictions off of the actual values we got for this graph's equation and they all matched the actual values well.

The launch velocity of the car does depend on the mass of the car, the mass of the block and the distance the block falls, according to $v = \sqrt{2xg[m_a/(m_c + m_a)]}$. For values of m_a that are much larger than m_c, m_c does not affect v very much, since $[m_a/(m_c + m_a)]$ becomes very close to 1.

The tension force upon the car and the block is dependent on the masses of both objects. Changing the mass of either one will change the tension force exerted on both. The tension force on the block is equal to its weight if the block has no net acceleration; in other words, when $T = F_g$. This would happen if the mass of the block was zero, and since it could never have zero mass, it would never happen in a frictionless system. It may come close to zero though, and would reach zero in a system with friction. We could test this experimentally by using a car with a very large mass and using blocks of decreasing masses. The acceleration of the car should go toward zero as the mass of the blocks decrease.

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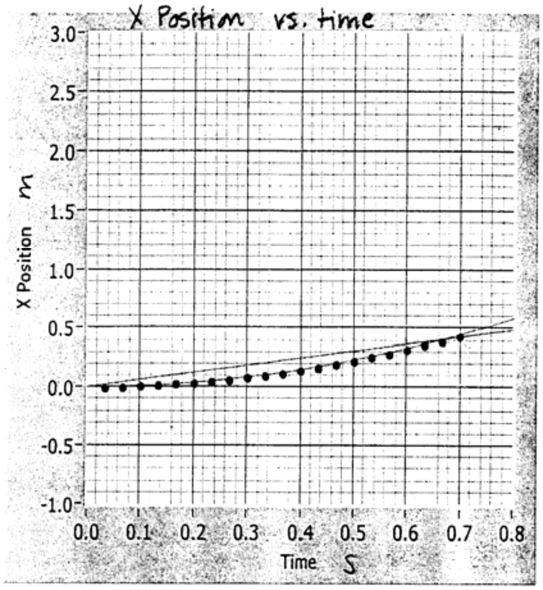
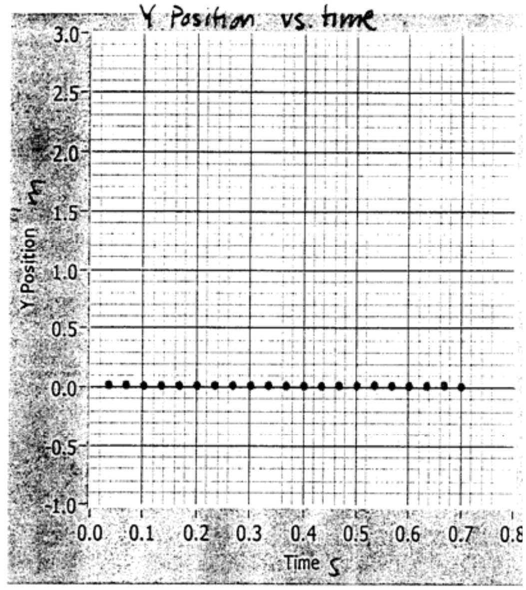
Graph Title

