Experiment
34

Velocity

Speed and velocity are rates. They tell us how much distance is covered in a unit of time. Velocity can be expressed by the formula

$$v = d/t$$

where v = velocity or speed (in m/s), d = distance traveled (in meters), and t = time (in seconds). In this experiment, you will study the velocity of a car after it is released from different points on a ramp. A Motion Detector will be used to measure velocity.

OBJECTIVES

In this experiment, you will

- Measure velocity using a Motion Detector.
- Calculate average velocities.
- Determine the relationship between velocity and release point.

MATERIALS

computer
Vernier computer interface
Logger*Pro*
Vernier Motion Detector
1.8 m board
several books
meter stick
masking tape
car
small index card

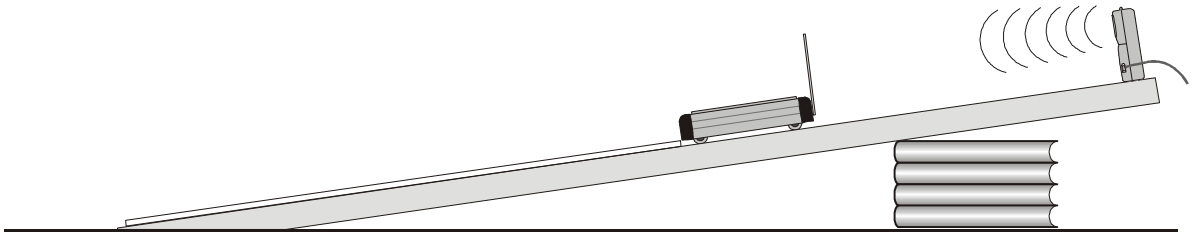

Figure 1

PROCEDURE

1. Prepare the track.
   a. Set up a ramp on books as shown in Figure 1. The high end of the ramp should be 45 cm above the floor.
   b. Place a meter stick down the center of the ramp. The 0 cm mark on the meter stick should be at the very bottom of the ramp. Tape the meter stick to the ramp in two places. The meter stick will serve as a guide rail for your car.
   c. Fasten the Motion Detector at the top and center of the ramp as shown in Figure 1. Connect the Motion Detector to the DIG/SONIC 1 port of the interface.

2. Use tape to fasten a small index card to the back of the car you will be using. The card acts as a reflective surface for the Motion Detector.

3. Prepare the computer for data collection by opening the file "34 Velocity" from the *Middle School Science with Computers* folder.

4. Collect data.
   a. Place your car on the ramp with its front wheels at the 40 cm line.
   b. Click Collect. Release the car after you hear a sound coming from the Motion Detector.
   c. When data collection has ended, click the Statistics button, STAT. Record the maximum velocity in your data table.

5. Repeat Step 4 two more times.

6. Repeat Steps 4 and 5 at positions of 70 cm and 100 cm.

DATA

	Velocity (m/s)			
Release point	Trial 1	Trial 2	Trial 3	Average
40 cm				
70 cm				
100 cm				

PROCESSING THE DATA

1. Calculate the average velocity for each release point. Show your work here. Record the results in your data table above.

2. Make a graph of your data. Plot Release Point (in cm) on the horizontal or x-axis and Average Velocity (in m/s) on the vertical or y-axis.

3. What happens to the velocity of the car as you release it from higher points?

4. How does friction affect the velocity of your car?

5. How could you improve your car to make it roll faster?

6. Describe one way you could change the ramp to make the car go faster, without changing the release points.

EXTENSIONS

1. Repeat the experiment with ramps of different heights.

2. Design, build, and test a different car.