

Kinematics

velocity

Kinematics

Kinematics = description of motion

- Fundamental quantities: Basic notions whose definitions we intuitively understand.

Length [m]

Mass [kg]

time [seconds]

- Derived quantities: Combinations of the fundamental ones.

Ex: Speed = distance/time = [m/s]

- Scalars: quantities having only magnitude and units. Magnitude is the number.

Ex: 50 m/s

- Vectors: Quantities having magnitude, units, and direction.

Ex: 50 m/s north

Vectors & Scalars

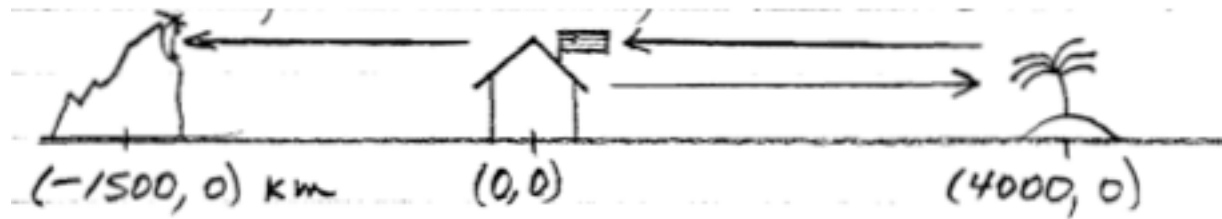
Scalars: distance, speed, pick up

Vectors: position, velocity, acceleration

Quantity	Meaning	+ or -	Units	Tool
Distance	Length of trip	+	[m]	Odometer
Position (s, x, or y)	Location on number line	+ or -	[m]	Map/graph
Displacement (Δx)	$\Delta x = x - x_0 =$ change in position	+ or -	[m]	Map/graph
Speed	How fast	+	[m/s]	Speedometer
Velocity (v)	How fast in a specific direction	+ or -	[m/s]	Speedometer & compass

Ex: We take a trip from Samo to Hawaii, back to Samo, then to Colorado.

Find the distance traveled, displacement, and final position.



Ex: Bob travels 6 m E, then 12 m S, then 4 m N.

What is his distance travelled?

His displacement?

Magnitude of displacement?

When does an object's distance traveled equal the magnitude of displacement?

Speed vs. Velocity

Average speed = distance/time [scalar]

$$\bar{s} = \frac{d}{\Delta t}$$

Average velocity = displacement/time [vector]

$$\bar{\mathbf{v}} = \frac{\Delta \mathbf{x}}{\Delta t}$$

Ex 1: Joe does 3 laps in 1 minute around a circular track ($r = 20$ m).

$$\bar{s} =$$

$$\bar{v} =$$

Ex 2: Now Joe starts at the southern most part of the track and runs 1.5 laps in 30 seconds.

$$\bar{s} =$$

$$\bar{v} =$$

Average vs. Instantaneous

\bar{v}

Average velocity is measured over a time interval.

v

Instantaneous velocity is the reading on the speedometer and compass right now.

$$\bar{v} = \frac{\Delta x}{\Delta t}$$

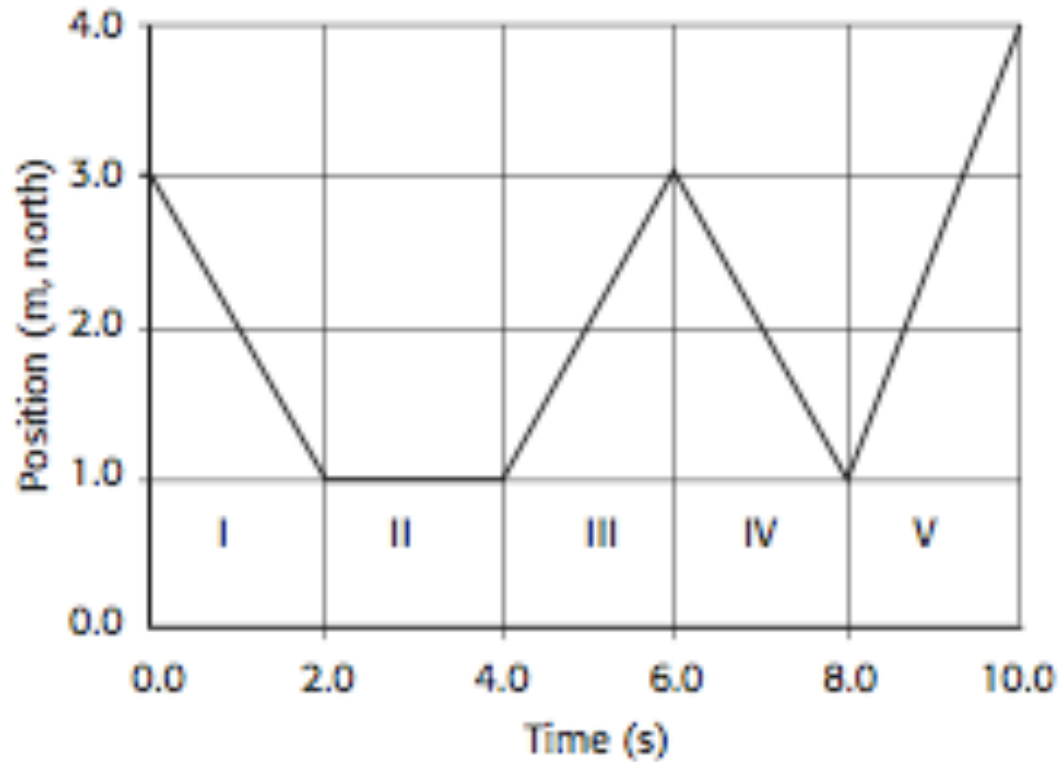
$$\Delta x = \bar{v} t$$

Ex: Sue drives 30 mph for 15 min. How far does she go?

Ex: Tim walks 56 ft east at 8 ft/s. He then pauses for 3 seconds. Finally, he walks west at 5 ft/s for 4 s. Find his average speed and average velocity.

Ex: Pat walks home from the store at 8 ft/s. He does the return trip at 6 ft/s. Find his average speed.

Position vs. Time Graphs



- What is the slope of this graph?
- What does this slope mean?