

Position-Time and Velocity-Time Graphs

Questions for Consideration

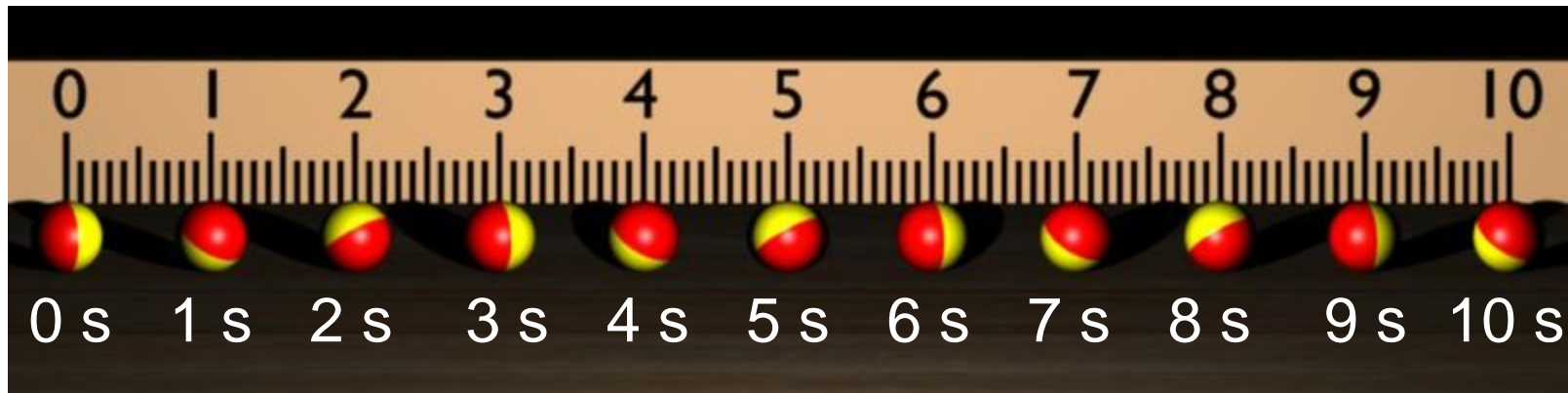
- What is a position-time graph?
- What is a velocity-time graph?
- How do features on one graph translate into features on the other?

Distance-Time Graphs

- Show an object's position as a function of time.
 - x-axis: time
 - y-axis: distance

