- **<u>Cartoon:</u> Jim Davis** ***Garfield***

Announcements

- Correction problem due now!
- Midsemester survey up on LON-CAPA in Ch7 reading questions folder
  - 10 questions, please take some time over the next week to fill it out
- Ch 7 reading questions due on Sunday
- Teaching experiment! Uploading solved problems (extensions of clicker questions in class) on LBC Physics You Tube Channel

The Pasco Motion Sensor

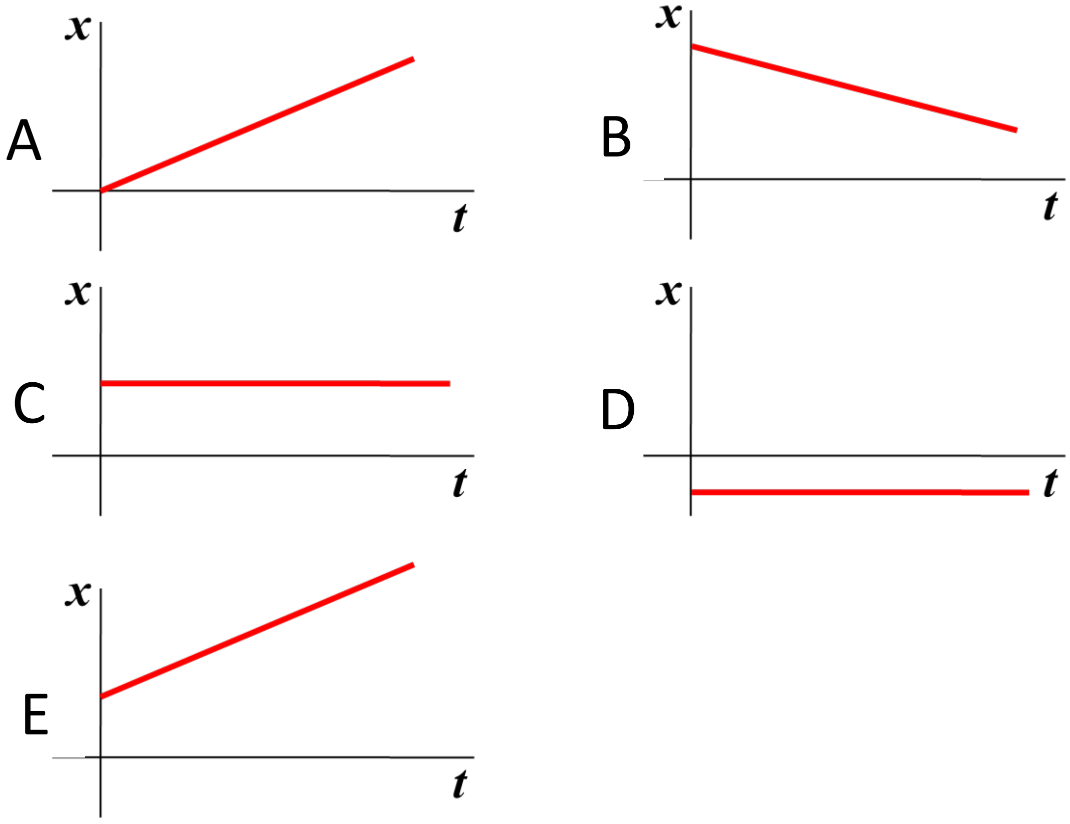
- The sonic ranger measures distance to the nearest object by echolocation.
  - A speaker clicks 30 times a second.
    A microphone detects the sound bouncing back from the nearest object in front of it.
  - The computer calculates the time delay between and using the speed of sound
    (about 343 m/s at room temperature)
    it can calculate the distance to the object.

