6 A Property of Matter - Mass

Name _____

Lab B: Acceleration vs. Mass

Inquiry Physics

How does the mass of an object affect its acceleration? The goal of this experiment will be to find the mathematical relationship between mass and acceleration when a constant unbalanced force is applied.

You will again be using an air track and gliders for this experiment. At your lab station are three gliders. The two red gliders each have a mass of 300. g or 0.300 kg. The gold glider has a mass of 150. g or 0.150 kg. (Please note that some of the gold gliders work best if they travel in the direction indicated by the large arrow penned on one side.) The gliders have velcro on their bumpers so that they can be hooked together in certain combinations.

In this lab, we will deliberately vary the mass, and observe what happens to acceleration. Mass is thus called the ***independent variable***, and acceleration the ***dependent variable***. We will hold force (the hanging weight holder), distance, and initial speed constant; indicate those values below:

Force _____ Distance _____ Initial Speed _____

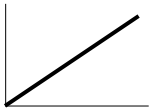
1. Start with all three gliders hooked together for a total mass of 0.750 kg. (Check that you have not hooked the velcro such that a glider drags along the track.) Take three measurements of the time required to constantly accelerate the gliders over a set distance (record that distance below). Record your data in the table. Remember that your times should vary by no more than 0.10 s.

2. Next use just the two red gliders for a mass of 0.600 kg. Repeat step one for this combination.

3. Repeat the procedure for glider(s) massing 0.450 kg, 0.300 kg and 0.150 kg.

Mass of Glider(s) (kg)	Time (s)	Average Time (s)	Average Acceleration (m/s^2)
0.750			
0.600			
0.450			
0.300			
0.150			

Calculate the average time and your group's average acceleration for each trial. Use the computer to make a graph from your group's averages. The ***independent variable*** should be plotted on the x axis. The ***dependent variable*** should be plotted on the y axis. The data will fall into one of the categories at right, and you should have the computer perform the appropriate fit. (Select the "Automatic Curve Fit" function from the "Analyze" menu.)



$y \propto x$
linear fit
$y = mx+b$

$y \propto x^2$
quadratic fit
$y = cx^2 + bx + a$

$y \propto 1/x$
inverse fit
$y = a / x$

Once you have a good fit, turn off the dot-to-dot line on the graph by de-selecting "Connecting Lines" on the "Graph" menu. Have Mr. M approve your graph before printing; save your data as "H_G_L6" with your hour and group numbers in place of the blanks.

ANSWER IN COMPLETE SENTENCES

1. What happened to the acceleration of the gliders as you increased their mass?

2. Describe the shape of the curve on your graph. What kind of function does it represent?

3. That shape/function allows you to predict how mass affects acceleration. If the mass were cut to one-fourth of its previous value, what would the new acceleration be?

4. Write the full equation for your graph. Remember to substitute the proper variable names for y and x and to indicate the correct values for any constants. Remember to round off values for significant figures.

CLASS EQUATION: _____

5. Let's test your answer to question 3. Use your graph's equation to find the theoretical acceleration for 0.100 kg and 0.400 kg of mass. Write down those values and then compare them mathematically in a ratio. (Divide the larger acceleration value by the smaller one.) Write your ratio down too, using 3 significant figures.

Accel. of 0.100 kg = _____ m/s^2 Accel. of 0.400 kg = _____ m/s^2 Ratio = _____ to 1

6. Theoretically, what **should** the ratio be between the two accelerations? (Use your answer to question 3 to help you answer this question. Notice how we changed the mass.)

7. Write in words the mathematical relationship you have found between mass and acceleration.