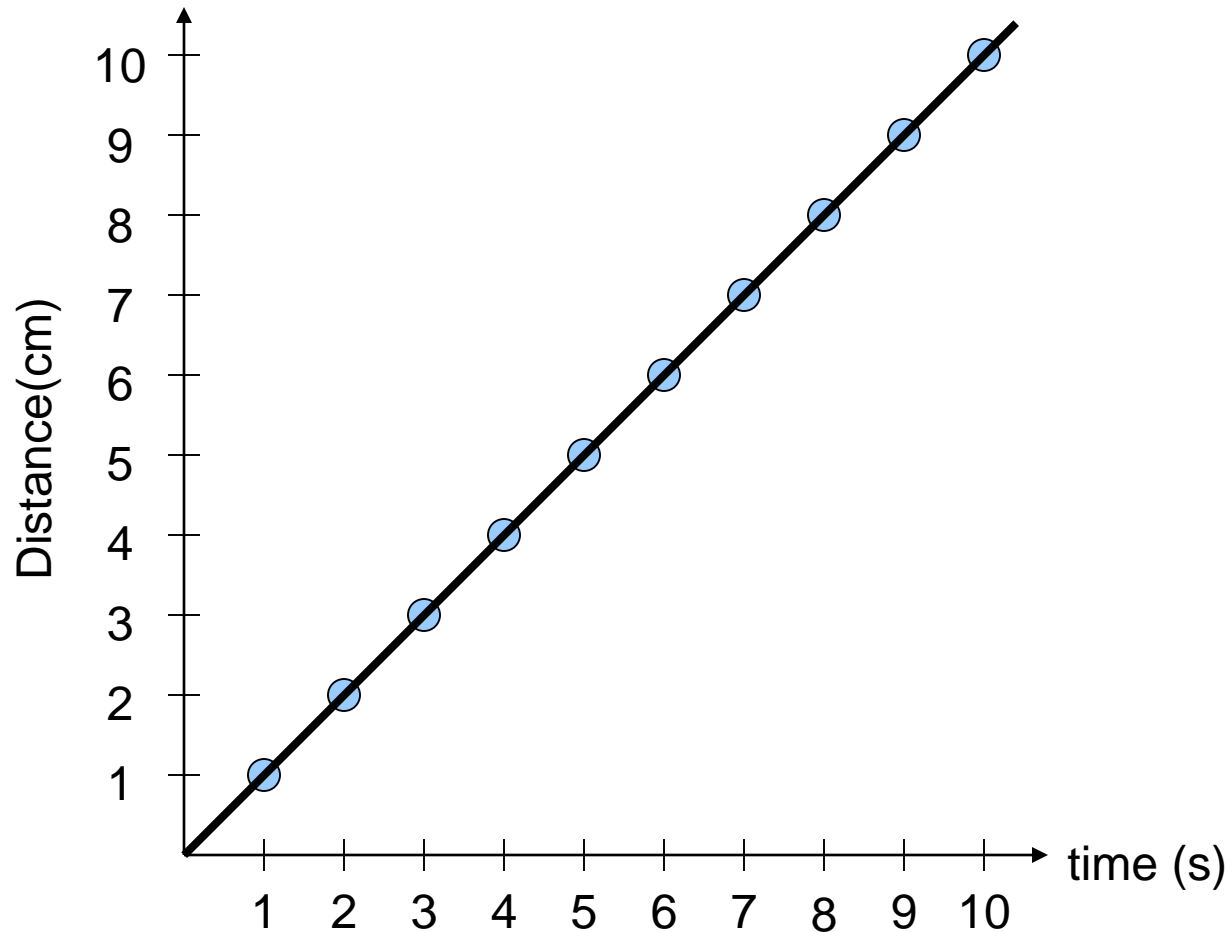
Distance-Time Graphs

- Imagine a ball rolling along a table, illuminated by a strobe light every second.



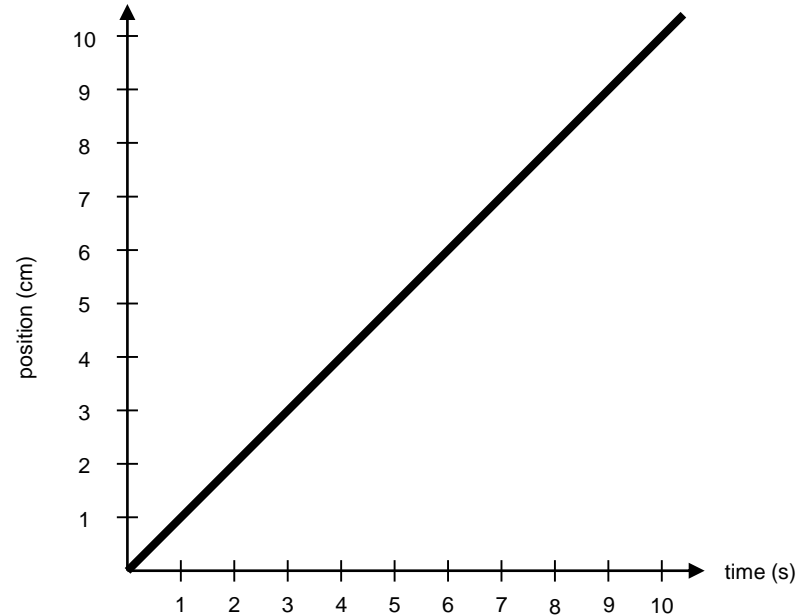
- You can plot the ball's position as a function of time.