Making predictions

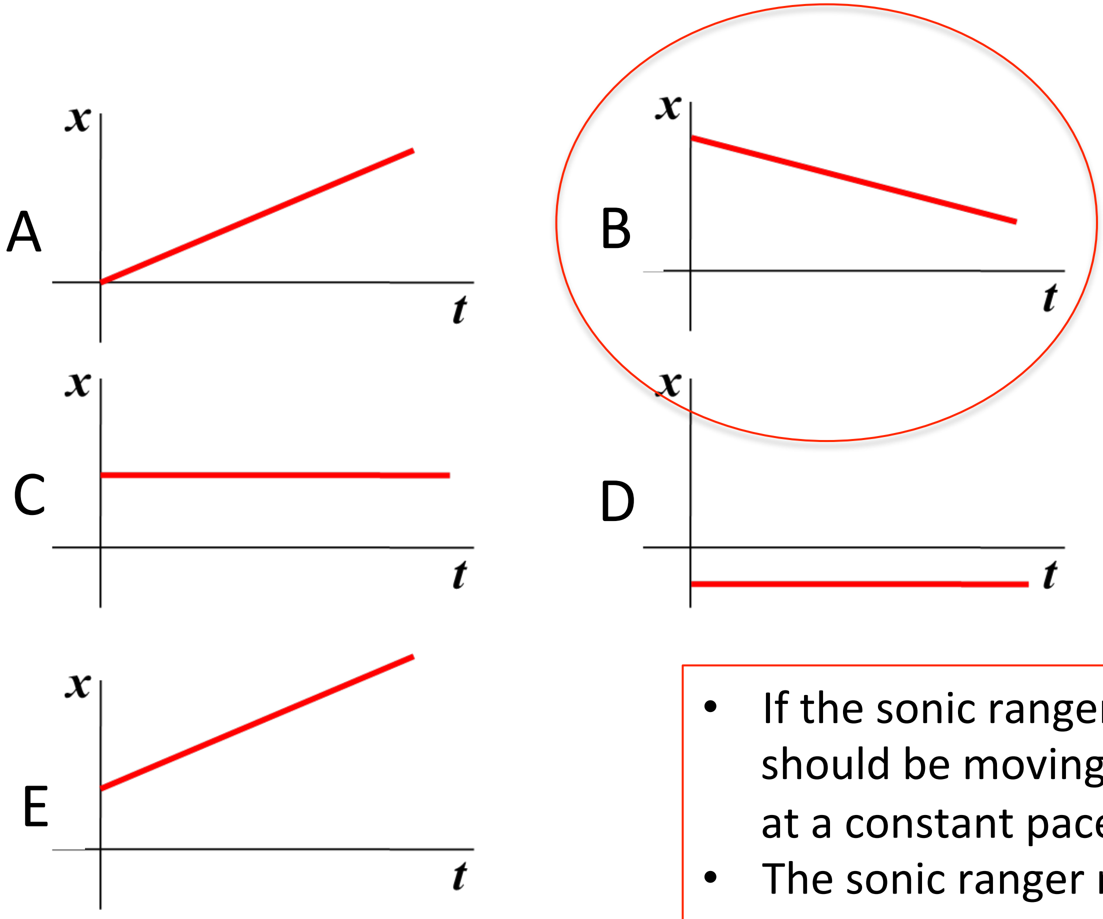
- If I place a motion sensor at the left side of the room and you walk slowly towards it at almost a constant velocity what will the **position** graph look like?

Generate the graph on your whiteboard.

Which is the correct graph?

