Acceleration Down an Incline (1)

During the early part of the seventeenth century, Galileo experimentally examined the concept of acceleration. One of his goals was to learn more about freely falling objects. Unfortunately, his timing devices were not precise enough to allow him to study free fall directly. Therefore, he decided to limit the acceleration by using fluids, inclined planes, and pendulums. In this lab exercise, you will learn the importance of linearizing your data and the meaning of the slope of the line.

To LabPro

Photogate

Gate



objectives

* Use a photogate to measure the speed of a cart rolling down an incline.
* Using your understanding of the kinematic equations:
* Determine the mathematical relationship between distance and speed
* Determine the value for the car’s acceleration.

Materials

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

Preliminary questions

1. In your lab book, sketch:
   1. Distance vs. time for a cart rolling without friction down an incline.
   2. Velocity vs. time for a cart rolling down an incline.
   3. Acceleration vs. time for a cart rolling down an incline.

Procedure:

1. Connect the Photogate to DIG/SONIC 1 of the LabPro.
2. Place the photogate so that it is at the 200cm mark on the incline.
3. Start LoggerPro 3.5.0 or higher, and open the file ***Acceleration Down an Incline #1.cmbl*** under ***RCK Student Common I:\Assignments\Mr. Ropes\Physics***. Make sure that the photogate timer is set to Gate Mode.
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. Place the car along the track so that the leading edge of the cart’s gate is at the 190 cm positon. Release the cart from rest, then measure and record the time for the cart’s gate to pass through the photogate.
6. Reposition the cart so that the leading edge of the cart’s gate is at the 180 cm positon. Release the cart from rest, then measure and record the time for the cart’s gate to pass through the photogate.
7. Again, reposition the cart so that the leading edge of the cart’s gate is at the 160 cm positon, and once again release it from rest and measure and record the time for the cart’s flag to pass through the photogate. Repeat this process by moving the cart up the incline an additional 20 cm, recording the final time measurement after releasing the car from the 20 cm position.

Data Summary & Analysis:

1. From your data, determine the speed of the cart as it passed through the photogate.
2. Create a representative graph (try using an Excel spreadsheet) of your data.

***Note: if your graph does not appear linear at this point, you must figure out how to linearize it.*** Use your knowledge of the motion equations that we use in physics to figure it out.

1. Once the data has been linearized, explain what information that the slope of the line provides. Can you now graphically determine the acceleration of the cart along the incline, assuming the acceleration is constant?

Error Analysis:

What were the sources of error in this labatory investigation? What type of speed did you calculate in step 1 of the data analysis? Was it valid to use this number in your calculations?

Conclusion:

Provide a brief summary on the importance of linearizing your data to find the significance of the slope.