5 Force and Acceleration

Name_____

Lab B: Varying Forces and Acceleration

AP/Inquiry Physics

The first lab with the air tracks showed that a constant unbalanced force creates a constant acceleration. The goal of this experiment is to determine if the acceleration changes when the force acting on the object is varied, and if so what the precise mathematical relationship is between the two variables.

Use the airtrack and glider system as before, but use **two** red gliders hooked together with velcro. Float each glider separately and then let them gently link up. Use a conveniently large distance to make your timing measurements as easy as possible.

1. Does every group have to use the same distance to compare their results? **Explain** why or why not.
USE COMPLETE SENTENCES

2. Measure your hanging weight holder on the precision balance. Record the reading below:

   Weight holder is _____ grams.

3. We need to convert the reading into the metric unit of weight, ***newtons***. (The abbreviation for newtons is "N".) Multiply the reading by 0.0098 to convert grams to newtons. Show the new value in the space below:

   Weight holder weighs _____ N.

Using only the weight holder as the force on the glider, make three measurements of the time required to accelerate the glider from rest to the end of the track. Record the distance traveled and the time elapsed in the table. Then gather data concerning the time and distance when the force is increased by adding one 0.070 N washer (don't forget to add the weight of the weight holder to the 0.070 N), then two washers (which adds 0.140 N to the weight of the holder), then 3, 4, and 5 washers. Fill out the table.

Force (N)	Distance (m)	Time (s)	Avg. Time (s)	Avg. Accel. (m/s^2)

4. Calculate the average time and acceleration of the glider for each run. How did increasing the force affect acceleration?
USE COMPLETE SENTENCES

Your group will now plot your data with the computer. Plot the independent variable on the x-axis and the dependent variable on the y-axis. Consider if it is logical to include (0,0) as a data point.

When you have plotted your data, ask Mr. M to approve it before it is printed and saved. (When saving, use the filename format "H#G#L5**B**", with your hour and group numbers in place of the # signs.)

ANSWER IN COMPLETE SENTENCES

5. Why is (0,0) a valid data point on your graph? (No, it is NOT because the objects started from rest.)

6. The shape of your graph indicates a specific mathematical relationship between force and acceleration. Describe that relationship using the terminology you learned in earlier labs.

7. The mathematical relationship you have described should allow you to predict how acceleration will change when force changes. For example, if the force acting on an object doubles, what does your graph predict will happen to the acceleration of the object?

8. You should recall that the equation of a line is **y=mx+b** where **m** is the slope and **b** is the y-intercept. Your graph shows the mathematical relationship between force and acceleration. Write the complete equation for your graph, using ***F*** as the symbol for force and ***a*** for acceleration and your graph's slope and y-intercept (properly rounded).

CLASS' AVERAGE EQUATION: _____

9. Let's test your answer to question 3 by checking the acceleration when the force doubles. Use your graph's equation to find the theoretical acceleration at 0.200 N and 0.400 N of force. 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, with 3 significant figures.

Accel. at 0.200 N = _____ m/s^2 Accel. at 0.400 N = _____ m/s^2 Accel. Ratio = _____ to 1

10. Theoretically, what **should** the ratio be between the two **accelerations**? (Use your answer to question 3 to help you answer this question. Notice the ratio of the **forces** we arbitrarily used in question 9.)

11. Write a brief conclusion stating what general principle or concept this lab has illustrated.