Distance-Time Graphs



Distance-Time Graphs

- What are the characteristics of this graph?
 - Straight line, upward slope
- What kind of motion created this graph?
 - Constant speed

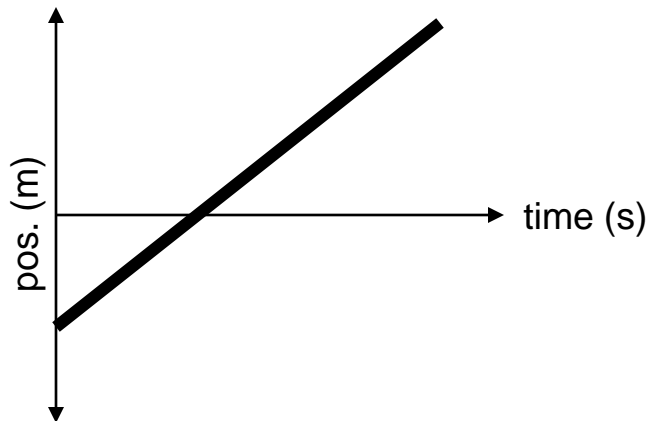


Distance-Time Graphs

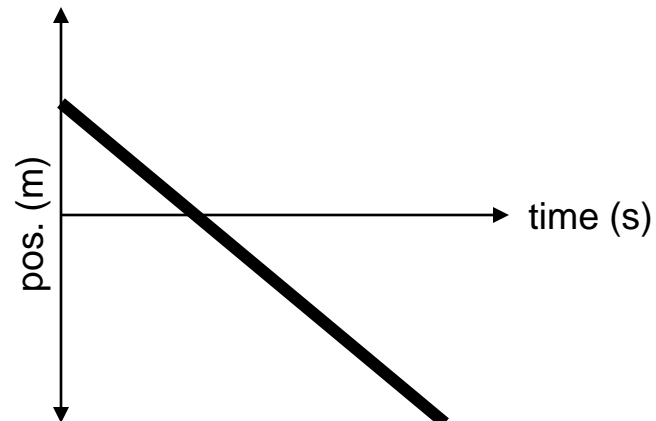
- Each type of motion has a characteristic shape on a D-T graph.
 - Constant speed
 - Zero speed (at rest)
 - Accelerating (speeding up)
 - Decelerating (slowing down)

Distance-Time Graphs

- Constant speed is represented by a straight segment on the D-T graph.



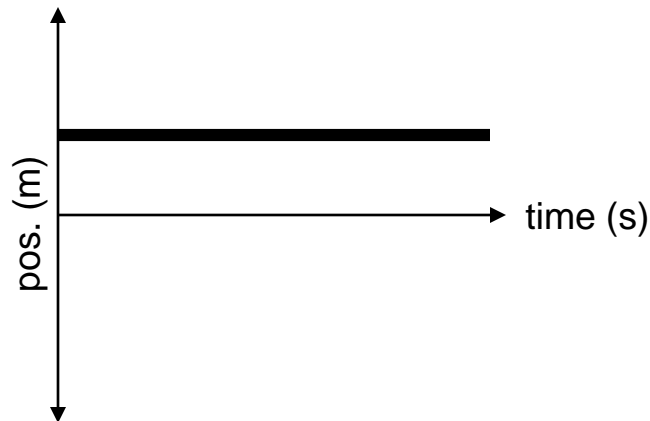
Constant speed in positive direction.



Constant speed in negative direction.

Distance-Time Graphs

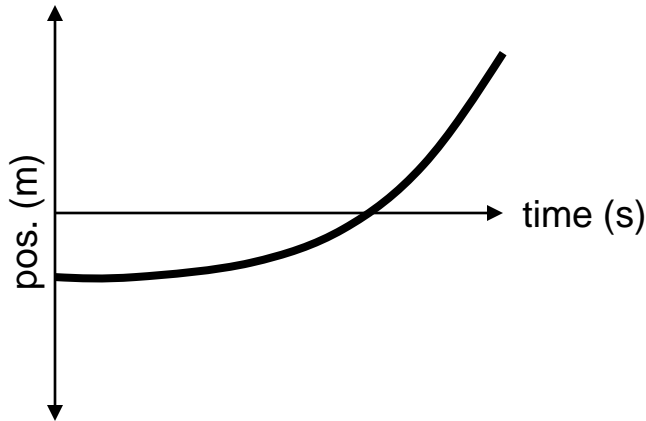
- Constant speed is represented by a straight segment on the D-T graph.



