

Speed and Acceleration Lab

Speed is defined as the distance an object travels per unit of time. Speed can be expressed as kilometers per hour (km/h), meters per second (m/s), and so on. In most cases, moving objects do not travel at a constant speed. The speed of an object usually increases and decreases as the object moves. Therefore, the average speed is used to describe the motion. Average speed is a ratio between the total distance and the total time that the object traveled.

$$\text{Average Speed} = \frac{\text{total distance}}{\text{total time}}$$

Acceleration is the rate at which an object's speed increases. You can express acceleration as meters per second per second (m/s^2). This unit represents the change in speed in meters per second each second. Forces cause objects to accelerate and decelerate (decrease the rate of speed). If a car has an average speed of 80 km/h on a hilly road, it probably changes speed many times. The car accelerates and decelerates. If the car is traveling at a constant speed of 80 km/h on a level road, it is not changing speed. Both the acceleration and the deceleration of the car are zero.

Objectives

In this experiment, you will

- determine the average speed of a tennis ball, and
- observe deceleration of the tennis ball.

Equipment

- stack of books
- wood ramp (about 50 cm long)
- masking tape
- stopwatch or watch with a second hand

Procedure

1. Clear a runway about 6 meters long.
2. At one end of the runway, set up a launching ramp.
3. Place a masking tape marker where the ramp touches the floor. Label this marker 0.0m. Place similar markers at 1.0m, 2.0m, 3.0m, 4.0m, 5.0m, from the bottom of the ramp.
4. Measure the time required for the tennis ball to pass each marker. You may require several practice runs to be able to observe and record the times quickly. One lab partner can observe the times while the other records the data.
5. Complete four trials. Record the times and distances in Table 4-1.

Name: _____

Analysis

1. Calculate the average time the tennis ball needed to travel each distance for the four trials. Record the results in Table 4-1.
2. Calculate the average speed of the tennis ball as it passes each marker. Record the result to the nearest 0.1 m/s in Table 4-1.
3. Make a graph to compare the average speed of the tennis ball (y axis) to the distance to each marker (x axis).

Table 4-1

| | Time (s) | | | | |
|--------------------|----------|-------|-------|-------|-------|
| Trial | 1.0 m | 2.0 m | 3.0 m | 4.0 m | 5.0 m |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| Average Time | | | | | |
| Average Speed(m/s) | | | | | |

Show Calculations for Speed for

Speed = Distance / Time

1.0 m

2.0 m

3.0 m

4.0 m

5.0 m

Name: _____

Conclusions

1. Describe the motion of the tennis ball as it moved across the floor.

2. What caused the tennis ball to slow down and stop?

3. Did the tennis ball travel at a constant speed? How do you know this?

4. How could you change this experiment to make the tennis ball decelerate at a faster rate?

5. How could you change this experiment to make the tennis ball accelerate at a faster rate?

6. Consider the 5.0 meters that the ball traveled. What conditions are necessary for the tennis ball to have no acceleration or deceleration?

Name: _____

