June 4, Week 1

Physics 151, Dr. Mark Morgan-Tracy

Today: Chapter 2, Motion Graphs

Please Register your Clicker.

Homework Assignment #1 - Available on class webpage, Due this Friday, June 6.

S. I. Units

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  - Unit of length = meter (m)
  - Unit of mass = kilogram (kg)
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Which of the following correctly lists these distances from smallest to largest?

(c)	$6000\,\mu m$,	$3\,m$,	$500\,cm$

$$6000\,\mu m = 6000\,(10^{-6})\ m = 6 \times 10^{3}\,(10^{-6})\ m = 6 \times 10^{-3}\,m = 0.006\,m$$

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$$500\,cm = 500\left(10^{-2}\right)\,m = 5 \times 10^{2}\left(10^{-2}\right)\,m = 5\,m$$

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- When adding or subtracting, we round to the fewest places past the decimal point.

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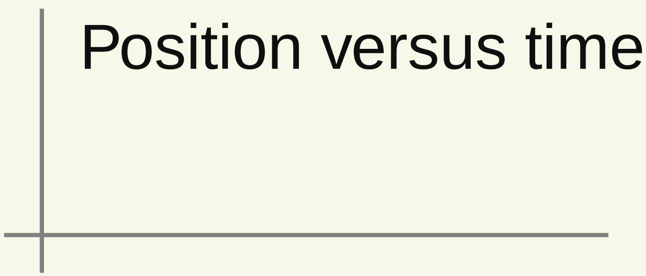

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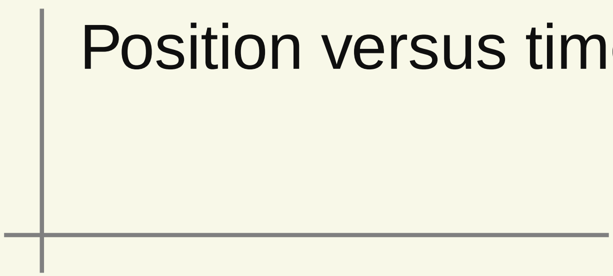

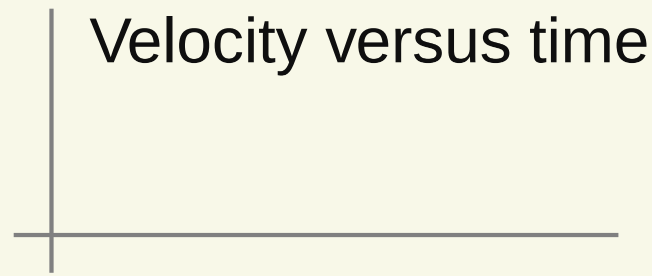

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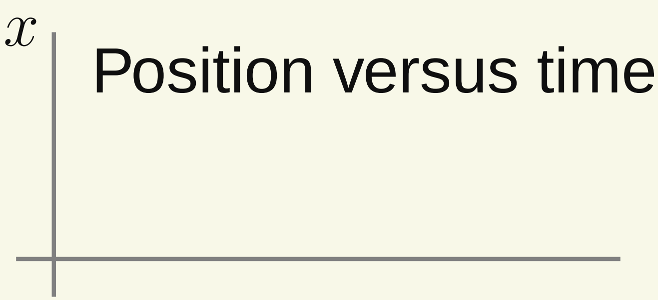

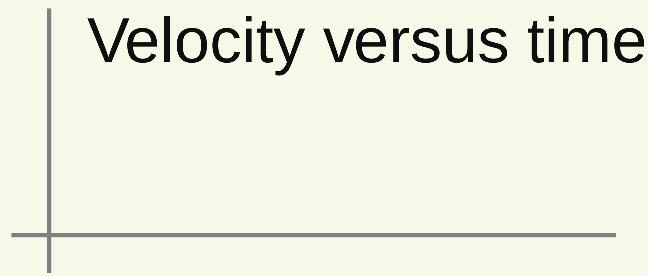

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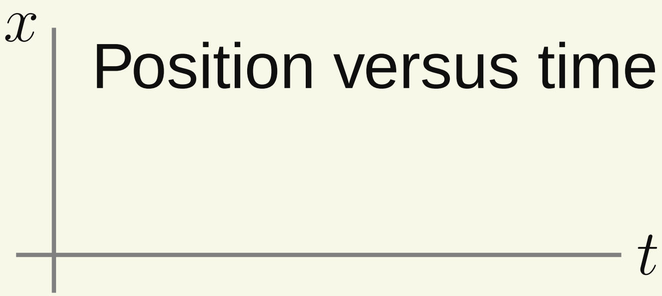

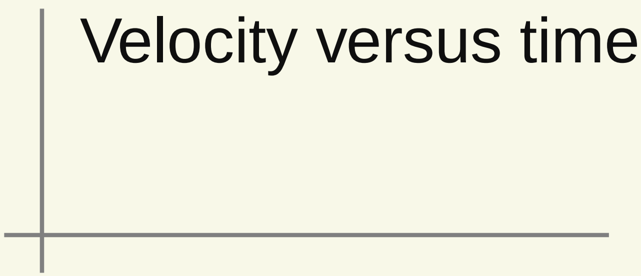

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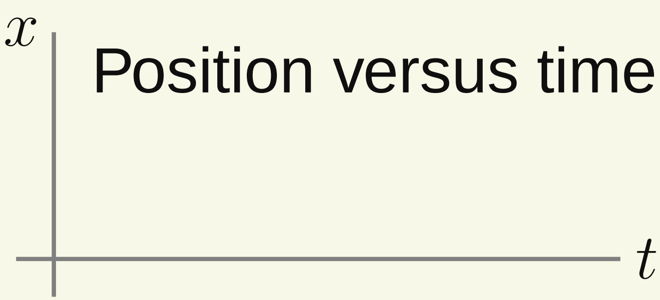

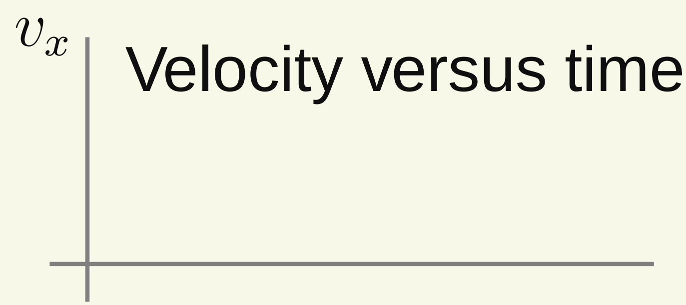

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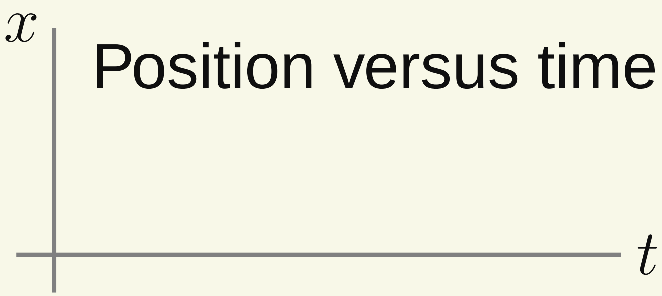