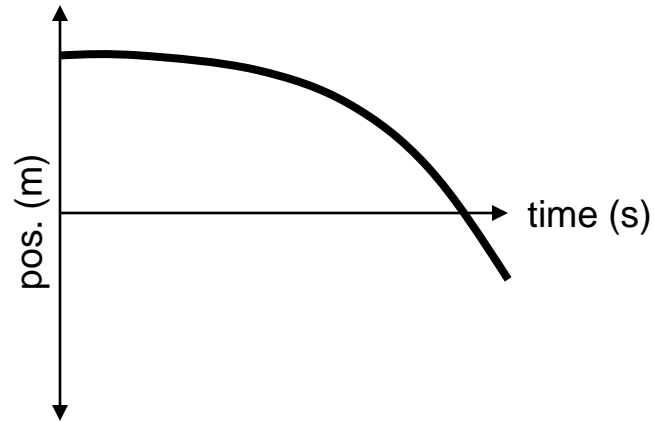
A horizontal segment means the object is at rest.

Distance-Time Graphs

- Curved segments on the D-T graph mean the object's speed is changing.



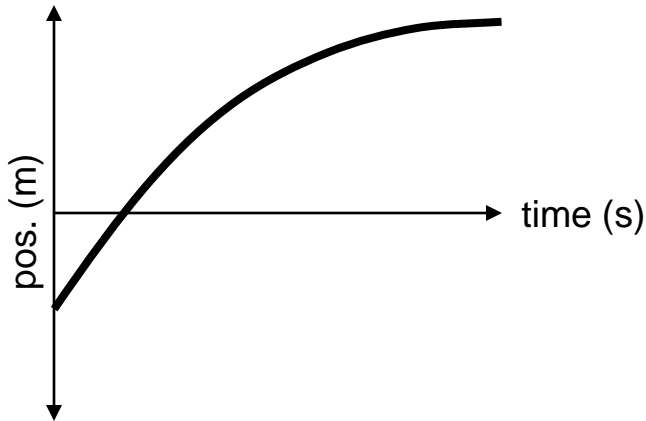
Speeding up in positive direction.



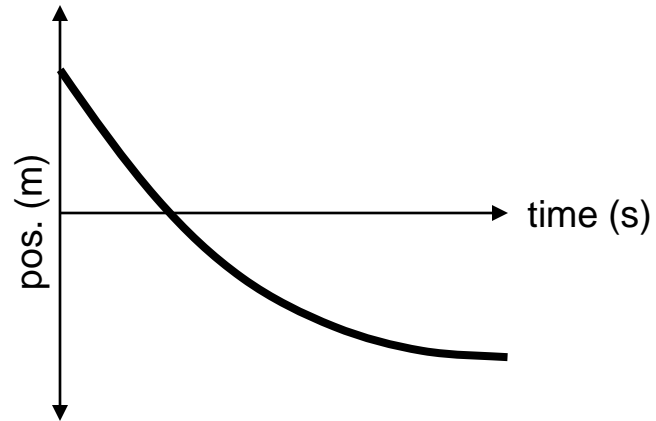
Speeding up in negative direction.

Distance-Time Graphs

- Curved segments on the D-T graph mean the object's speed is changing.