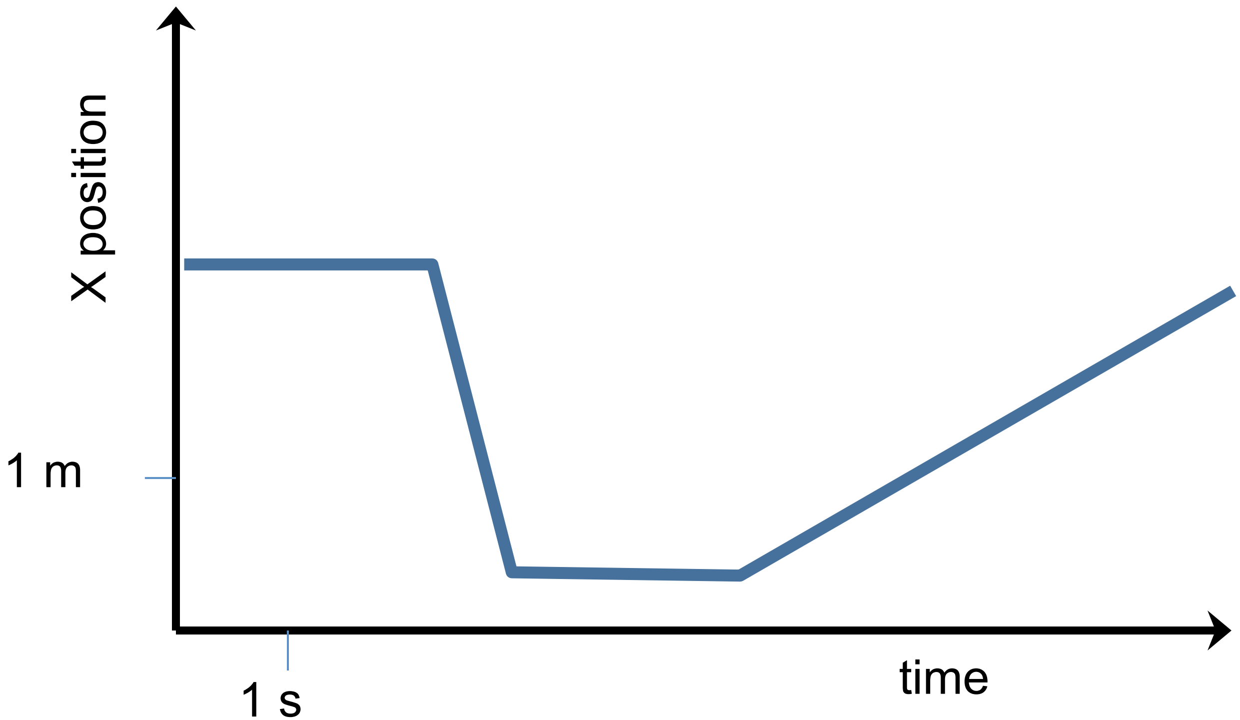


Which is the correct graph?



- If the sonic ranger is the origin, we should be moving toward the origin at a constant pace.
- The sonic ranger measures distance from it, so as I get closer that distance decreases.

Describe in your own words the motion captured in this position vs time graph



Velocity: Change in position

- Velocity is the rate of change of position
- Average velocity

  = (how far did you go?)/(how long did it take you?)

$$\langle v \rangle = \frac{\Delta x}{\Delta t}$$

- Instantaneous velocity = same (but for short Δt)

$$v = \frac{dx}{dt}$$

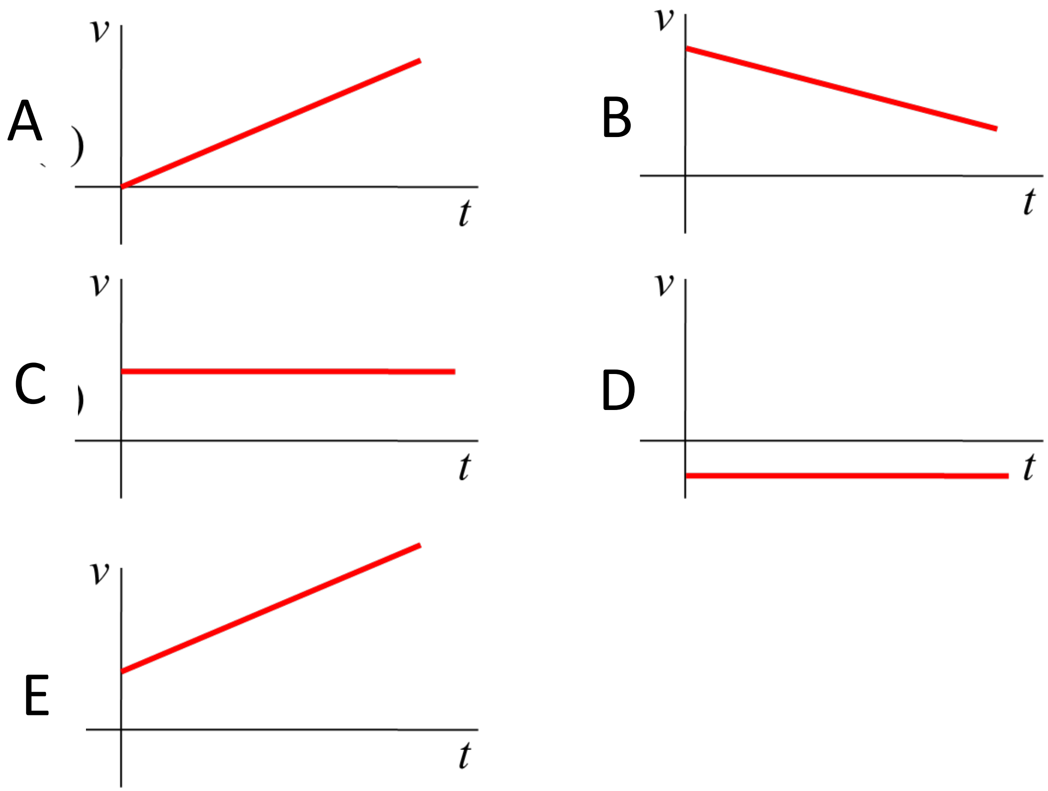
Also tells us that the instantaneous velocity is the slope of the position graph at that point in time.