Lab III Problem 1: Before [A] hit the ground





X - Prediction Equation

u(t) = 0.000 + 0.600t

X - Fit Equation

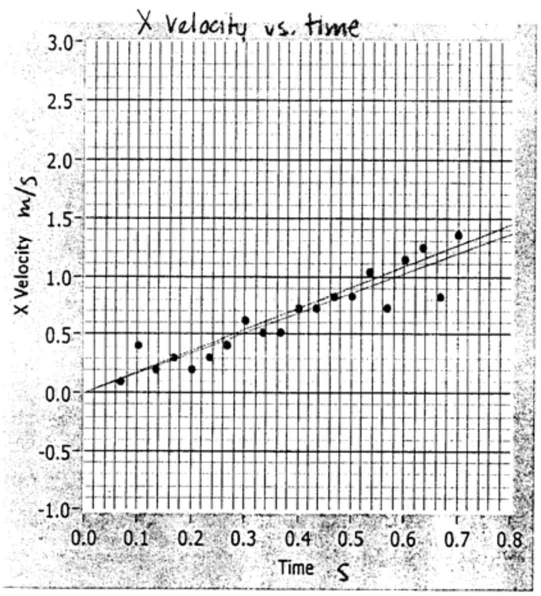
u(t) = 0.000 + 0.000 t + 0.897 t^2

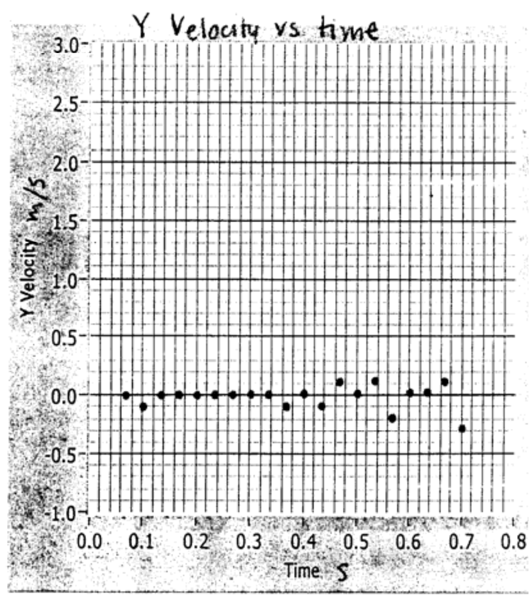
Y - Prediction Equation

u(t) = 0.000 + 0.000t

Y - Fit Equation

u(t) = 0.000 + 0.000t





Vx - Prediction Equation

u(t) = 0.000 + 1.800t

Vx - Fit Equation

u(t) = 0.000 + 1.700t

Vy - Prediction Equation

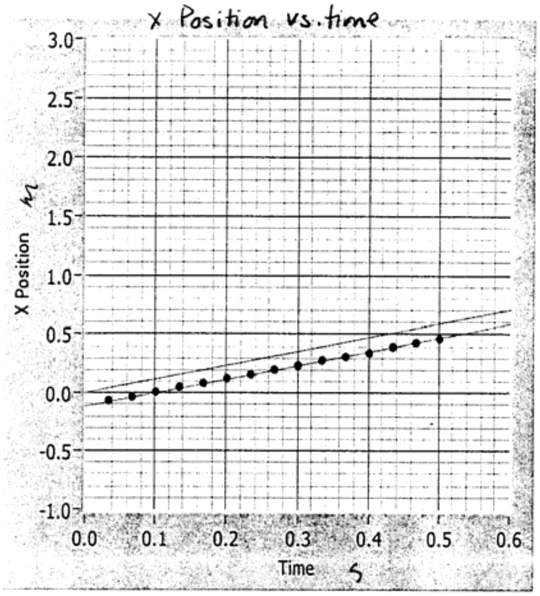
u(t) = 0.000 + 0.000t

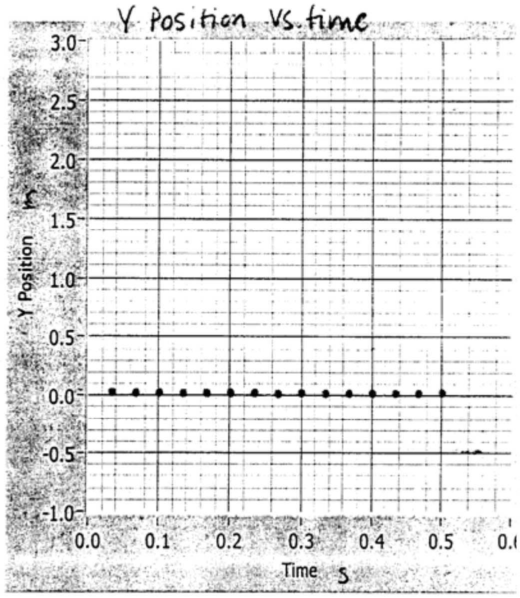
Vy - Fit Equation

u(t) = 0.000 + 0.000t

Graph Title

Lab III Problem 1: After [A] hit the ground





X - Prediction Equation

u(t) = 0.000 + 1.167t

X - Fit Equation

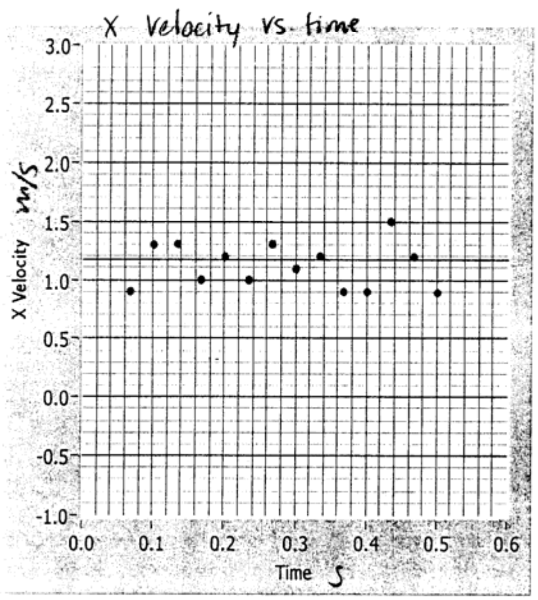
u(t) = -0.120 + 1.167t

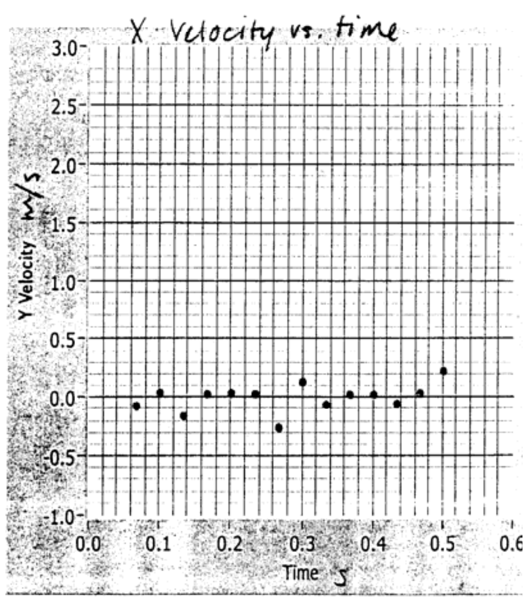
Y - Prediction Equation

u(t) = 0.000 + 0.000t

Y - Fit Equation

u(t) = 0.000 + 0.000t





Vx - Prediction Equation

u(t) = 1.167 + 0.000t

Vx - Fit Equation

u(t) = 1.170 + 0.000t

Vy - Prediction Equation

u(t) = 0.000 + 0.000t

Vy - Fit Equation

u(t) = 0.000 + 0.000t

 Name: ______________________

Homework #8

Judging Problems

1. Read/Review the criteria for judging whether a problem would be a good group practice problem (20 - 25 minutes), a good graded group problem (45 - 50 minutes), and/or a good (easy, medium, difficult) individual problem (see pages 39 to59 in the *Instructor's Handbook*). There is considerable overlap in the criteria, so most problems can be judged to be **both** a good group practice or graded problem *and* a good easy, medium-difficult, or difficult individual problem.

