

Describing Motion Verbally with Speed and Velocity

Read from **Lesson 1** of the 1-D Kinematics chapter at **The Physics Classroom**:

<http://www.physicsclassroom.com/Class/1DKin/U1L1d.html>

MOP Connection: Kinematic Concepts: sublevels 3 and 6

Review:

1. A _____ quantity is completely described by magnitude alone. A _____ quantity is completely described by a magnitude with a direction.
 - a. scalar, vector
 - b. vector, scalar
2. Speed is a _____ quantity and velocity is a _____ quantity.
 - a. scalar, vector
 - b. vector, scalar

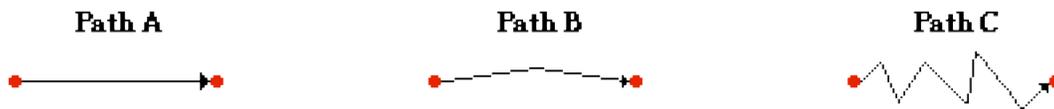
Speed vs. Velocity

Speed and velocity are two quantities in Physics that seem at first glance to have the same meaning. While related, they have distinctly different definitions. Knowing their definitions is critical to understanding the difference between them.

Speed is a quantity that describes how fast or how slow an object is moving.

Velocity is a quantity that is defined as the rate at which an object's position changes.

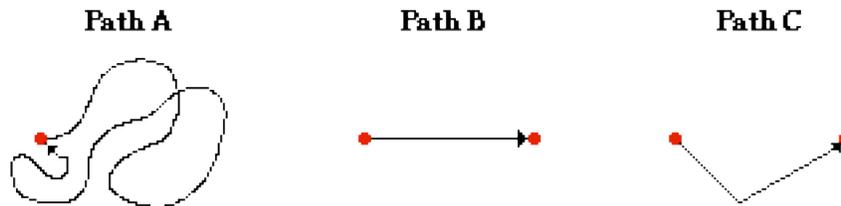
3. Suppose you are considering three different paths (A, B and C) between the same two locations.



Along which path would you have to move with the greatest speed to arrive at the destination in the same amount of time? _____ Explain.

4. **True or False:** It is possible for an object to move for 10 seconds at a high speed and end up with an average velocity of zero.
 - a. True
 - b. False
5. If the above statement is true, then describe an example of such a motion. If the above statement is false, then explain why it is false.

6. Suppose that you run for 10 seconds along three different paths.



Rank the three paths from the lowest average speed to the greatest average speed. _____

Rank the three paths from the lowest average velocity to the greatest average velocity. _____

Calculating Average Speed and Average Velocity

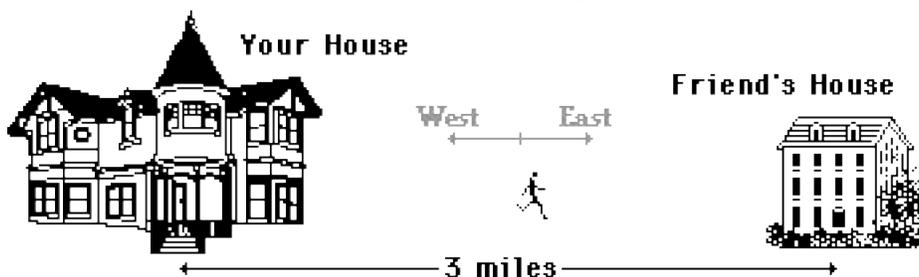
The average speed of an object is the rate at which an object covers distance. The average velocity of an object is the rate at which an object changes its position. Thus,

$$\text{Ave. Speed} = \frac{\text{distance}}{\text{time}}$$

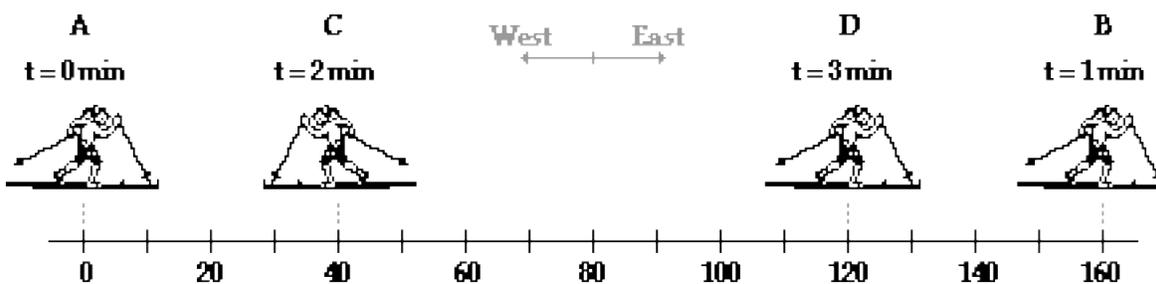
$$\text{Ave. Velocity} = \frac{\text{displacement}}{\text{time}}$$

