Modified Atwood Machine Lab

Name: _____

Objective:

To verify the equations relating to constant acceleration and Newton's second law of motion as applied to Atwood's Machine.

Materials:

Two pulleys, two strings, two cups, 4 paperclips, masses, meter stick, stopwatch, gray track, cart

Introduction:

This modified atwood machine will consist of two hanging masses (i.e. cups) each suspended by a pulley and both connected with string to a central mass (i.e. cart). When the cup masses are unequal, the system will accelerate in the direction of the heavier cup. In this experiment, you will measure the acceleration and compare it to that predicted by Newton's second law. For the purposes of this experiment, we shall assume that the acceleration is constant. Therefore, if the system begins at rest, y is the distance traveled and t is the time it takes to go a distance of y. You will measure y and t to calculate the acceleration, using the kinematic equation:

$$y = \frac{1}{2}at^2$$

- Connect the cart to the two cups via two lengths of string over two pulleys on opposite sides of the gray track. The string lengths should be such that when one cup is near table or counter height, the other is on the ground. Measure the height of the table or counter cup: y = _____ m
- 2. Place an unequal amount of mass in both cups such that the system easily accelerates.
- 3. Pull the light side down to the floor and hold it. Place something soft to gently break the fall of the heavier cup as it accelerates to the floor.
- 4. Begin at rest and time the fall of the heavy cup by starting the stopwatch as you release the cup and stopping it when it reaches the floor. Take three time readings and record them in a data table. Find the average.
- 5. Add an additional mass on top of the cart. Repeat the previous steps 3 times, each time adding an additional mass to the cart.

					Heavier	Lighter			
	Time	Time	Time	Average				Total	
Scenario	1	2	3	Time	Cup 1	Cup 2	Cart	Mass	Acceleration
1									
2									
3									
4									

6. Fill in the table with your data. Calculate the acceleration of the system using kinematics.

Using a Newton's 2nd Law literal equation, applied to the modified atwood machine, calculate the acceleration of the system, in each of the four scenarios. Show your work below.

Scenario 1Scenario 2Scenario 3Scenario 4

Acceleration with Newton's 2nd Law:

	Heavier	Lighter				
				Total		
Scenario	Cup 1	Cup 2	Cart	Mass	Net Force	Acceleration
1						
2						
3						
4						

Find the percent difference in the kinematics acceleration (experimental) and the Newton's 2nd Law acceleration (actual) for all three scenarios.

$$\% error = \left(\frac{Actual - Experimental}{Actual}\right) x100\%$$

Scenario 1: _____% Scenario 2: _____% Scenario 3: _____% Scenario 4: _____%

Why are there discrepancies between the actual and the experimental accelerations? Describe at least two potential sources of error. Answer with complete sentences.

What happened to the acceleration as mass was added? Did net force change? Explain.