2. Check the items in the right column that apply to each problem you solved in Homework #3. Then use the decision strategy to decide whether you think each problem is a good individual problem, group practice problem, or graded group problem [check your decision(s) in the right column]. Finally, explain your reasoning for each decision.

1. **Oil Tanker Problem:** Assume students have *just started* their study of linear kinematics (i.e., they only have the definition of average velocity and average acceleration).

Reject if:
- ___ one-step problem
- ___ tedious math, little physics
- ___ problem needs "trick"

Decision:
- ___ group practice problem (20 - 25 minutes);
- ___ group test problem (45 - 50 minutes); and/or
- ___ easy medium difficult individual problem (circle one)

Reasons:

Approach	Analysis	Mathematical Solution

1. Cues Lacking ___ A. No target variable ___ B. Unfamiliar context 2. Agility with Principles ___ A. Choice of principle ___ B. Two principles ___ C. Abstract principle 3. Non-Standard Application ___ A. Atypical situation ___ B. Unusual target	4. Excess or Missing Info. ___ A. Excess data ___ B. Numbers required ___ C. Assumptions 5. Seemingly Missing Info. ___ A. Vague statement ___ B. Special constraints ___ C. Diagrams 6. Additional Complexity ___ A. >2 subparts ___ B. 5+ terms ___ C. Vectors	7. Algebra required ___ A. No numbers ___ B. Unknown(s) cancel ___ C. Simultaneous eqns. 8. Targets Math Difficulty ___ A. Calc/vector algebra ___ B. Lengthy algebra

2. **Ice Skating Problem:** Assume students have *just finished* their study of the application of Newton's Laws of Motion.

