Section 8.1.
The Language of Motion.

Textbook pages 344 to 361.

Before You Read.

What does the term “uniform” mean to you? If motion is uniform, how does it behave?

How is motion measured?

Motion involves a change in location. There are different ways of measuring motion. These can be placed in two categories:

1. Scalar quantity: A scalar quantity or **scalar** describes the size of a measurement or the amount (number) being counted, a factor known as *magnitude*. A scalar quantity has magnitude only. It does not include direction. Example: You walk four kilometers per hour.
2. Vector quantity: A vector quantity or **vector** has both magnitude and direction. Example: You walk four kilometers per hour, east.

The table below summarizes some of the measurements used to describe motion.

Distance.

- Measures the length of a path between two points.
- Scalar.
- Measured in meters or kilometers.
- For example, If you skateboard ten kilometers east of your home, you travelled a *distance* of ten kilometers.

Position.

- Measures a specific point relative to the point of origin.
- Vector.
- Measured in meters or kilometers.
- For example, If you skateboard ten kilometers east and return home in a straight line along the same route, your *position* upon returning is zero kilometers because you are back at your point of origin.

Next page.

Time.

- Measures when an event occurs.
- Scalar.
- Measured in seconds or hours.
- For example, You pass a fire hydrant two seconds after you leave your point of origin.

Time interval.

- Measures the duration of an event; final time minus the initial time.
- Scalar.
- Measured in seconds or hours.
- For example, You pass a fire hydrant two seconds after you leave your point of origin. Then, five seconds after you leave your point of origin, you pass a road sign. The *time interval* between these two events is three seconds.

Displacement.

- Measures the straight-line distance and direction from one point to another; final position minus the initial position.
- Vector.
- Measured in meters or kilometers.
- For example, At two seconds, you pass the fire hydrant two meters east of your point of origin. At five seconds, you pass the sign at seven meters east. Your *displacement* is five meters east during this three second time interval.

Why are signs important when using vectors?

Directions are designated as positive or negative when using vectors. North, east, up, and right are positive and south, west, down, and left are negative. If a skater traveled from nine meters east of a hydrant to five meters west of the hydrant, to calculate her displacement, nine meters east becomes positive nine meters and five meter west becomes negative five meters.

Since the negative sign represents west, the skater's displacement is fourteen meters west.

What is uniform motion and how is it represented?

An object in **uniform motion** travels equal displacements in equal time intervals. It does not change speed or direction. A **position-time graph** shows how an object's position changes over time, allowing its motion to be analyzed. These graphs have the following characteristics:

- Time is plotted on the horizontal axis (*x*-axis) and position is plotted on the vertical axis (*y*-axis).
- Uniform motion is shown as a straight line.
- Real motion is not perfectly uniform. It is useful to use a **best-fit line**, a smooth curve or straight line that most closely fits the general shape outlined by the points, to graph real motion.

Next page.

- Positions and times not given as data can be estimated by finding the location corresponding to a specific time and position on the best-fit line. The line can also be extended beyond the first and last points to indicate what might happen beyond the measured data.

What does the slope of a position-time graph tell you?

The **slope** of a graph refers to whether a line is horizontal or goes up or down at an angle. There are three types of slope on a position-time graph:

1. Positive slope. : A **positive slope** slants up to the right, indicating that an object's position, from the origin, is increasing with respect to time.

2. Zero slope. : **Zero slope** is a straight, horizontal line. It represents an object at rest.

3. Negative slope. : A **negative slope** slants down to the right, indicating an object is moving in a negative direction—left, down, west, or south.