Making predictions

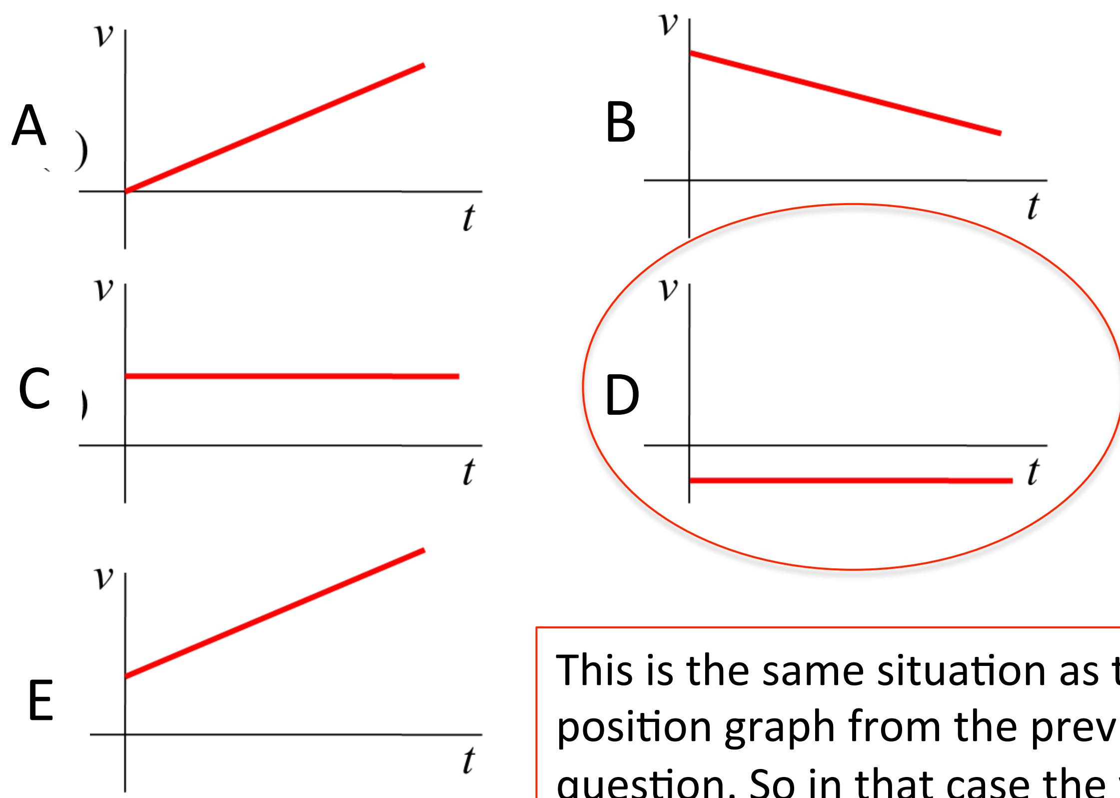
- If I place the sonic ranger at the left side of the room and you walk slowly towards it at almost a constant velocity what will the **velocity** graph look like?

Generate the graph on your whiteboard.

Which represents the correct velocity graph?



Which represents the correct velocity graph?

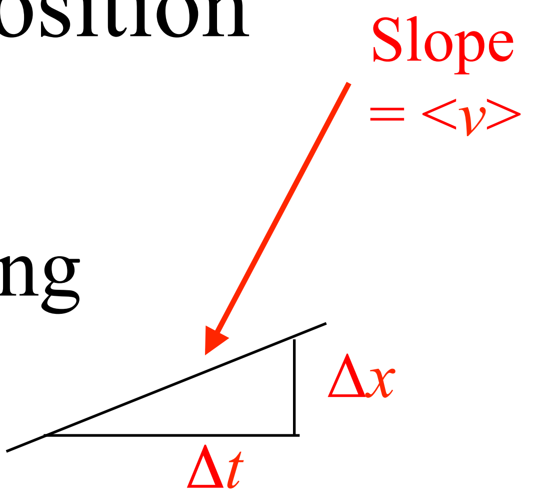


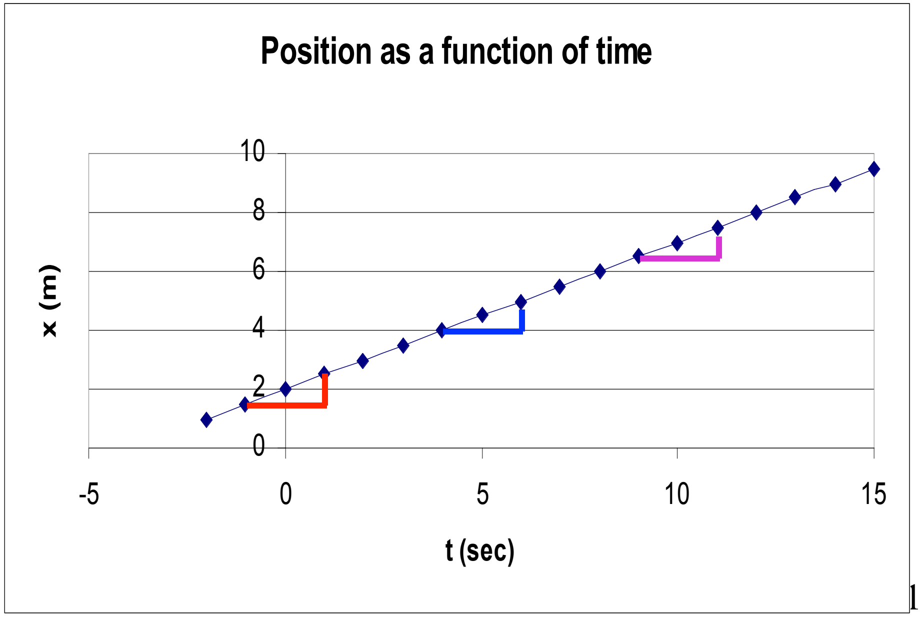
This is the same situation as the position graph from the previous question. So in that case the velocity is constant, but it's moving in the negative direction.