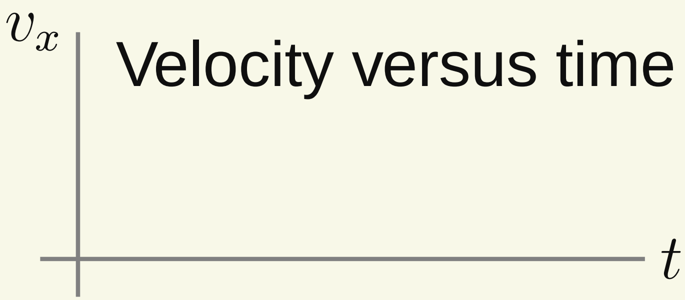

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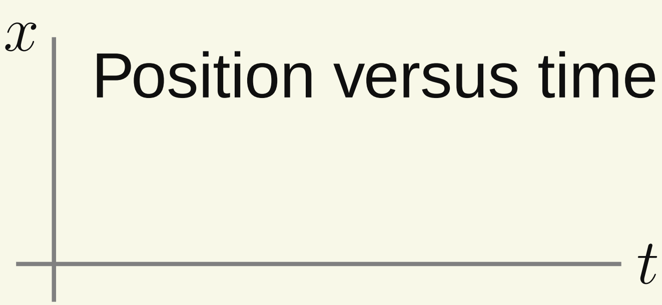

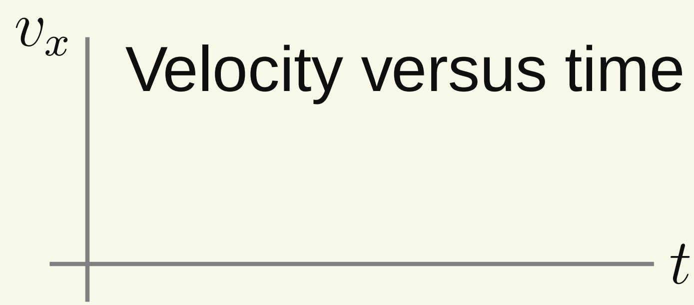

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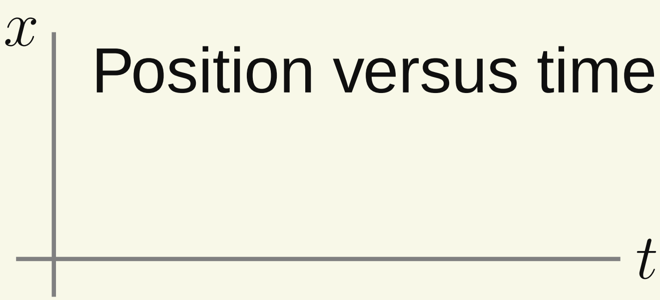

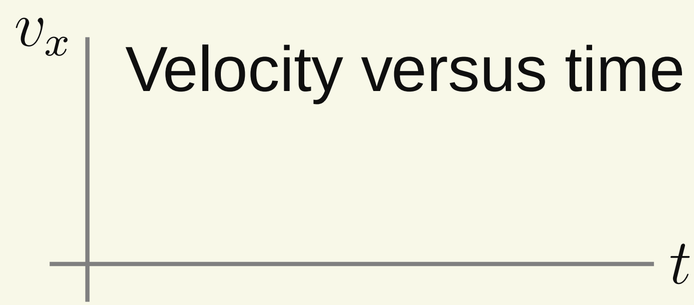

Vertical Motion

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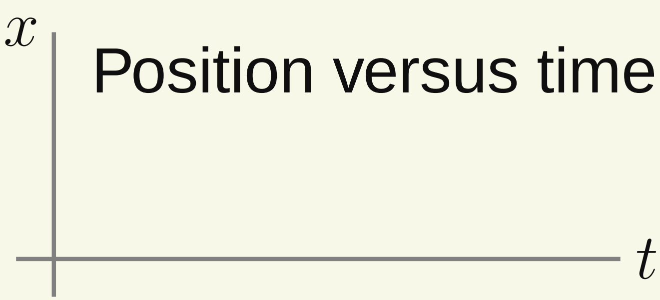

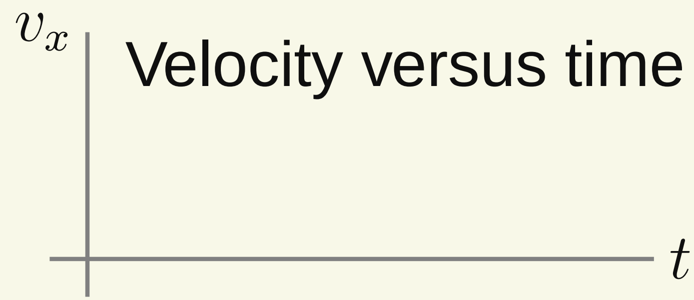

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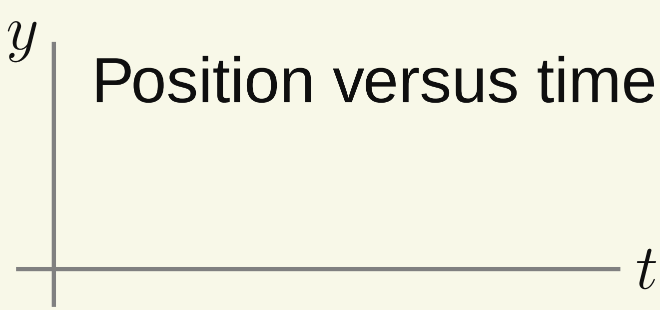

