

Motion

Speed - How fast an object moves

The Formula for speed is

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Common units for speed include:

mph (miles per hour), km/hr, ft/sec, meters/sec

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Speed Example

Example - A car drives 100 meters in 10 seconds.
What is the speed?

$$s = \frac{d}{t} = \frac{100 \text{ m}}{10 \text{ s}} = 10 \text{ m/s}$$

v is also commonly used to represent speed.

$$v = \frac{d}{t}$$

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Manipulating the Equation

The equation for speed can be changed to find the time or distance.

Find Distance → Multiply both sides by t

$$v \cdot t = \frac{d \cdot x}{x} \quad \boxed{d = v \cdot t}$$

Find Time → Divide both sides by v

$$\frac{d}{v} = \frac{x \cdot t}{x} \quad \boxed{t = \frac{d}{v}}$$

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Distance vs. Displacement

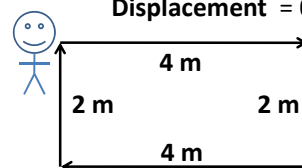
Distance – Total path traveled

Displacement – Change in position

Example: You travel completely around the block.

Distance = 12 m

Displacement = 0 m



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Speed vs. Velocity

Speed is a scalar – has magnitude (a number value)

Velocity is a vector – has magnitude and direction

$$\text{Speed} = \frac{\text{Distance Traveled}}{\text{Time of Travel}}$$

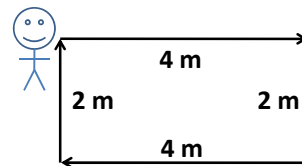
$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time of Travel}}$$

Displacement = Change in position

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Speed vs. Velocity

Example: You travel a distance of 12 meters in 24 seconds along the following path. What is your speed and your velocity?



$$\text{Speed} = \frac{12 \text{ m}}{24 \text{ s}} = 0.5 \text{ m/s} \quad \text{Velocity} = \frac{0 \text{ m}}{24 \text{ s}} = 0 \text{ m/s}$$

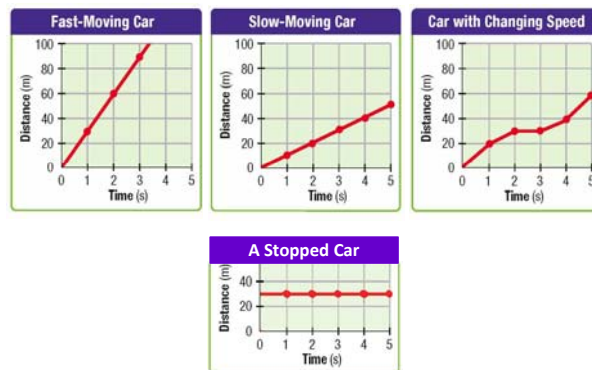
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Distance - Time Graph

- Distance: plotted on the vertical (y) axis
- time: plotted on the horizontal(x) axis
- The slope represents the speed
 - Constant speed is a straight line on the graph
 - Resting object: line is flat with 0 slope.
 - Steeper the line → greater the speed/velocity

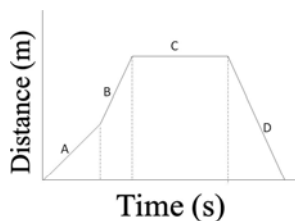
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Distance-Time Graphs



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Reading Distance - Time Graphs



- Moving at a constant medium speed
- Moving at a constant fast speed
- Standing Still
- Moving at a constant fast speed in a reverse direction

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Acceleration

Acceleration – A change in velocity over time

- This can be a change in speed
 - Ex. Speeding up or slowing down
- This can be a change in direction
 - Ex. Making a turn, even at constant speed
- You can “feel” when acceleration happens when a car changes speeds or makes sharp turns

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Acceleration

The common SI Units are m/s^2

- positive acceleration = increase in velocity
 - Ex. Hit gas pedal → increase speed
- negative acceleration = decrease in velocity (also called deceleration)
 - Ex. Hit break pedal → decrease speed

Faster speed change → greater acceleration

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Acceleration

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{time}}$$

$$a = \frac{\text{Final velocity} - \text{Initial velocity}}{\text{time}}$$

Formulas

$$a = \frac{\Delta v}{t} = \frac{v_f - v_i}{t}$$

Δ Means a change in something

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Motion Sign Conventions

	+	-
d	Forward/Up	Backward/Down
v	Move Forward	Move Reverse
a	Speeding Up	Slowing Down

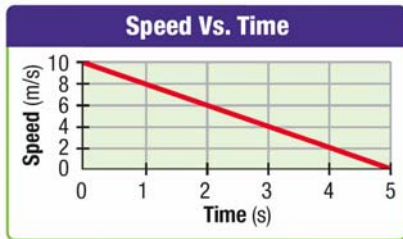
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Velocity - Time Graph

- Speed: plotted on the vertical (y) axis
- time: plotted on the horizontal(x) axis
- The slope represents the acceleration
 - Positive slope → Speeding up
 - Negative slope → Slowing down
 - line is flat with 0 slope → Constant speed
 - Steeper the line → greater the acceleration

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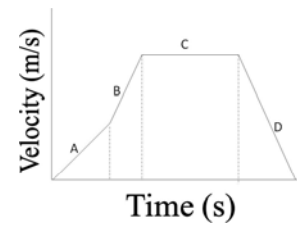
Velocity - Time Graph



The slope represents acceleration
This graph shows something slowing down

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Reading Velocity - Time Graphs



- Increasing speed
- Increasing speed more rapidly
- Constant Speed
- Slowing down rapidly

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