Speed, being a scalar, is dependent upon the scalar quantity distance. Velocity, being a vector, is dependent upon the vector quantity displacement.

7. You run from your house to a friend's house that is 3 miles away in 30 minutes. You then immediately walk home, taking 1 hour on your return trip.



- a. What was the average speed (in mi/hr) for the entire trip? _____
- b. What was the average velocity (in mi/hr) for the entire trip? _____
8. A cross-country skier moves from location A to location B to location C to location D. Each *leg* of the back-and-forth motion takes 1 minute to complete; the total time is 3 minutes. The unit of length is meters.



Calculate the average speed (in m/min) and the average velocity (in m/min) of the skier during the three minutes of recreation. PSYW

Ave. Speed =

Ave. Velocity =

Instantaneous Speed vs. Average Speed

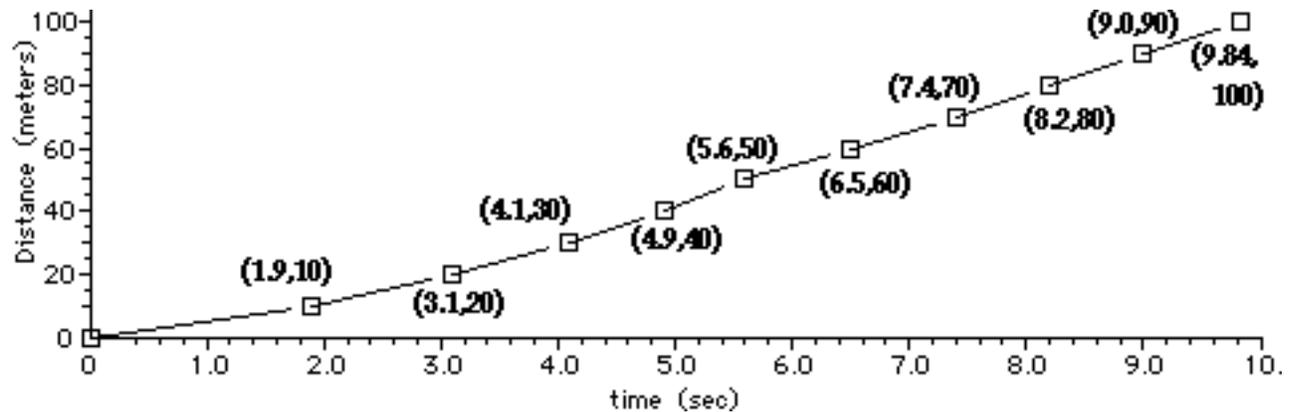
The instantaneous speed of an object is the speed that an object has at any given instant. When an object moves, it doesn't always move at a steady pace. As a result, the instantaneous speed is changing. For an automobile, the instantaneous speed is the speedometer reading. The average speed is simply the average of all the speedometer readings taken at regular intervals of time. Of course, the easier way to determine the average speed is to simply do a distance/time ratio.

9. Consider the data at the right for the first 10 minutes of a teacher's trip along the expressway to school. Determine ...
- ... the average speed (in mi/min) for the 10 minutes of motion.

Time (min)	Pos'n (mi)
0	0
1	0.4
2	0.8
3	1.3
4	2.1
5	2.5
6	2.7
7	3.8
8	5.0
9	6.4
10	7.6

- ... an estimate of the maximum speed (in mi/min) based on the given data.

10. The graph below shows Donovan Bailey's split times for his 100-meter record breaking run in the Atlanta Olympics in 1996.



- At what point did he experience his greatest average speed for a 10 meter interval? Calculate this speed in m/s. **PSYW**
- What was his average speed (in m/s) for the overall race? **PSYW**