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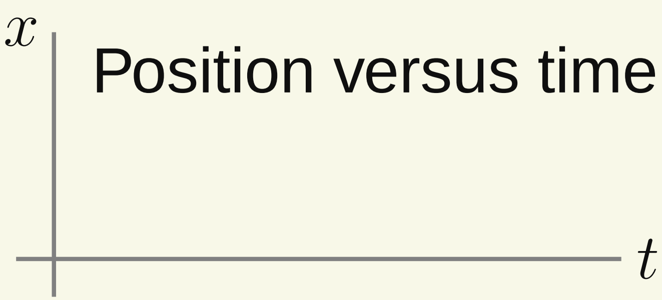

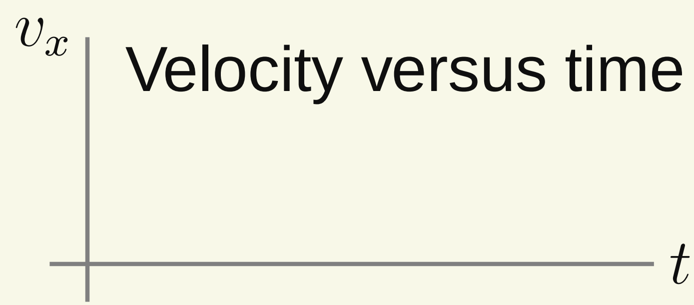

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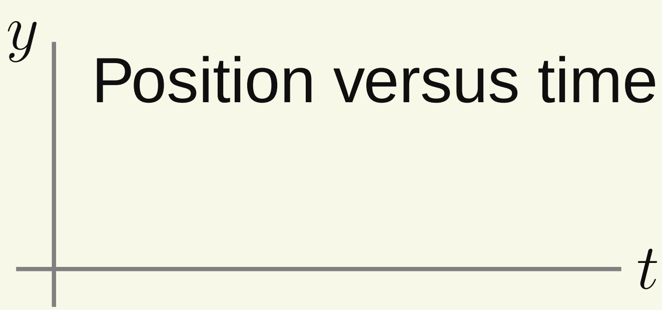

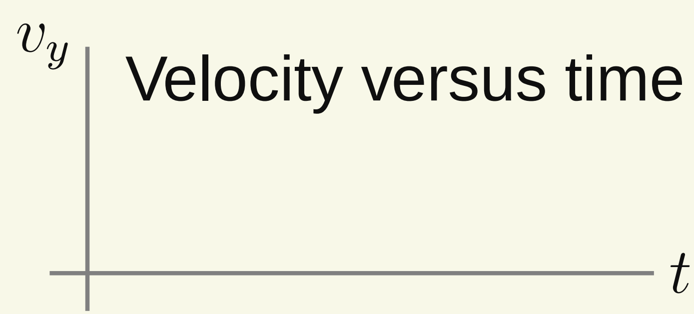

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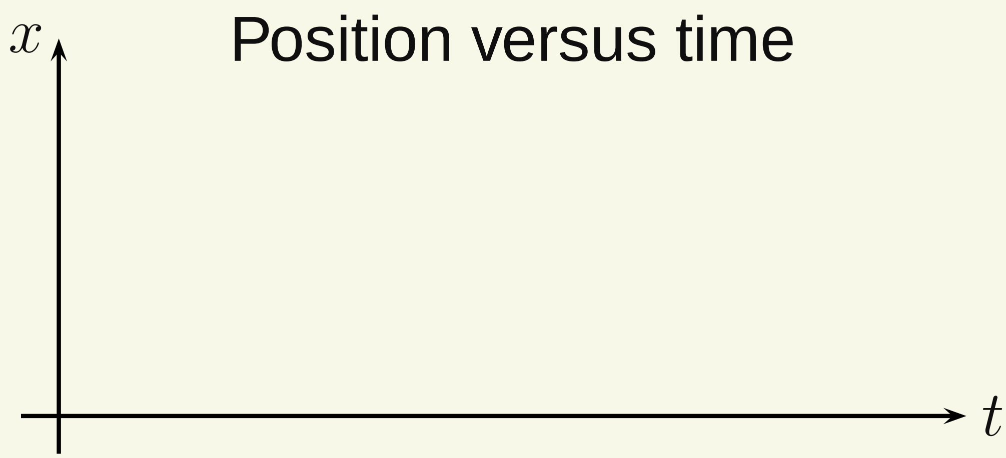

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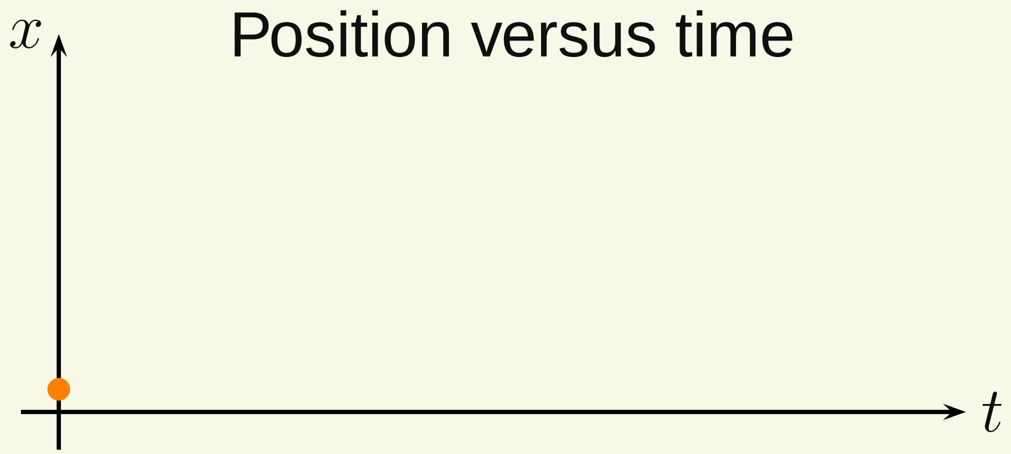

Uniform Motion Position Graph

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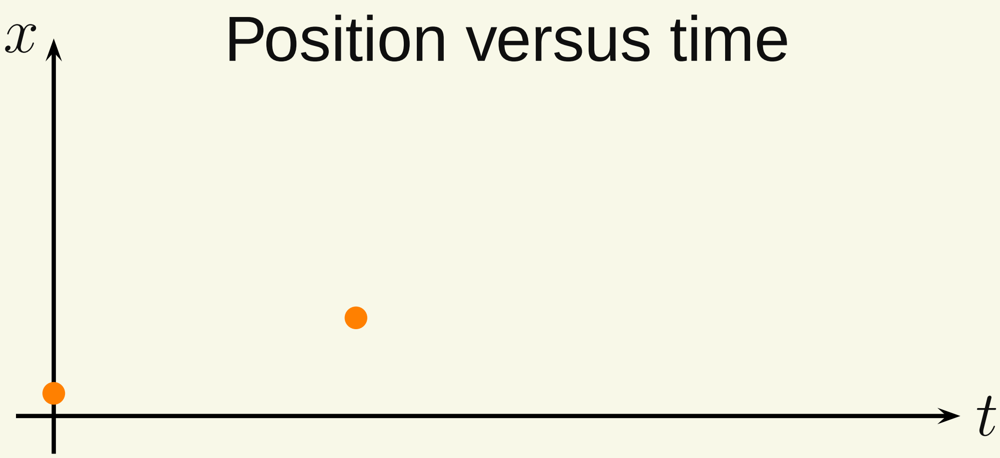

