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Warm-Up | Acceleration

Lesson Question

Lesson Goals

Describe the concept of _____.

Solve _____ involving velocity, time, and acceleration.

Interpret _____ of velocity versus time.

Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

_____ acceleration

_____ negative acceleration

_____ positive acceleration

_____ velocity vs time graph

A. a graph that shows the relationship between the velocity of an object over time; time is plotted on the *x*-axis and the velocity of the object is plotted on the *y*-axis

B. a type of acceleration that describes the speeding up of an object

C. the rate of change of velocity

D. a type of acceleration that describes the slowing down of an object

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Speed

- _____ is a description of how fast or slow an object is moving.
- Speed depends on _____ and time.
  - For example, this plane is moving at 250 _____.

Velocity

- _____ is a description of how fast or slow an object is moving and in what _____.
- Velocity depends on _____ and time.
  - For example, this plane is moving at 250 meters/second, headed _____.

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Acceleration

- [ ] is the rate of change in velocity.
  - Involves a change in [ ] and [ ]

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Positive and Negative Acceleration

- When acceleration involves a change in speed only:
  - [ ] acceleration occurs when an object speeds up.
  - [ ] acceleration occurs when an object slows down.

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Acceleration

- Acceleration is a change of velocity over a period of [ ], expressed by the equation below.

$$a = \frac{\Delta v}{t}$$

$$a = \frac{m/s - m/s}{s}$$

$$= \frac{m/s}{s} = m/s^2$$

  - Acceleration is equal to the change in [ ] in meters per second every second.
  - Change in velocity is determined by subtracting the [ ] velocity (the starting velocity) from the final velocity (ending velocity).
  - To get acceleration, you divide change in velocity by [ ].
  - The unit for acceleration is [ ], which is usually written as m/s^2.

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Positive Acceleration of a Car: Example

A race car moving west speeds up from 17 m/s to 47 m/s in 2 seconds. What is the car's [ ]?

- Given:
  - $v_i =$ [ ] m/s
  - $v_f =$ [ ] m/s
  - $t =$ [ ] s
- Unknown: a
- Equation to use: $a = \frac{\Delta v}{t}$

$$a = \frac{v_f - v_i}{t} = \frac{47\ m/s - 17\ m/s}{2s} = \frac{30\ m/s}{2s} = [\ ]$$

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Negative Acceleration of a Car: Example

- Given:
  - $v_i =$ [ ] m/s
  - $v_f =$ [ ] m/s
  - $t =$ [ ] s
- Unknown: a
- Equation to use: $a = \frac{\Delta v}{t}$

$$a = \frac{v_f - v_i}{t} = \frac{32\ m/s - 47\ m/s}{3s} = \frac{-15\ m/s}{3s} = [\ ]$$

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Final Velocity of a Car: Example

Suppose the same car had at one point an acceleration of 12 m/s^2 and an initial velocity of 8 m/s. After 2 seconds, what would be the car's final [ ]?

- Given:
  - $a =$ [ ] m/s^2
  - $v_i =$ [ ] m/s
  - $t =$ [ ] s
- Unknown: v_f
- Equation to use: $v_f = at + v_i$
  - $v_f = at + vi = (12\ \text{m/s}^2)(2s) + 8\ \text{m/s} = 24\ \text{m/s} + 8\ \text{m/s} =$ [ ]

Velocity and Time Equations

- The [ ] equation can be rearranged or manipulated to get velocity and time.

$t = \frac{\Delta v}{a}$

$v_f = v_i + at$

$v_i = v_f - at$

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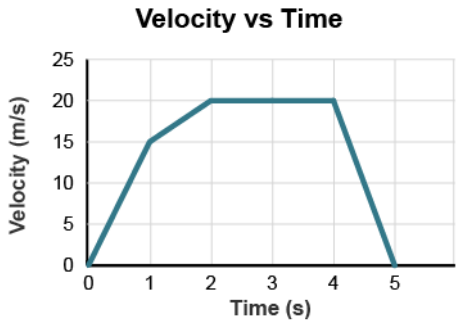
Velocity vs Time Graphs

- A velocity vs time graph shows how [ ] changes over time.
  - Time is plotted on the [ ]-axis.
  - Velocity is plotted on the [ ]-axis.



Time (s) x-axis	Velocity (m/s) y-axis
0	0
1	15
2	20
3	20
4	20
5	0

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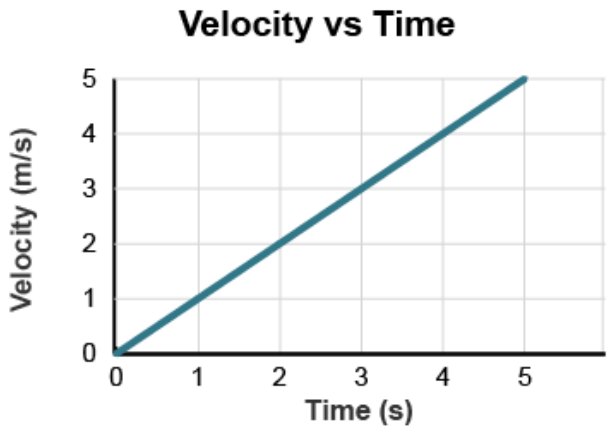
Velocity vs Time Graphs with a Positive Slope

- A line with a positive slope represents [ ] velocity as a result of speeding up.
  - The object is accelerating with a [ ] acceleration.



