Names: ___________________

Title:

Cart, Pulley, & Hanging Mass Lab Part 2 (aka Newton's Second Law Lab 2)

Materials:

Pasco cart, gray ramp, pulley, .1 kg masses, digital scale, stop watch, meter stick, cup, paper clips, string

Keep in Mind:

The instructor will demonstrate how to utilize the ramp, pulley, cart, and hanging mass. Misuse of the lab equipment automatically results in a zero on the assignment and you will be required to pay for broken equipment. Your writing must be legible.

Instructions for Experiment 2:

Hypothesis 2: Acceleration is directly proportional to net force.

Hypothesis Test: Graph acceleration against net force, net force on the x-axis and acceleration on the y-axis. Net force is the force gravity of the hanging mass. If acceleration is directly proportional to net force, then the graph of acceleration and net force will have a linear relationship that passes through the origin.

Instructions:

Keep the total mass of the system (cart, cart masses, and hanging mass) constant, however you will be removing masses individually from the cart and placing them into the cup one at a time. The total mass of the system should NOT change. Do not add external masses once you have begun collecting data! You should NOT begin with an empty cart; you should have around ten .1 kg masses on the cart to begin. Include the mass of the cart in the total mass of the system; measure the mass of your cart using a digital scale.

To begin place a .1 kg mass from the cart into the hanging cup. The net force on the cart is caused by the hanging mass which is its Force Gravity. Net force will change in this experiment. Make certain that all masses are measured in kg not grams! Calculate the force gravity on .1 kg:

Use the equation $F_g = mg$ where g = - 9.8 N/kg.

$Net\ Force = F_g = mg$ =(________ kg) x (-9.8 N/kg) = ____________ N

Make sure the hanging masses land on something soft (e.g. a backpack). Report the cart mass, added masses to the car, hanging mass, and system mass below:
Cart: ____ kg + Cart Masses: ____ kg + Hanging Masses: ____ kg = System Mass:_____ kg

Section A: Force Diagrams and Literal Equations

Draw a force diagram for the cart with the masses stacked on top:

Draw a force diagram for the cup with masses inside:

Write the net force literal equation for the cart and stacked masses:

Write the net force literal equation for the cup with masses inside:

Solve for Tension:

Solve for Tension:

Combine the net force equations to create a literal equation for the system acceleration:

Use the literal equations above to solve for acceleration and tension in each of the scenarios. Fill in the table below with your results:

Scenario	Hanging Masses (kg)	Net Force (N)	Cart + Masses (kg)	System Mass (kg)	Acceleration (m/s/s)	Tension (N)
1						
2						
3						
4						
5						
6						

Section B: Kinematics

Keep the hanging mass constant for three trials as you measure the time it takes the cart to accelerate over a distance of .75 m beginning from rest. Students will use a stop watch to measure how much time in seconds is required for the system to travel a distance of .75 m. Repeat three times and find the average:

$t_1 =$ ________ $seconds$ $t_2 =$ ________ $seconds$ $t_3 =$ ________ $seconds$

$$t_{average} = \frac{t_1 + t_2 + t_3}{3} = \_\_\_\_\_\_\_\_ \quad seconds$$

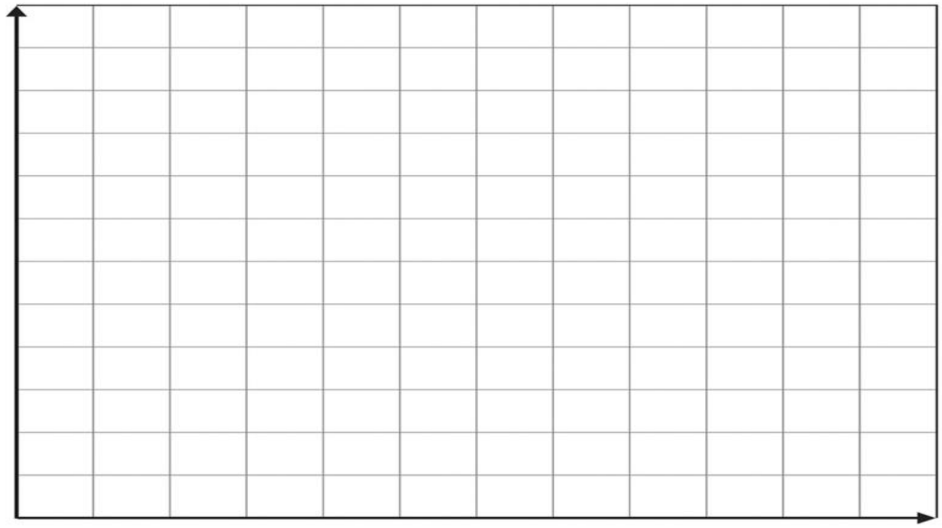
After completing the three trials and finding average time, add an additional .1 kg mass from the cart to the hanging cup and again perform three timed trials. Do NOT add any external mass to the cup, only from the cart! Repeat the process five times. Substitute the average time as ‘t’ in the following equation to calculate acceleration:

$\Delta x = v_i t + \frac{1}{2}\bar{a}t^2$ where $v_i = 0\frac{m}{s}$ and $\Delta x = .75$ m (or $d = \frac{1}{2}\bar{a}t^2$ $where$ $d = .75\ m$)

Report your hanging mass, net force, average time, and acceleration in the table:

Scenario	Hanging Mass (kg)	Net Force (N)	Avg.Time (seconds)	Acceleration (m/s/s)
1				
2				
3				
4				
5				
6				

After organizing the data in the above table, graph the net force the x-axis with the corresponding acceleration on the y-axis to create a scatterplot.



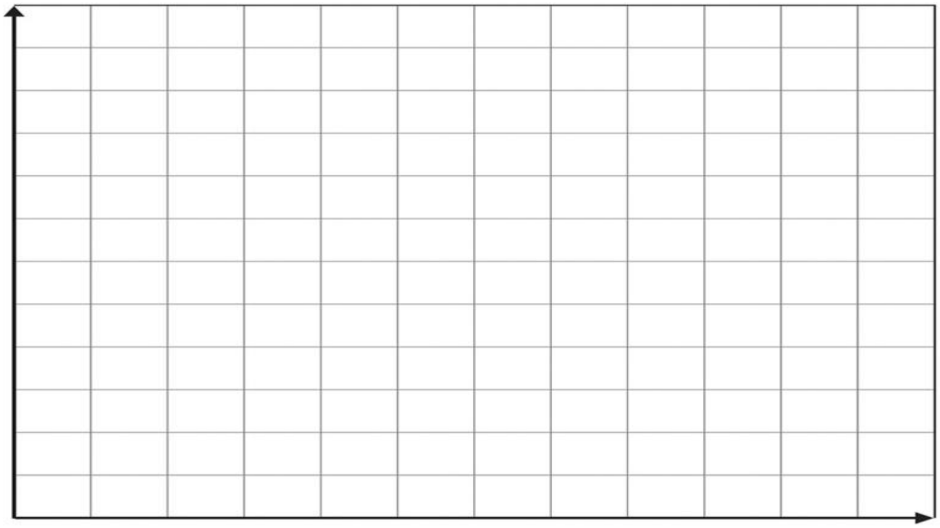
Questions:

1. Draw a line of best fit through the points; use an online regression applet (link is below) or ti-84 calculator to find the slope of the best fit line. What is significance is of the slope of the graph? Compare your slope to the reciprocal of the system mass.

2. What is the relationship between net force and acceleration?

3. What do your result suggest about the correctness of the hypothesis? Is it confirmed or rejected? Answer in complete sentences. Restate the hypothesis in your answer.

You should have two accelerations for each of the six scenarios. Create a table of ordered pairs where the x value is the acceleration calculated in Section A and the y value as the acceleration calculated in Section B. Plot your points on the graph below.



4. . Draw a line of best fit through the points; use an online regression applet (link is below) or ti-84 calculator to find the slope of the best fit line. What do your results indicate about the two methods of finding acceleration of the system? Explain.

5. List at least two control variables.

6. What are some potential sources of error in your data?