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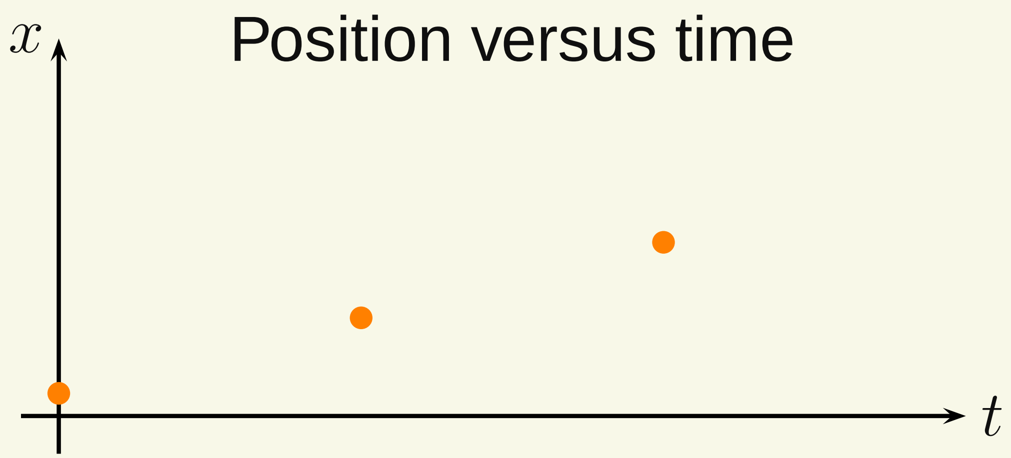

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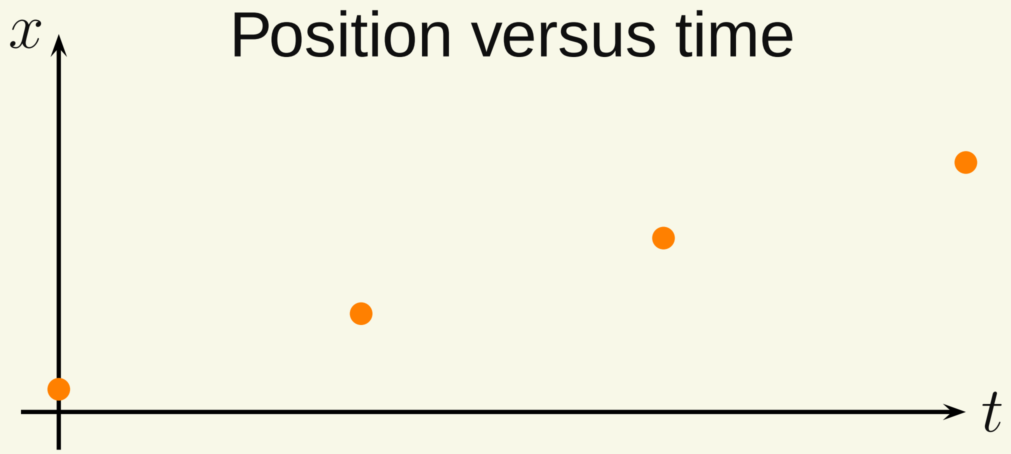
Position versus time



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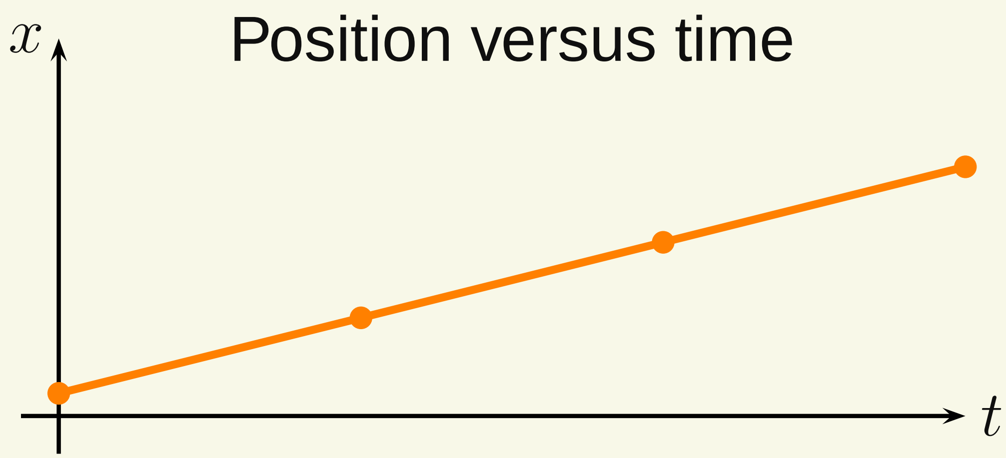

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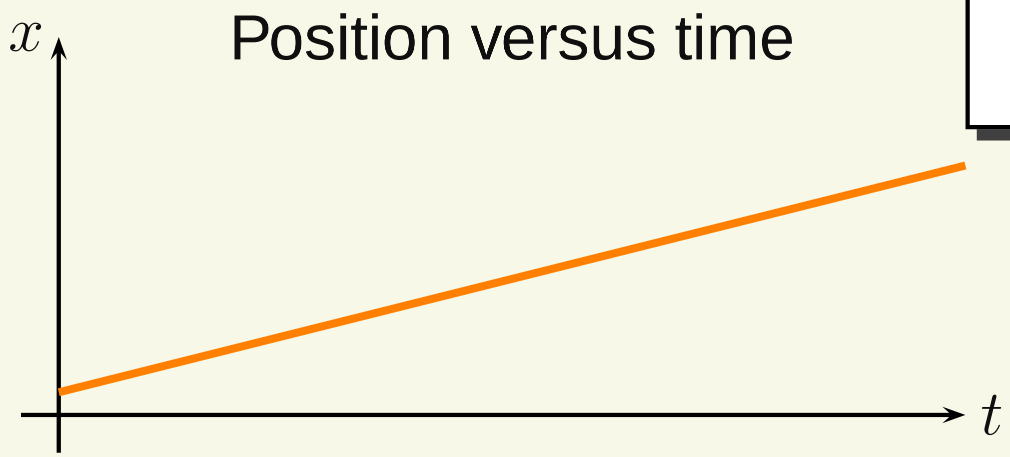