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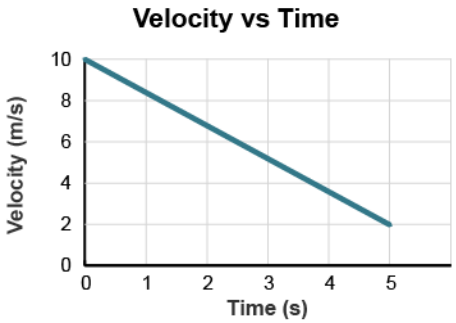
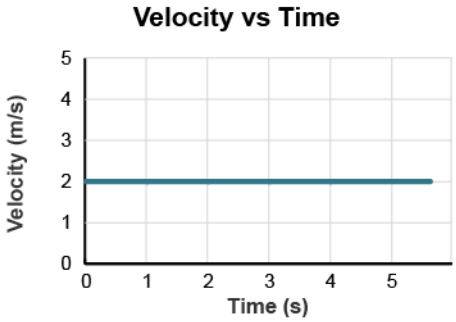
Velocity vs Time Graphs with a Negative Slope

- A line with a negative slope represents [ ] velocity as a result of slowing down.
  - The object is accelerating with a [ ] acceleration.



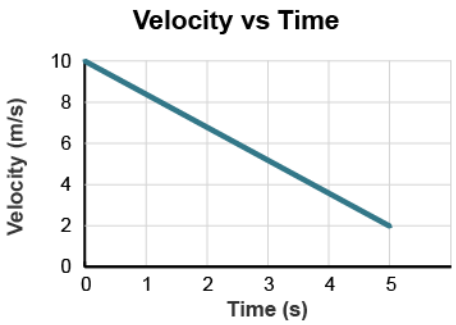
Velocity vs Time Graphs with No Slope

- A horizontal line has no [ ] and represents no change in velocity.
  - The object is [ ] accelerating.
  - The object is traveling at a [ ] velocity.



Initial Velocity

- The *y*-intercept represents the [ ] velocity.
  - The initial velocity of graph is [ ].



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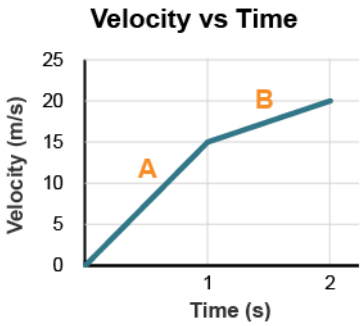
Velocity vs Time Graphs and Acceleration

- The slope of the line on a velocity vs time graph represents [ ].
- The equation for calculating [ ] is:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$



- The slope of segment [ ] is:

$$m = \frac{15\,\frac{m}{s} - 0\,\frac{m}{s}}{1\,s - 0\,s} = \frac{15\,\frac{m}{s}}{1\,s} = 15\,m/s^2$$

- The steeper the slope, the [ ] the acceleration.

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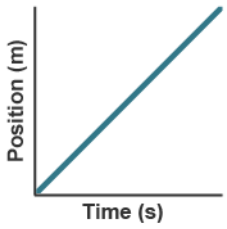
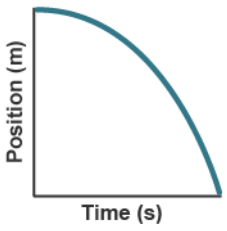
Position vs Time Graphs

- Whether or not an object is accelerating can also be determined from the [ ] of a position vs time graph.
  - Straight lines on a position vs time graph show constant [ ]; therefore, the object is not accelerating.





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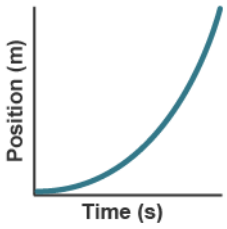
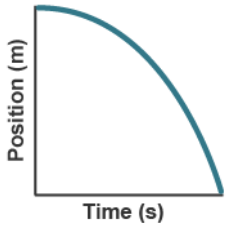
Position vs Time Graphs and Acceleration

- A curved position vs time graph indicates [ ].





- A line curving upward to the right shows increasing velocity; therefore, the object has [ ] acceleration.
- A line curving downward to the right shows movement in the negative direction with a negative velocity; therefore, the object has [ ] acceleration.

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Lesson Question

What is acceleration?

Answer

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Review: Key Concepts

- Acceleration is the rate of change in [ ].
  - Acceleration involves a change in speed, direction, or [ ].
- Acceleration can be calculated using the equation:

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

- Which can be [ ] to solve for:

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

$$v_f = v_i + at$$

$$v_i = v_f - at$$

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- Velocity vs time graphs can be used to represent and calculate [ ].
  - Positive slopes indicate positive acceleration, or [ ].
  - Negative slopes indicate negative acceleration, or [ ].
  - Horizontal lines indicate no acceleration, or a [ ].
- Position vs [ ] graphs can also show acceleration.
  - [ ] lines indicate no acceleration.
  - [ ] lines indicate acceleration.

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Use this space to write any questions or thoughts about this lesson.

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