Physics Name: _____

LAB #10: NEWTON'S 2ND LAW Date: _____

Verifying Newton's 2nd Law — Lab #10

Pre-Lab Discussion: Using a pulley and an air cart, we can use different masses to accelerate a cart. By measuring the accelerations caused by a range of masses, we should be able to confirm Newton's second law of motion, $F = ma$. Since the mass of the cart (m_{cart}) is a constant (k), the ratio of the force used to pull the cart ($F_{\parallel}$) and the acceleration of the cart (a_{cart}) should be a constant:

$$m_{cart} = k = \frac{F_{\parallel}}{a_{cart}}$$

Bad Lab: issues with changing mass and acceleration.

Purpose: To verify Newton's 2nd Law of motion.

Materials: cart ramp hook masses (10, 20, 30 g)

Method:

1. Adjust the air track so that the cart remains stationary.
2. Add a 20. g hook to accelerate the cart. (Note the $m_{\parallel}$ has already been entered in the data table.)
3. Record the acceleration of the cart using a stopwatch or an iPhone to take a movie.
4. Scan the movie to determine both the time and the distance the cart travels.
5. Calculate the acceleration *of the cart*. Fill in the data and results chart. ($F_{\parallel} = mg$)
6. Add 10. g to the hook and repeat 1-4. Do this for 30 g, 40 g, and 50 g total mass.

Data and Processing: Record data and results on the table below:

Data and Results Table

Mass (m_p in kg)	Distance (Δd in m)	Time (Δt in s)	a_{cart} (m/s^2)	Weight ($F_{\parallel}$ in N)	$\frac{F_{\parallel}}{a_{cart}}$
0.0200					
0.0300					
0.0400					
0.0500					

Calculations:

As example calculations, use the data for the 20. g hook and show how to calculate:

Δv_{cart}

a_{cart}

$F_{\parallel}$

$\frac{F_{\parallel}}{a_{cart}}$

Conclusions:

1. Calculate the average value for $\frac{F_{\parallel}}{a_{\text{cart}}}$. _____

2. Calculate the percent difference between the average value for $\frac{F_{\parallel}}{a_{\text{cart}}}$ and the values for $\frac{F_{\parallel}}{a_{\text{cart}}}$ in each trial. Show the calculation of % error for trial 1 in the space below.

3. Did your data validate Newton's 2nd Law of Motion? Explain your answer.

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4. How could this lab procedure be improved?

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Applications:

1. What did you, *personally*, learn from this lab.

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2. By whom and how can any idea, principle, or activity in this lab be used in the real world?

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