In uniform motion, the position graph is a straight line

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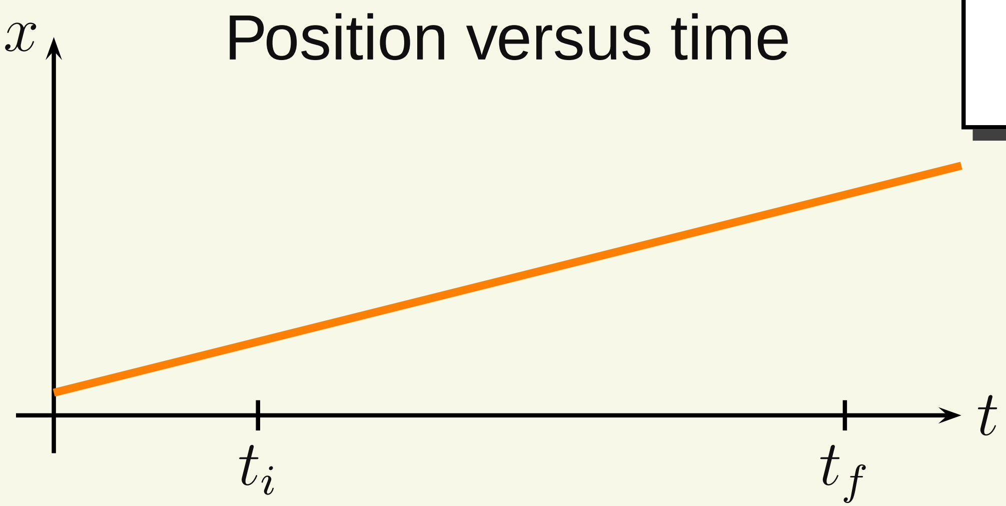

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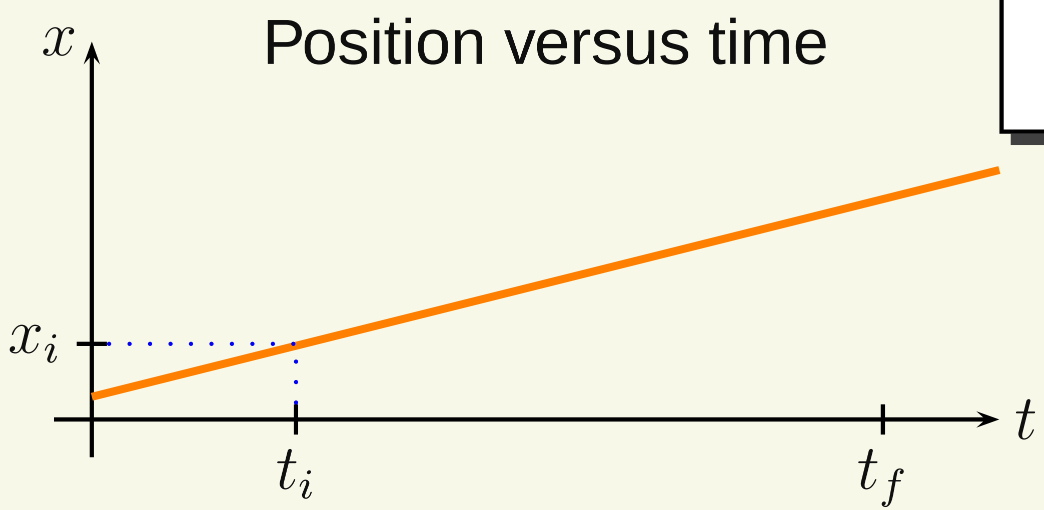

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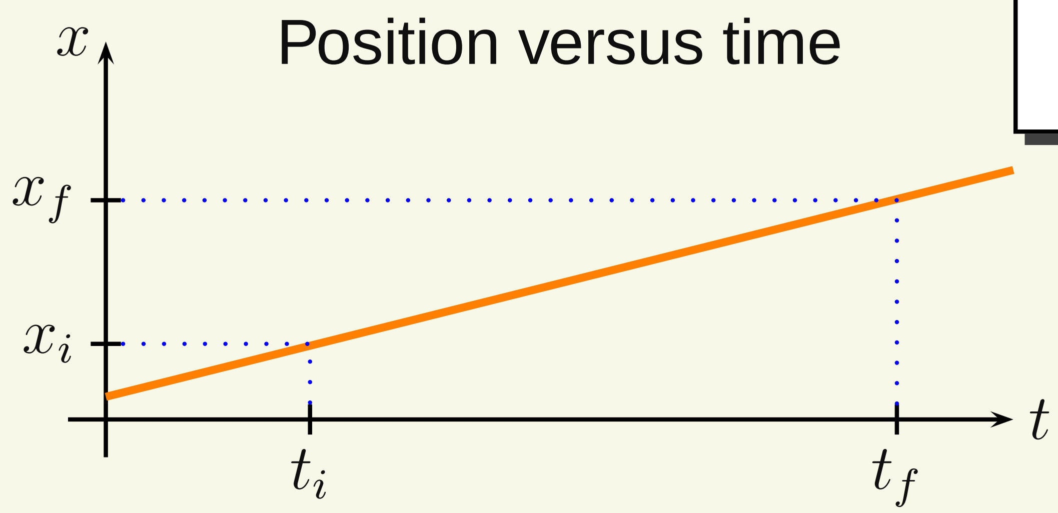

