



# Physics

LAB #11: DILUTING GRAVITY

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Diluting Gravity

## Lab #11

**Pre-Lab Discussion:** When Galileo studied gravity, he found that objects fell too fast for careful study. He used ramps to slow the motion of rolling spheres, disks, and hoops. He found that the ramp ‘diluted’ the effect of  $a_g$ . By rolling objects, he eliminated the effects of friction. Air carts are an essentially frictionless surface that can be slanted at an angle to reduce  $g$  and  $a_g$ . Draw a free body diagram of a block on a frictionless ramp (show all forces acting on the center of the block). Draw and label  $mg$  using a dashed line (it will have no opposing force). Draw and label  $F_{||}$ ,  $F_{\perp}$ , and  $F_{net}$  using solid lines.

**Purpose:** To calculate the value of  $g$ .

**Materials:** air cart air ramp motion detector

### Method:

1. Use the motion detector or stopwatch and graph the motion of an air cart on a level track.
  - a. Use a spreadsheet and create a position vs. time graph.
  - b. On the spreadsheet, create a speed vs. time graph.
2. Repeat Step 1 with one end of the track raised by about 5 cm. Report exactly how high the end of the track was raised (see calculation 2a on the next page).
  - a. Use a spreadsheet and create a position vs. time graph.
  - b. On the spreadsheet, create a speed vs. time graph.

### Data and Processing:

1. On the position vs. time graph and the speed vs. time graph created in a spreadsheet (step 1 of the method), title this sheet and both graphs, “Motion on a Level Track”.

Calculations:

- a. Show the equation, substitutions, and result of calculating the slope of a position vs. time graph and tell what value the slope represents.
  
  
  
  
  
  
  
  
  
  
- b. Show the equation, substitutions, and result of calculating the slope of a speed vs. time graph and tell what value the slope represents.
  
  
  
  
  
  
  
  
  
  
- c. Show the equation, substitutions, and result of calculating the acceleration of the air cart.

2. On the same spreadsheet, title the graphs made for step 2, "Motion on a Raised Track".

Calculations:

- a. How high was the end of the track raised? \_\_\_\_\_ cm
- b. What is the distance between the supports on the air track? \_\_\_\_\_ cm
- c. Show the equation, substitutions, and result of calculating angle of the air track.
- d. Show the equation, substitutions, and result of calculating the net force acting on the air cart.
- e. What is the shape of the position vs. time graph? \_\_\_\_\_
- f. Show the equation, substitutions, and result of calculating the slope of a speed vs. time graph and tell what value the slope represents.
- g. Show the equation, substitutions, and result of calculating the acceleration of the air cart.

**Conclusions:**

1. Explain the slopes and results of 1a and 1b using a free body diagram. (Use the space to the right.)
2. Use the information above and show the equation, substitutions, and result of calculating the experimentally determined value of  $g$  (remember that we diluted this value by using a ramp and we want the actual value of  $g$ ).