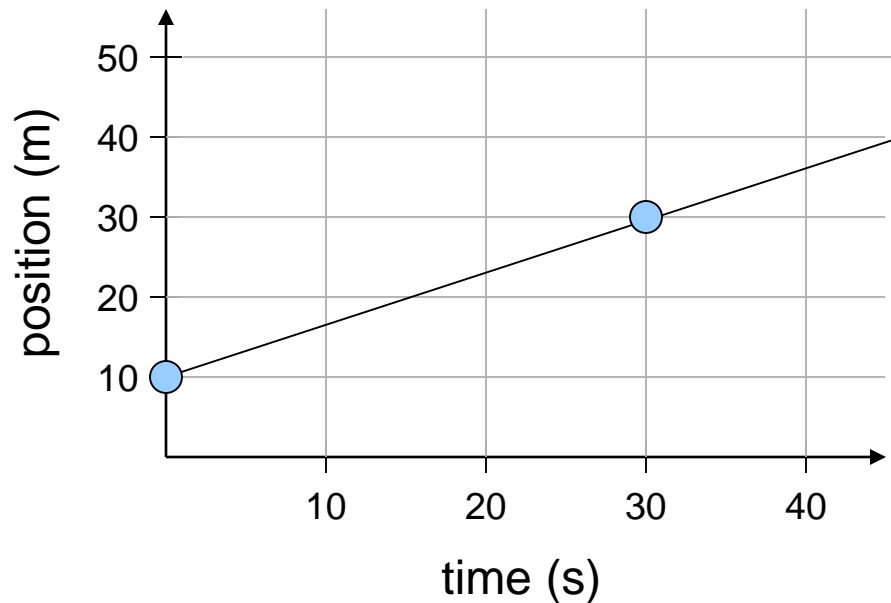
Traveling in positive direction, but slowing down.



Traveling in negative direction, but slowing down.

Distance-Time Graphs

- The slope of a D-T graph is equal to the object's velocity in that segment.



$$\text{slope} = \frac{\text{change in } y}{\text{change in } x}$$

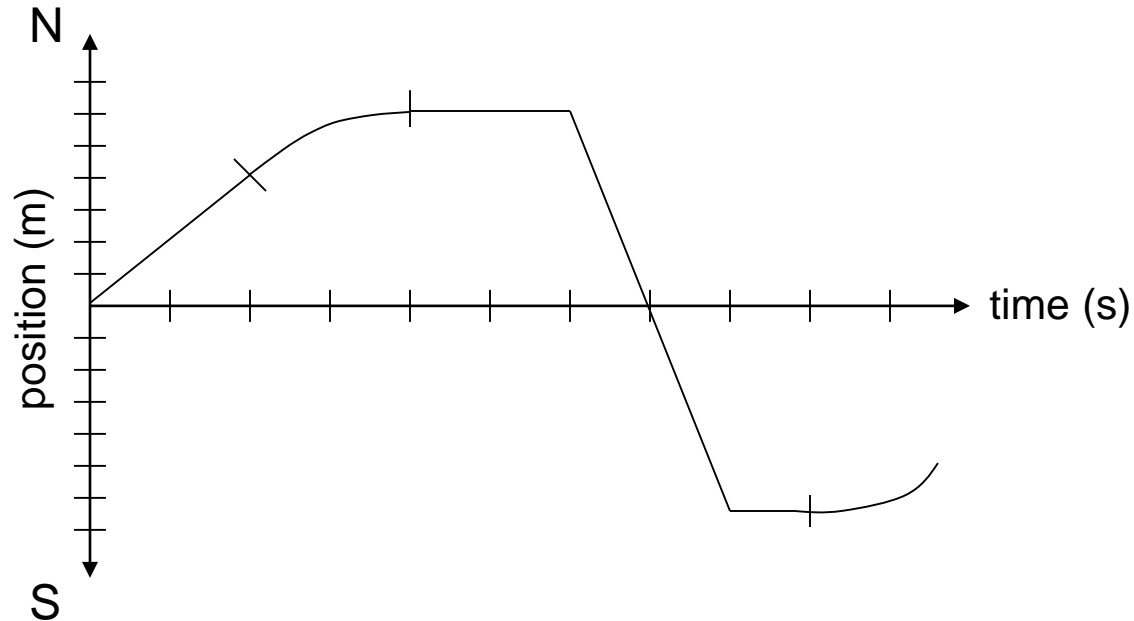
$$\text{slope} = \frac{(30 \text{ m} - 10 \text{ m})}{(30 \text{ s} - 0 \text{ s})}$$

$$\text{slope} = \frac{(20 \text{ m})}{(30 \text{ s})}$$

$$\text{slope} = 0.67 \text{ m/s}$$

Distance-Time Graphs

- The following D-T graph corresponds to an object moving back and forth along a straight path. Can you describe its movement based on the graph?