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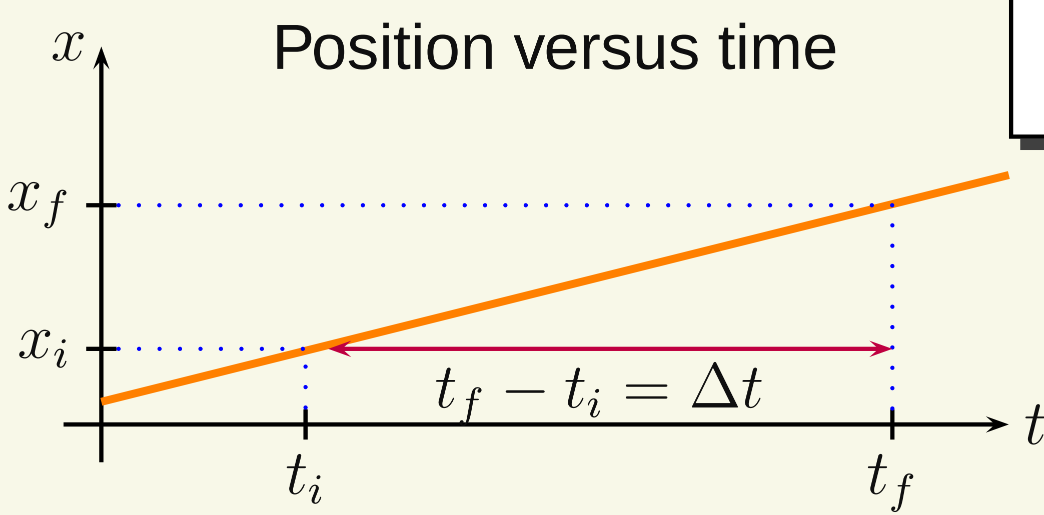

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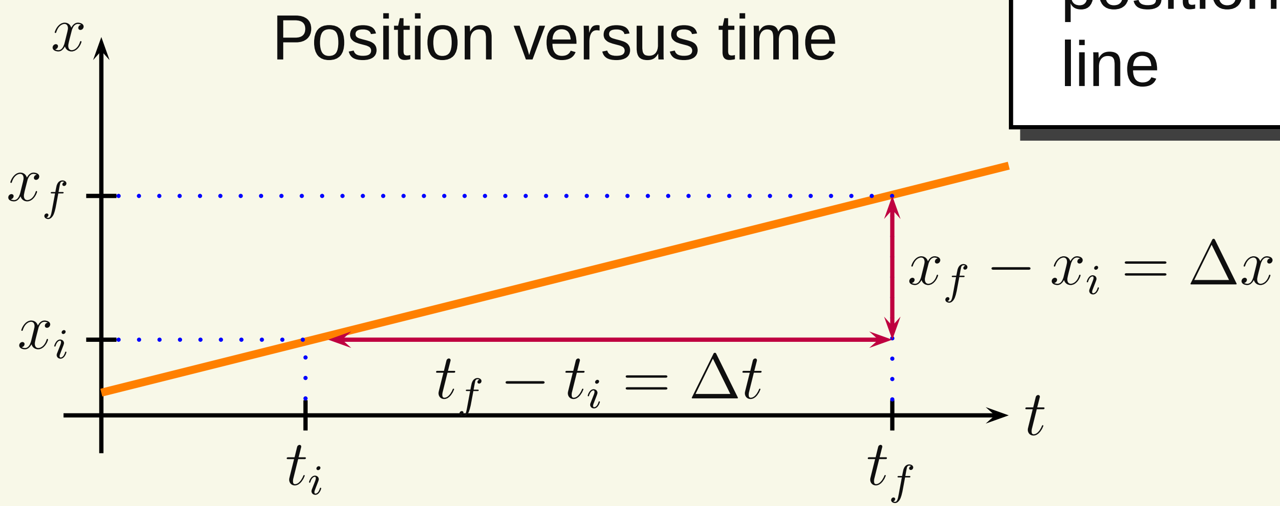

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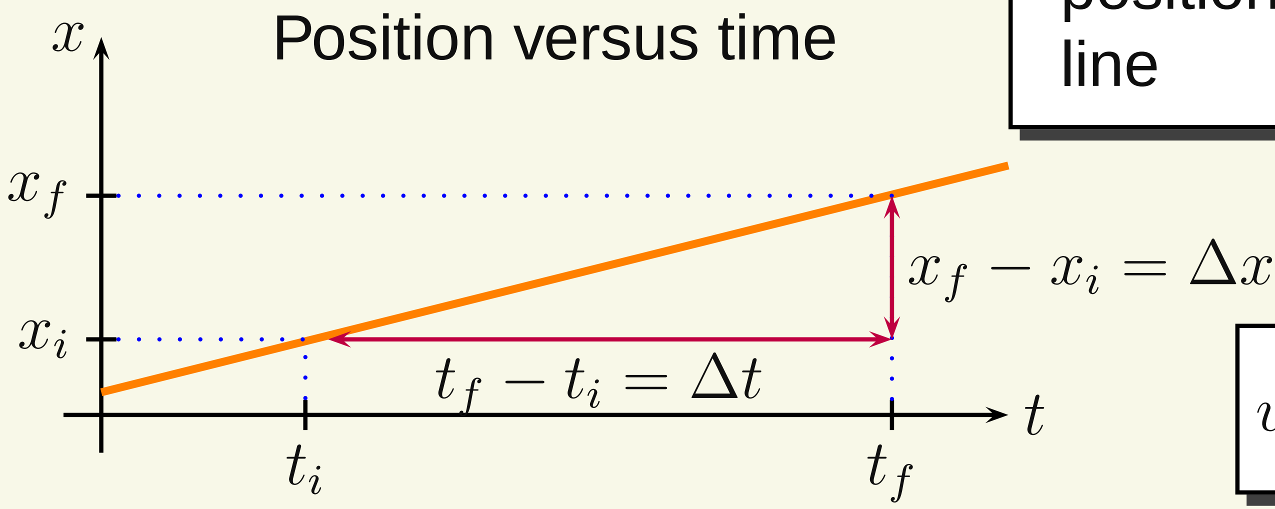

