Acceleration Down an Incline(2)

In the previous lab, you learned the importance of linearizing your data and the meaning of the slope of the line. In the speed (or velocity) vs. distance (or displacement) graph, you learned that the slope of the linearized data was . In this lab, you are going to investigate the affets of changing the angle on the acceleration of the cart and find its relationship to g.

To LabPro

Photogate

Gate



θ

To LabPro

objectives

* Use two photogates to measure the time for a dynamics cart to accelerate from rest to a known distance over a variety of angles of inclination.
* Using your understanding of the physics of an inclined plane, determine the acceleration due to gravity.

Materials

|  |  |
| --- | --- |
| Power Macintosh or Windows PC | 2 - Vernier Photogates |
| LabPro or Universal Lab Interface | Graphical Analysis software or graph paper |
| Logger *Pro* | 2.2m Pascoe Dynamics Track |
| Pascar Dynamics Cart |  |

Preliminary questions

1. A cart travels along a track similar to the figure above. If the angle of the incline were to approach 90 degrees, what would happen to the acceleration of the cart?

1. Draw a free-body diagram for the cart on the inclined plane. Make sure you label all your forces.
2. What force acts perpendicular to the incline?
3. What force acts parallel to the incline?

Procedure:

1. Connect the Photogates to DIG/SONIC 1 and DIG/SONIC 2 of the LabPro.
2. Place the photogate plugged into DIG/SONIC 1 at the 50cm mark on the track, and place the photogate plugged into DIG/SONIC 2 at the 200cm mark on the incline.
3. Start LoggerPro 3.5.0 or higher, and open the file “**Acceleration Down an Incline #2.cmbl**” in the student assignments directory under ***RCK Student Common I:\Assignments\Mr. Ropes\Physics***.
4. With the gate positioned in the center of the car, measure and record its width in centimeters, and record this value in LoggerPro.
5. Adjust the dynamics track so that it makes an angle of about 5 degrees with the horizontal.
6. Place the cart along the track so that the ***leading edge*** of the cart’s gate is at the 50 cm positon where photogate #1 is placed. Release the cart from rest, then measure and record the time it takes to descend the track and get to the second photogate.
7. Increase the angle of the dynamics track by about 5 degrees and repeat step number 6.
8. Continue steps 9 and 10 until you have achieved an angle of about 25 degrees.

Data Table

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Position | Height of track, *h* (m) | Length of incline, *x*  (m) | ** | Time to Descend Track | | | |  |
| trial 1  (s) | trial 2  (s) | trial 3  (s) | Avg Time  (s) | Average Acceleration  (m/s2) |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |

Data Summary & Analysis:

1. From your data, determine the average acceleration of the cart for each set of trials at each position. ***You must show a sample calculation in your lab book.***
   1. How did the acceleration of the cart change as the angle increased?
2. Plot your value for acceleration vs. sine of the angle, θ, for each trial and draw your best fit line and find it’s slope.
   1. What does this value represent? If you are not sure, you might want to look at your free-body diagram.
   2. Is there agreement between this value and the accepted value for g of 9.8 m/s2?
   3. Find the percent difference.

Error Analysis:

What were the sources of error in this labatory investigation? Make sure that you consider how you collected your data and any measurements that you made. Procedural flaws should be considered.

Conclusion:

How well does your data support the physics of a cart rolling down a frictionless incline?