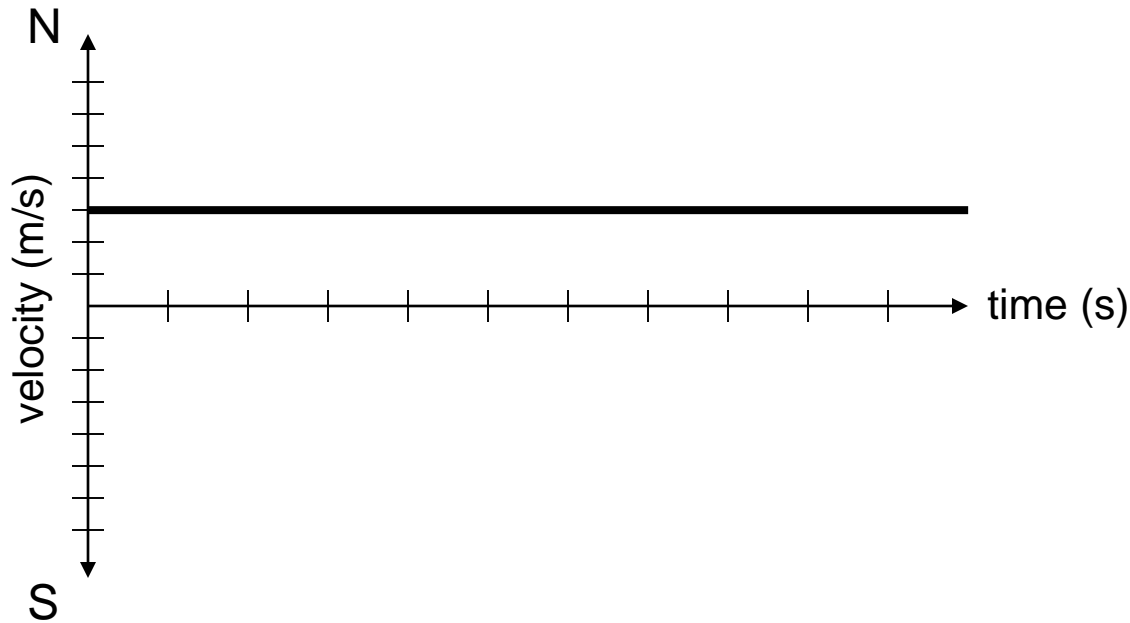


Velocity-Time Graphs

- A velocity-time (V-T) graph shows an object's velocity as a function of time.
 - A horizontal line = constant velocity.
 - A straight sloped line = constant acceleration.
 - Acceleration = change in velocity over time.
 - Positive slope = positive acceleration.
 - Not necessarily speeding up!
 - Negative slope = negative acceleration.
 - Not necessarily slowing down!

Velocity-Time Graphs

- A horizontal line on the V-T graph means constant velocity.



Object is moving at a constant velocity North.

