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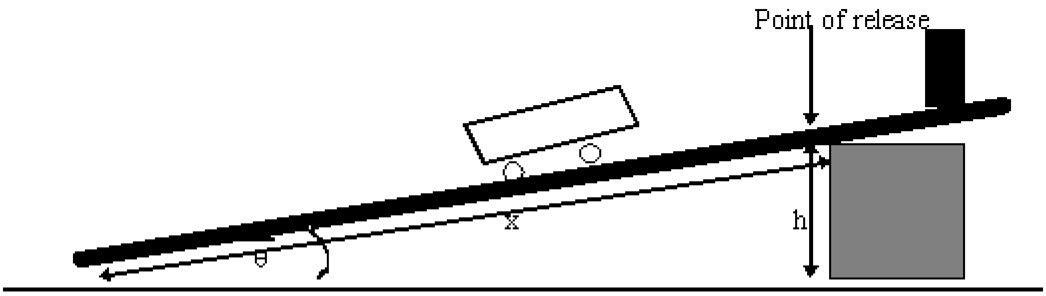
DETERMINING G ON AN INCLINE PLANE

Introduction

During the early part of the 17th 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, you will see how the acceleration of a rolling cart depends on the ramp angle. Then you will use your data to extrapolate the acceleration of an object in free fall.

If the angle of an incline with the horizontal is small, a ball or cart rolling down the incline moves slowly and can be easily timed. Using time and distance data, it is possible to calculate the acceleration. When the angle of the incline is increased, the acceleration also increases. The acceleration is directly proportional to the sine of the incline angle, (◎◎. A graph of sin ◎◎can be extrapolated to a point where the value of sin ◎◎is equal to 1 (Or, in other words, the angle of incline is equal to 90°.) This is equivalent to free fall. Therefore, the acceleration during free fall can be determined from the graph.

Galileo was able to measure acceleration only for small angles. You will collect similar data. Can these data be used to extrapolate an accurate value of g? We will see how valid this method can be. Rather than measuring time, as Galileo did,. You will take measurements of the cart rolling down inclines of various small angles.



Objectives

- Determine the value of g by extrapolating the Acceleration vs. Sin ◎ to Sin ◎=1.

Pre-Lab Questions-turn these in before you leave the lab

1. One of the timing devices used by Galileo was his pulse. Drop a ball from a height of about 2 m and try to determine how many pulse beats elapsed before it hits the ground. What was the timing problem that Galileo encountered?

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2. Now, measure the time it takes the ball to fall 2m, using a wrist watch or wall clock. Did the results improve substantially?
3. Roll the hard ball down a ramp with an angle of about 10° with the horizontal. First use your pulse and then use your wrist watch to measure the time of descent.
4. Do you think that during Galileo's day it was possible to get useful data for any of these experiments? Why?

Procedure:

1. Adjust the angle of the incline plane to 5º then release the ball from the following x distances and measure the time required for each case and calculate the acceleration.
   x = 20cm , x = 40cm, x = 60cm x = 80cm
2. Adjust the angle of the incline plane to 10º then release the ball from the following x distances and measure the time required for each case and calculate the acceleration.
   x = 20cm , x = 40cm, x = 60cm x = 80cm
3. Adjust the angle of the incline plane to 15º then release the ball from the following x distances and measure the time required for each case and calculate the acceleration.
   x = 20cm , x = 40cm, x = 60cm x = 80cm
4. Adjust the angle of the incline plane to 5º then release the car from the following x distances and measure the time required for each case and calculate the acceleration.
   x = 20cm , x = 40cm, x = 60cm x = 80cm
5. Adjust the angle of the incline plane to 10º then release the car from the following x distances and measure the time required for each case and calculate the acceleration.
   x = 20cm , x = 40cm, x = 60cm x = 80cm
6. Adjust the angle of the incline plane to 15º then release the car from the following x distances and measure the time required for each case and calculate the acceleration.
   x = 20cm , x = 40cm, x = 60cm x = 80cm

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RETURN THİS PAGE BEFORE YOU LEAVE THE LAB.

STUDENTS
Name:
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Date:

Using the ball

Height, h (m)	length, x (cm)	Sinθ	acceleration for x=20cm (m/s^2)	acceleration for x=40cm (m/s^2)	acceleration for x=60cm (m/s^2)	acceleration for x=80cm (m/s^2)	Average acceleration
	20						
	40						
	60						
	80						

Using the Cart

Height, h (m)	length, x (cm)	Sinθ	acceleration for x=20cm (m/s^2)	acceleration for x=40cm (m/s^2)	acceleration for x=60cm (m/s^2)	acceleration for x=80cm (m/s^2)	Average acceleration
	20						
	40						
	60						

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	80						

<u>Analysis</u>:

1. Compare the average acceleration with the gravitational acceleration (g = 9.81m/s²).
2. Explain the difference between the actual value and the experimental value.