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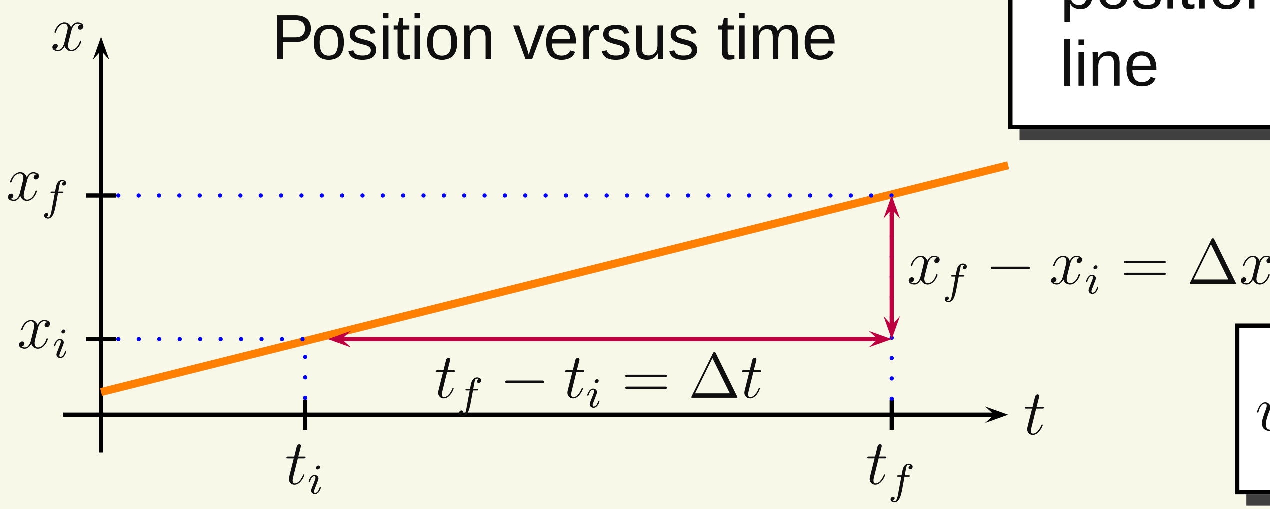

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Velocity is the slope of the position versus time graph

Math and Physics Slopes

In Physics, slopes have units and don’t necessarily correspond to the steepness of the line on the drawing.

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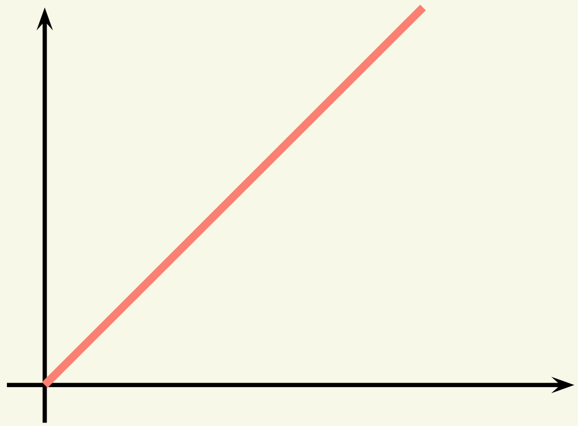

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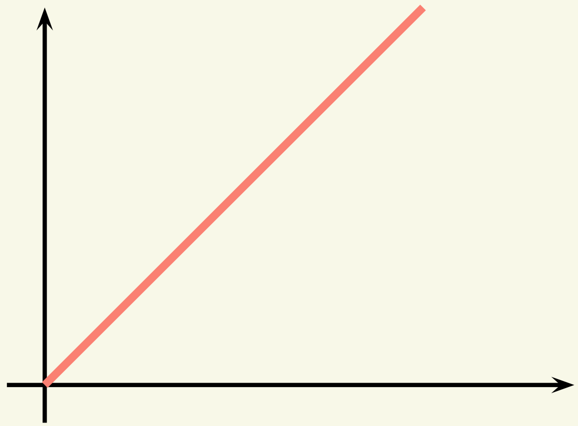

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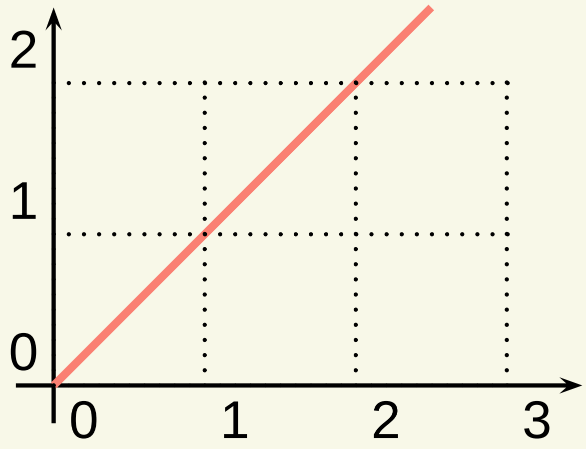

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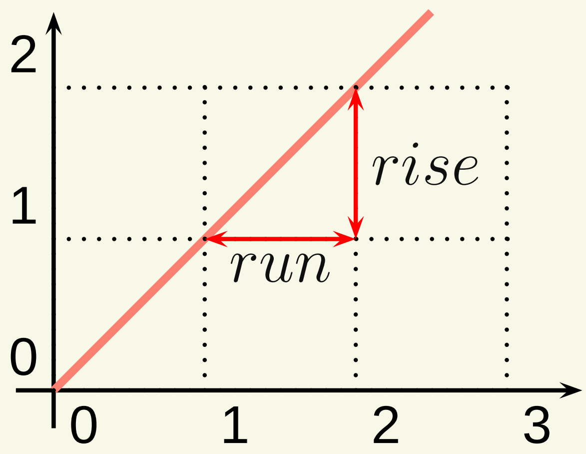

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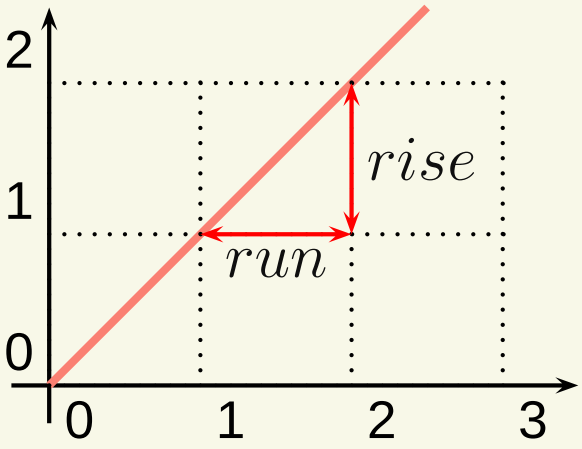

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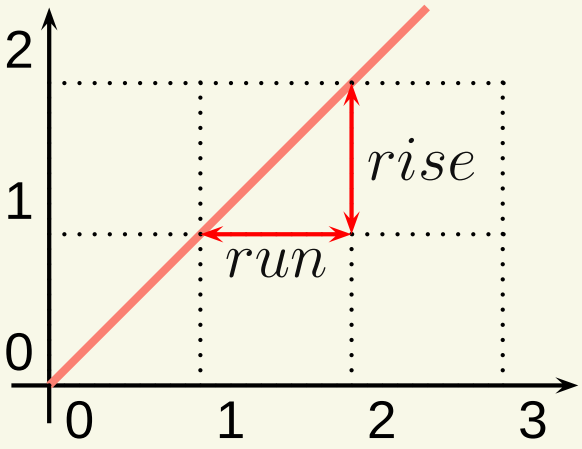