Velocity-Time Graphs

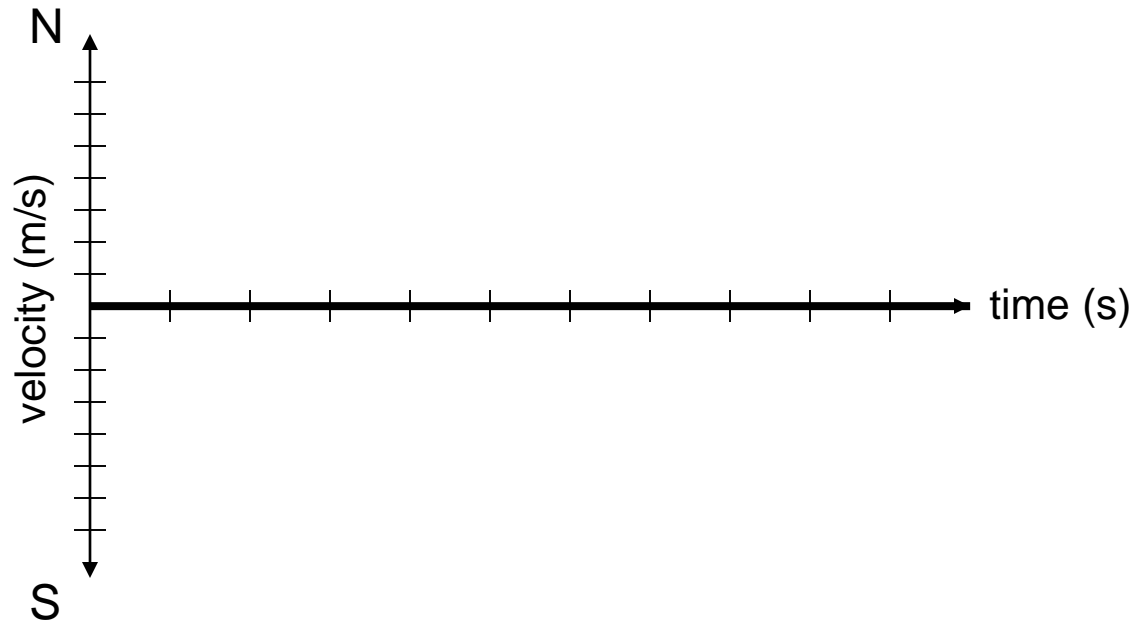
- A horizontal line on the V-T graph means constant velocity.



Object is moving at a constant velocity South.

Velocity-Time Graphs

- If an object isn't moving, its velocity is zero.



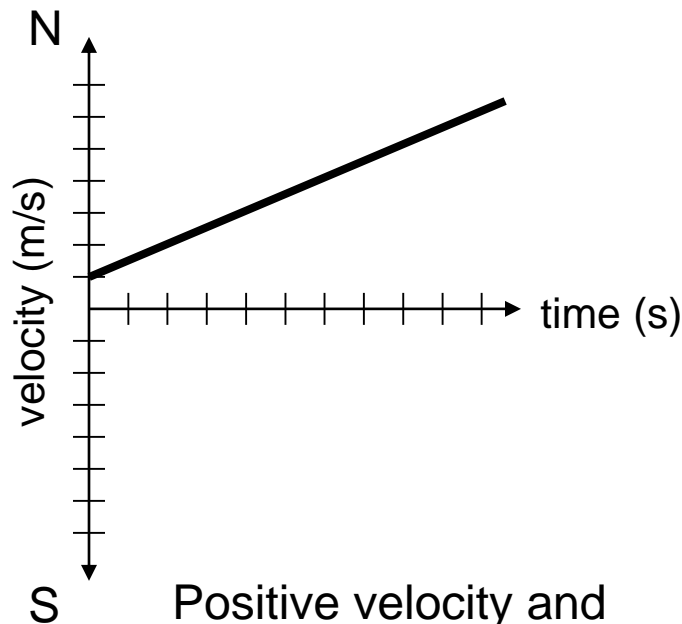
Object is at rest

Velocity-Time Graphs

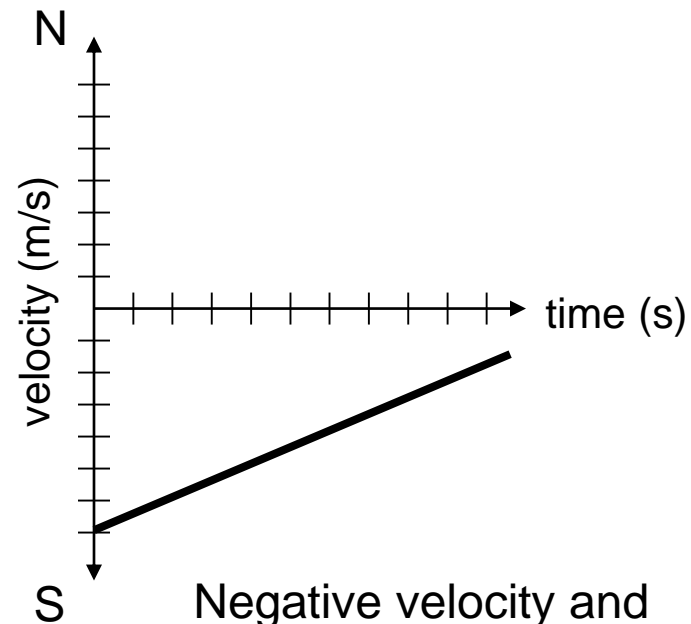
- If the V-T line has a positive slope, the object is undergoing acceleration in positive direction.
 - If v is positive also, object is speeding up.
 - If v is negative, object is slowing down.

