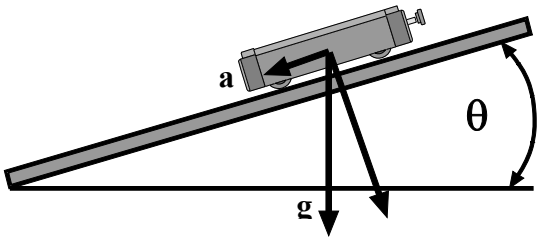
Acceleration on an inclined plane

Introduction

The purpose of this activity is to measure the acceleration of a cart moving down an inclined plane and compare the measured acceleration to the theoretical value, g sin θ. A cart on an incline will roll down the incline as it is pulled by gravity. The direction of the acceleration due to gravity is straight down as shown in the diagram. The component of the acceleration due to gravity that is parallel to the inclined surface is g sinθ where θ is the angle of the incline. Neglecting friction, this is the acceleration of the cart.



$$a = g \sin \theta$$

Use the motion sensor to measure the motion of a cart as it moves down an inclined track. Measure the height of the incline to calculate the angle of the inclined track. Use the slope of a graph of the cart's acceleration versus sin θ to determine the value of "g", the acceleration due to gravity.

SAFETY REMINDER

- Follow directions for using the equipment.

Setup

1. Set up the Lab quest mini Interface and computer and start *Logger Pro*. Connect the Motion Sensor to the interface.
2. The *Logger Pro displays* graphs of x-t and v-t.
3. Incline the track, elevate the end near the motion sensor. You can start by elevating the motion sensor end by 25-30 cm. Note the height in the worksheet.
4. Determine the angle of the track. Measure the height of the track near motion sensor end and use the height and length of the track to calculate the sine of the angle. Write this down in the worksheet.
5. ***Make sure the motion sensor is aligned parallel to the track (Always check).***
6. Place the cart near the motion sensor end, 20 cm away from the sensor and hold it. Press the 'collect' button and release the cart so it moves down the track.
7. Catch the cart when it reaches the end of the track and stop recording data.
8. Check whether you need to repeat the experiment to obtain a smooth v-t and a-t graph. You need to insert new graph to view the a-t graph as you did in the previous lab.
9. In the v-t graph, do a linear fit as you did in the previous lab and determine the average acceleration of the cart. Make sure that you only select the linear region of

v-t graph for fitting. Also obtain the average acceleration from the *a-t* graph. Select the interval where the acceleration is nearly constant (Select only the region where the cart is in motion) and use the Logger Pro "STAT" to obtain the mean acceleration from the *a-t* curve.

10. Calculate the sine of the angle and enter the average acceleration for that angle into the Table in the worksheet.
11. Lower the raised end of the track by four centimeters.
12. Repeat the procedure (Steps 4-9) at the new height. Continue to repeat the procedure until the raised end is at 4 centimeters.
13. Now you have at least four sets of data, acceleration and sine angle for four different heights of the track. Plot the experimental acceleration (obtained from *v-t* graph) on the y-axis and sin angle on the x-axis. This can be done by entering the sine angle and experimental acceleration as a new data set in the logger pro.
14. Make a linear fit to the *a* vs. $sin\theta$ graph and record the slope, "m" as the acceleration due to gravity, g.