Driveway Races

Overview We know from earlier work that acceleration due to gravity is a uniform or constant rate of acceleration at 9.8 m/s^2, or 32 ft/s^2. However, if something is rolling down a ramp, it is still pulled by gravity, but at a portion of it, or not the full "strength."

What to Learn In this experiment, learn how changes in velocity can be changes in speed, direction, or both.

Materials

- ball (hard and smooth like a golf ball, racquetball, pool ball, soccer ball, etc.)
- tape or chalk
- driveway (slightly sloping – you can also use a board propped on one end as a ramp)
- timer or stopwatch
- pencil
- measuring tape or yard stick

Lab Time

1. Place the board on the books or whatever you use to make the board a slight ramp. You really don't want it to be slanted very high. An inch or less would be fine. If you wish, you can increase the slant later just to play with it.
2. Put a line across the board where you will always start the ball. Some folks call this the "starting line."
3. Start the timer and let the ball go from the starting line at the same exact time.
4. Now, this is the tricky part. When the timer hits one second, mark where the ball is at that point. Do this several times. It takes a while to get the hang of this. I find it easiest to have another person do the timing while I follow the ball with my finger. When the person says to stop, I stop my finger and mark the board at that point.
5. Do the exact same thing but this time, instead of marking the place where the ball is at one second, mark where it is at the end of two seconds.
6. Do it again but this time mark it at 3 seconds.
7. Continue marking until you run out of board or driveway.

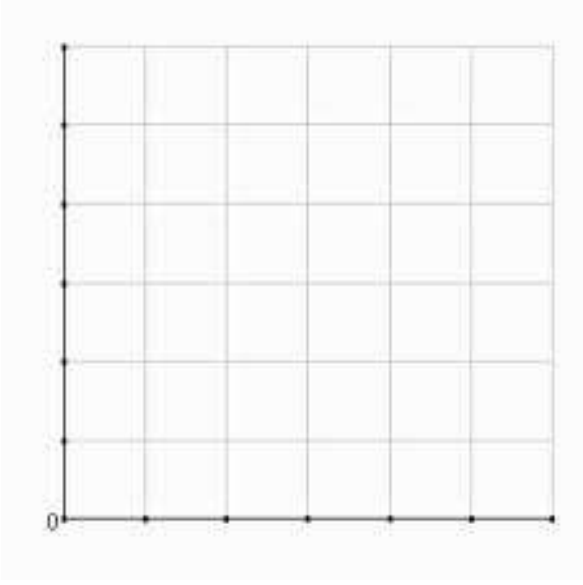
Driveway Races Data Table

Trial #	Trial 1 Distance	Trial 2 Distance	Trial 3 Distance	Average

You should have noticed that the distance didn't increase uniformly as it would when the velocity was constant. But the speed kept increasing, so the distance got larger each time. Use the following table, and we are going to determine the acceleration of your ramp by graphing it.

Using the equation $d = \frac{1}{2} at^2$. You can see that distance will be our y-axis and time will be our x-axis.

Using these variables, graph the results below. Be sure to label your axes!

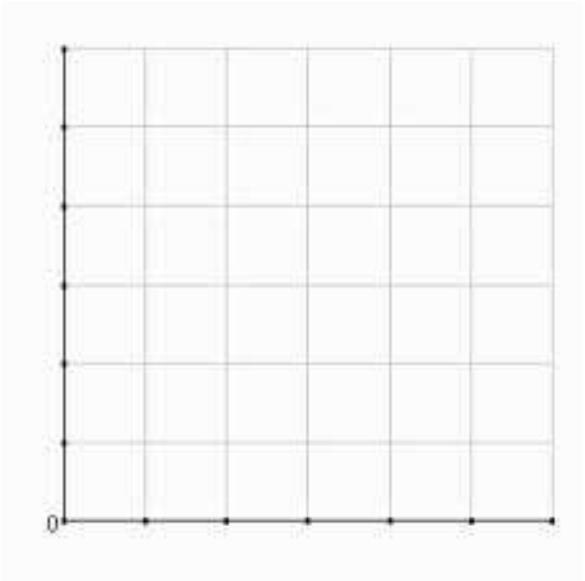


You should see that this does not create a straight line, so it can be difficult to try and determine the slope of the line.

This time, instead of graphing the time as is, square the time, then take half of it. So you have taken out ½ t^2.

That means what is left will be acceleration.

Now graph the results of the modified time.



Reading

You may notice that when things move, they rarely move at the same speed all the time. Especially when you drive, you can see right away that your speed is constantly changing. When your speed changes, you are accelerating. You can be either speeding up or slowing down. The type of acceleration we deal with, especially in introductory physics, is uniform acceleration, which means that it is accelerating at a constant rate.

Exercises Answer the questions below:

1. Was the line a straight line?

2. It should be close now, and the slope represents the acceleration it experienced going down the ramp. Calculate the slope of this line.

3. What do you think would happen if you increased the height of the ramp?

4. Knowing what you do about gravity, what is the highest acceleration it can reach?

Answers to Exercises: Driveway Racers

1. Was the line a straight line? (Yes.)
2. It should be close now, and the slope represents the acceleration it experienced going down the ramp. Calculate the slope of this line. (Answers vary.)
3. What do you think would happen if you increased the height of the ramp? (Acceleration would increase.)
4. Knowing what you do about gravity, what is the highest acceleration it can reach? (9.8 m/s^2)