Velocity-Time Graphs

- V-T graph has positive slope.



Positive velocity and positive acceleration: object is speeding up!



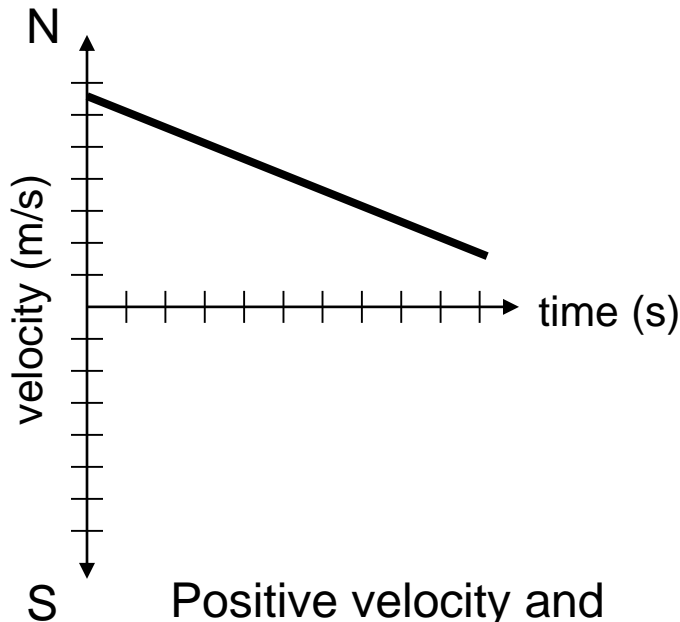
Negative velocity and positive acceleration: object is slowing down.

Velocity-Time Graphs

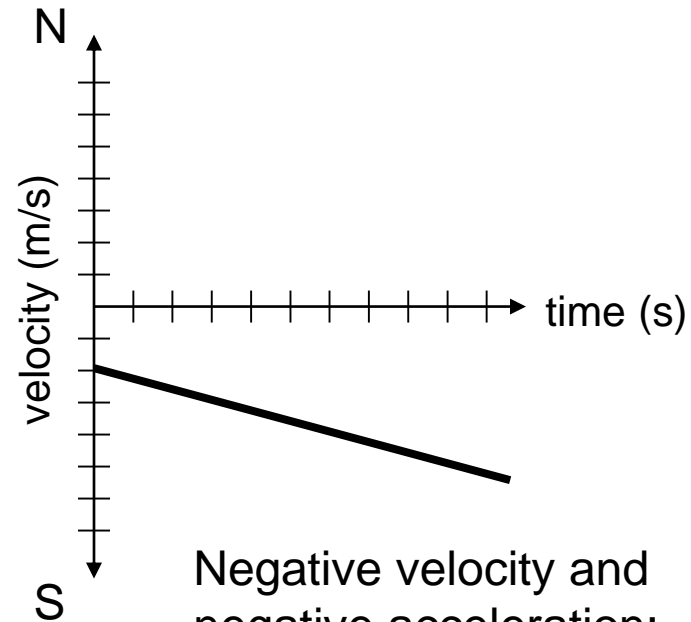
- If the V-T line has a negative slope, the object is undergoing acceleration in the negative direction.
 - If v is positive, the object is slowing down.
 - If v is negative also, the object is speeding up.

Velocity-Time Graphs

- V-T graph has negative slope.



Positive velocity and negative acceleration: object is slowing down,



Negative velocity and negative acceleration: object is speeding up! (in negative direction)