# Section 8.2.
# Average Velocity.

Textbook pages 362 to 375.

## Before You Read.

Based on your current knowledge, how do you think speed differs from velocity?

## What is the difference between velocity and speed?

**Velocity** is a vector that describes how quickly an object's position changes, as well as the direction of this change. **Speed** is a scalar that measures the magnitude of velocity. Both speed and velocity are measured in metres per second.

Objects travelling at the same speed can have different velocities. Imagine two escalators travelling at the same speed, one going up, and the other down. Because they are travelling in opposite directions, one of the directions has a negative sign. Thus, they have different velocities.

## How is velocity determined on a position-time graph?

Velocity can be determined from the slope of a position-time graph. Where the graph shows a straight line, the velocity is constant. The slope is calculated as follows:

- Slope equals rise divided by run.
- Slope equals the displacement divided by the time interval.

The slope shows, on average, how far an object has moved in a certain time interval. In other words, the slope shows the object's average velocity. **Average velocity** is the rate of change in position over a time interval. It is almost impossible for an object to move at a perfectly uniform rate. Many factors, such as wind or an uneven surface, may cause the object to slightly speed up or slow down. Average velocity "smoothes out" these changes. It is a vector and includes direction. The slope of a position-time graph can be positive, zero, or negative.

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If moving away from the origin is considered positive:

- a positive slope represents the average velocity of the object moving away from the origin.
- a horizontal line, which has zero slope, represents an object at rest.
- a negative slope represents the average velocity of the object moving back toward the origin.

**How is average velocity calculated without using a position-time graph?**

Since average velocity is the slope of a position-time graph, it can be written as follows:

- Average velocity equals the displacement divided by the time interval.

By using this relationship, you can calculate the average velocity without analyzing a position-time graph.

Example: A sprinter takes eight point two seconds to run forward seventy five meters. What is the sprinter's average velocity?

- The displacement equals positive seventy five meters.
- The time interval equals eight point two seconds.
- The average velocity equals the displacement divided by the time interval.
- The average velocity equals  positive seventy five meters divided by eight point two seconds.
- The average velocity equals  positive nine point one meters per second.

Thus, the sprinter ran nine point one meters per second forward.

This equation can also be rearranged to calculate displacement or time.

- **For displacement**. : the displacement equals the average velocity multiplied by the time interval.
- **For time**. : the time equals the displacement divided by the average velocity.