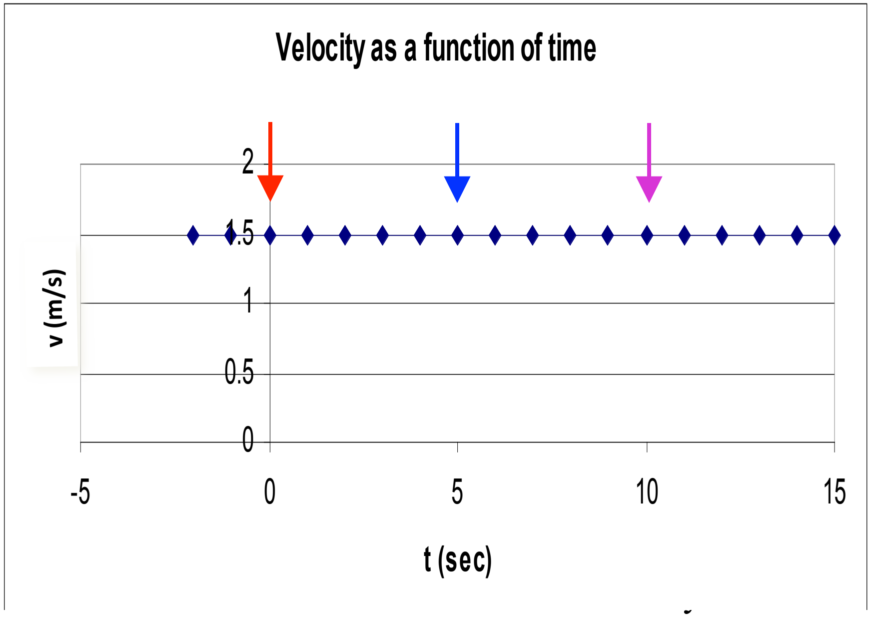
Graphing velocity: Figuring it out from the position

- You can figure out the velocity graph from the position graph using

$$\langle v \rangle = \frac{\Delta x}{\Delta t} \qquad \Delta x = \langle v \rangle \Delta t$$