Reject if:
___ one-step problem
___ tedious math, little physics
___ problem needs "trick"

Decision:
___ group practice problem (20 - 25 minutes);
___ group test problem (45 - 50 minutes); and/or
___ easy medium difficult individual problem (circle one)

Reasons:

Approach	Analysis	Mathematical Solution

1. Cues Lacking ___ A. No target variable ___ B. Unfamiliar context 2. Agility with Principles ___ A. Choice of principle ___ B. Two principles ___ C. Abstract principle 3. Non-Standard Application ___ A. Atypical situation ___ B. Unusual target	4. Excess or Missing Info. ___ A. Excess data ___ B. Numbers required ___ C. Assumptions 5. Seemingly Missing Info. ___ A. Vague statement ___ B. Special constraints ___ C. Diagrams 6. Additional Complexity ___ A. >2 subparts ___ B. 5+ terms ___ C. Vectors	7. Algebra required ___ A. No numbers ___ B. Unknown(s) cancel ___ C. Simultaneous eqns. 8. Targets Math Difficulty ___ A. Calc/vector algebra ___ B. Lengthy algebra

<table>
<tr><td colspan="3">

3. Safe Ride Problem: Assume that students have *just finished* their study of forces and uniform circular motion.

Reject if:
___ one-step problem
___ tedious math, little physics
___ problem needs "trick"_

Reasons:

Decision:
___ group practice problem (20 - 25 minutes);
___ group test problem (45 - 50 minutes); and/or
___ easy medium difficult individual problem (circle one)

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<tr><td>Approach</td><td>Analysis</td><td>Mathematical Solution</td></tr>
<tr><td>1. Cues Lacking
___ A. No target variable
___ B. Unfamiliar context

2. Agility with Principles
___ A. Choice of principle
___ B. Two principles
___ C. Abstract principle

3. Non-Standard Application
___ A. Atypical situation
___ B. Unusual target</td><td>4. Excess or Missing Info.
___ A. Excess data
___ B. Numbers required
___ C. Assumptions

5. Seemingly Missing Info.
___ A. Vague statement
___ B. Special constraints
___ C. Diagrams

6. Additional Complexity
___ A. >2 subparts
___ B. 5+ terms
___ C. Vectors</td><td>7. Algebra required
___ A. No numbers
___ B. Unknown(s) cancel
___ C. Simultaneous eqns.

8. Targets Math Difficulty
___ A. Calc/vector algebra
___ B. Lengthy algebra</td></tr>
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4. **Fusion Problem:** Assume students have *just finished* their study of the electricity.

Reject if:
___ one-step problem
___ tedious math, little physics
___ problem needs "trick"

Reasons:

Decision:
___ group practice problem (20 - 25 minutes);
___ group test problem (45 - 50 minutes); and/or
___ easy medium difficult individual problem (circle one)

Approach	Analysis	Mathematical Solution
B. Cues Lacking ___ A. No target variable ___ B. Unfamiliar context C. Agility with Principles ___ A. Choice of principle ___ B. Two principles ___ C. Abstract principle D. Non-Standard Application ___ A. Atypical situation ___ B. Unusual target	E. Excess or Missing Info. ___ A. Excess data ___ B. Numbers required ___ C. Assumptions F. Seemingly Missing Info. ___ A. Vague statement ___ B. Special constraints ___ C. Diagrams G. Additional Complexity ___ A. >2 subparts ___ B. 5+ terms ___ C. Vectors	H. Algebra required ___ A. No numbers ___ B. Unknown(s) cancel ___ C. Simultaneous eqns. I. Targets Math Difficulty ___ A. Calc/vector algebra ___ B. Lengthy algebra

Name: ____