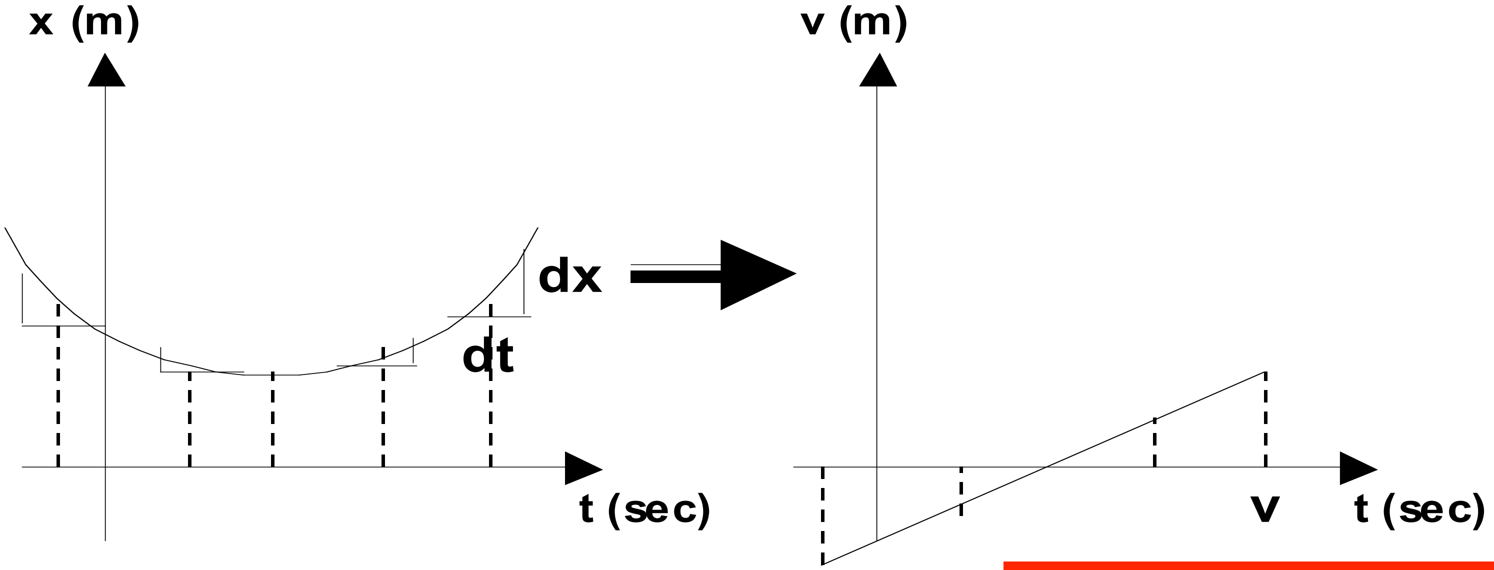




Graphing Velocity: Figuring it out from the motion

- An object in uniform motion
  has constant velocity.
- This means the instantaneous velocity
  does not change with time.
  Its graph is a horizontal line.
- You can make sense of this by
  putting your mind in "velocity mode"
  and running a mental movie.

Position to velocity

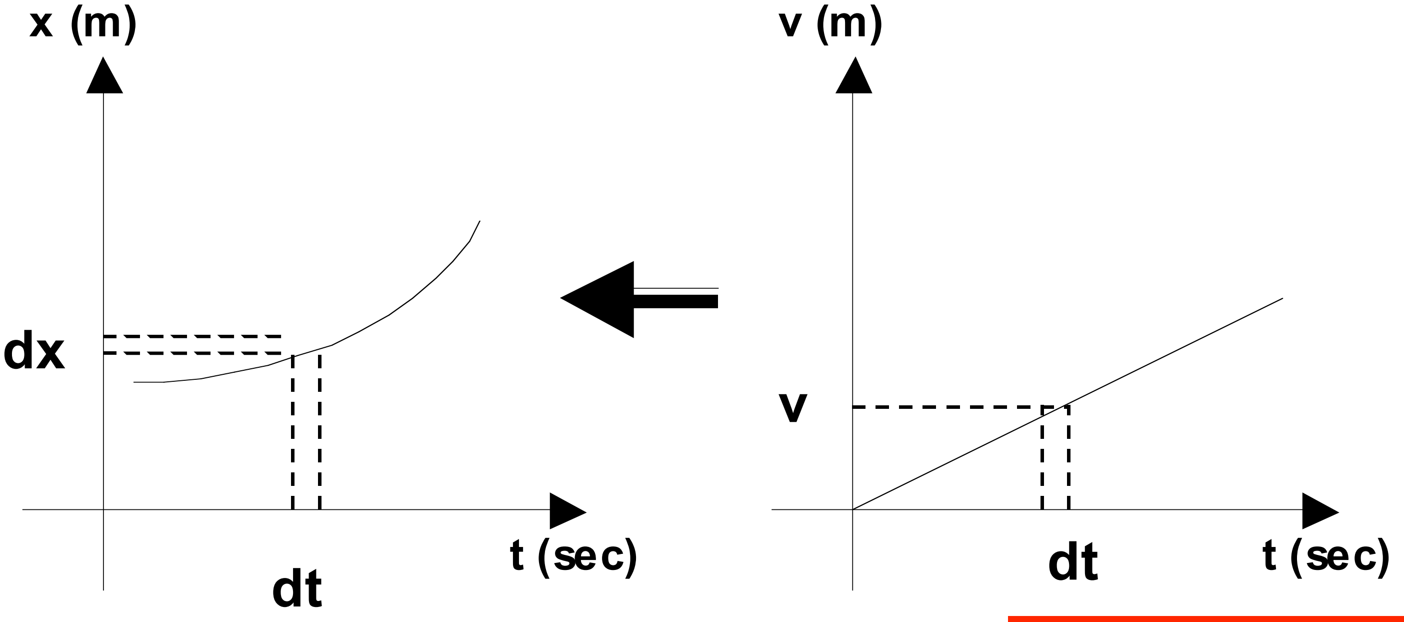


$$v(t) = \frac{dx}{dt}$$

Ratio of change in position that takes place in the (small) time interval

Difference of two positions at two (close) times

Velocity to position



$$dx = v(t)\ dt$$

change in position that takes place in a small time interval

sum ("Σ") in the changes in position over many small time intervals

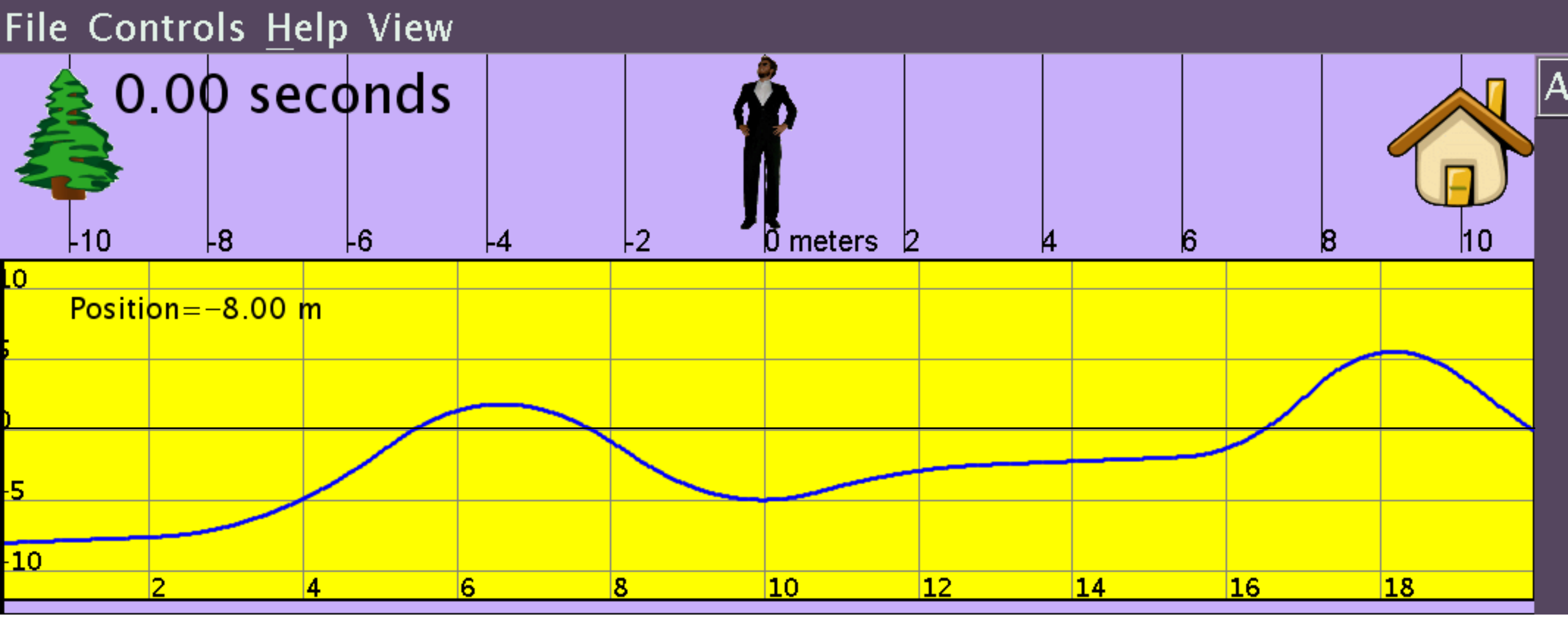
What have we learned?
Representations and consistency

- Visualizing where an object is at different times → a position graph
- Visualizing how fast & what direction an object is moving → a velocity graph
- Position graph → velocity graph

  slopes $v = \dfrac{\Delta x}{\Delta t}$

- Velocity graph → position graph

  areas $\Delta x = v\,\Delta t$



How many times does the man's speed go to zero?

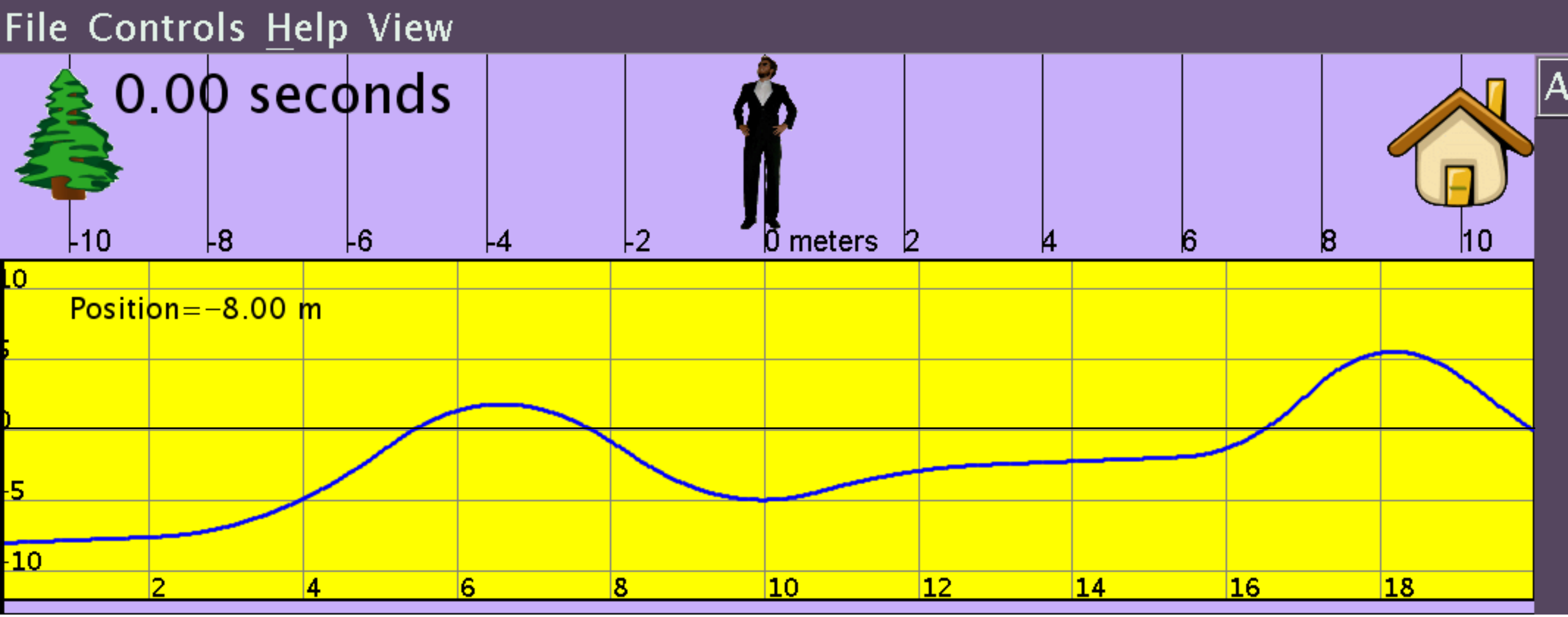
a. Never

b. Once

c. Twice

d. Three times

e. Four times



How many times does the man's speed go to zero?

a. Never
b. Once
c. Twice
d. Three times
e. Four times

There are three "peaks" in this graph, or points where the tangent line to the curve has a slope of zero. So the speed goes to zero three times.

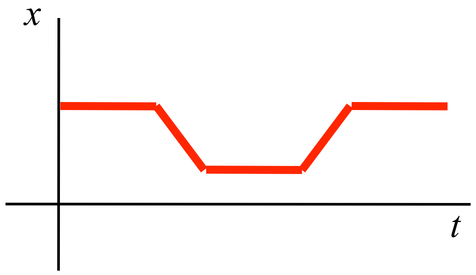
Example

Hint! Describe in words what is happening first!

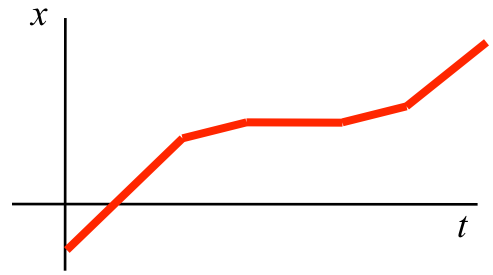
A ball rolls is rolling at a constant speed along a horizontal track as shown.
It comes to a hill and has enough speed to get over it. By thinking about its speed as it goes, sketch a graph of the position of the ball as a function of time. (ignore friction)

Which graph best describes the motion?

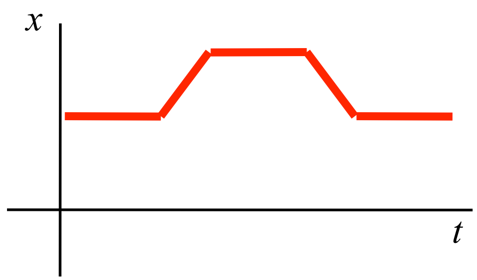
A



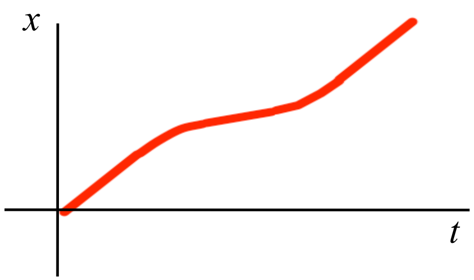
B



C



D



E