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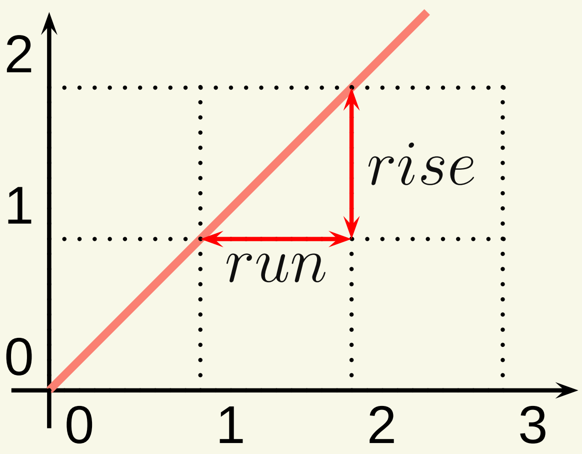

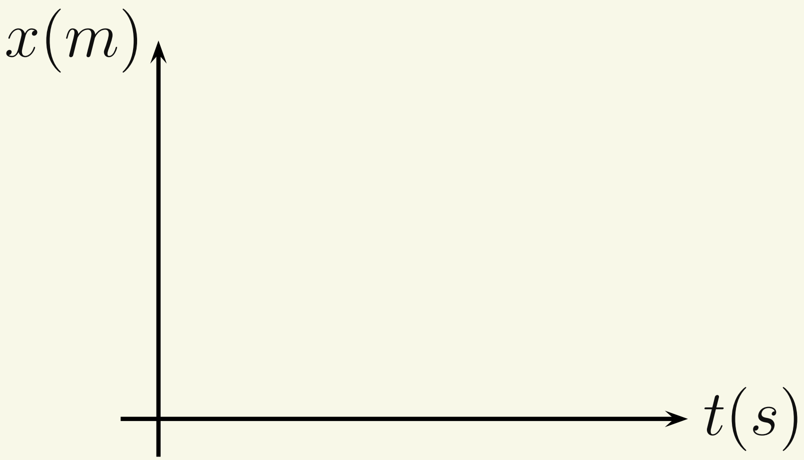

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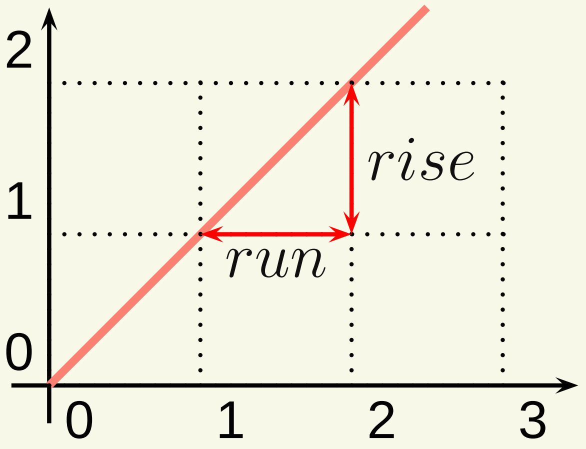

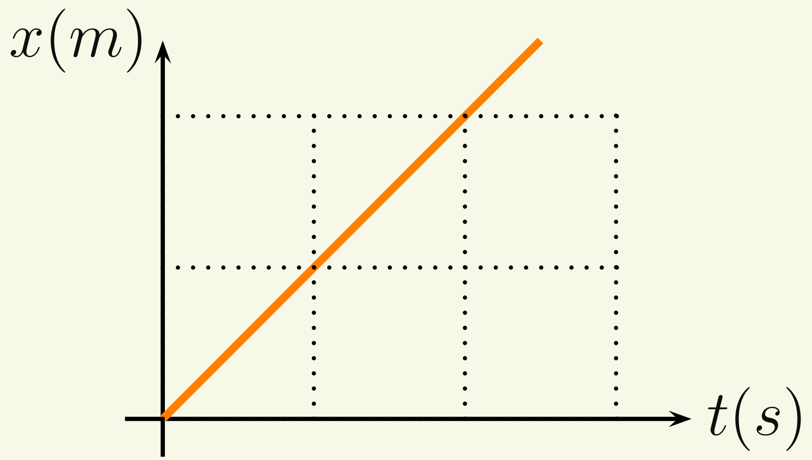

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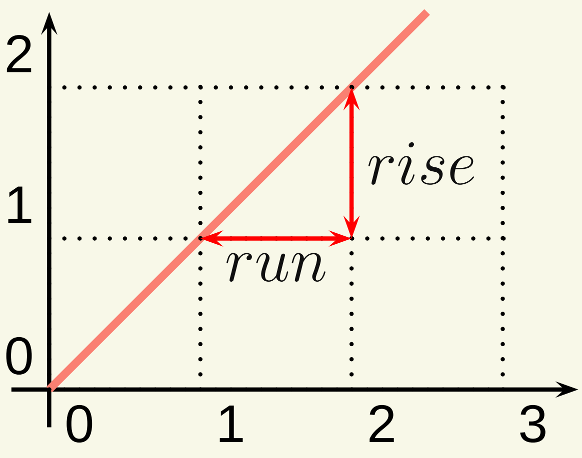

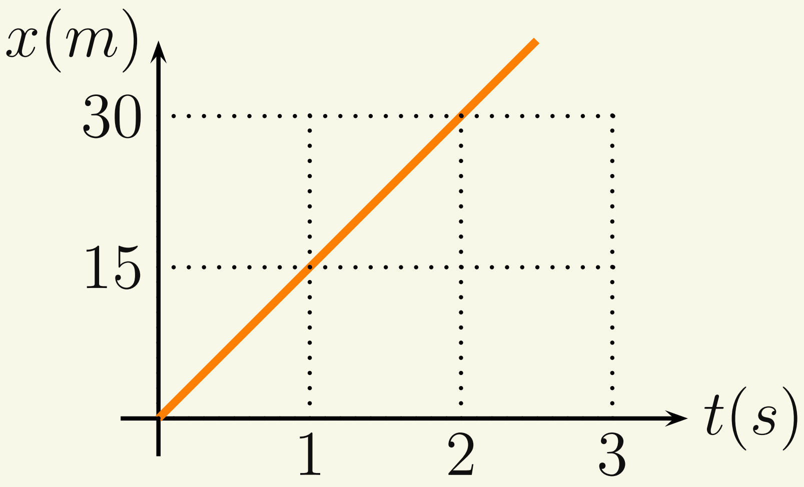

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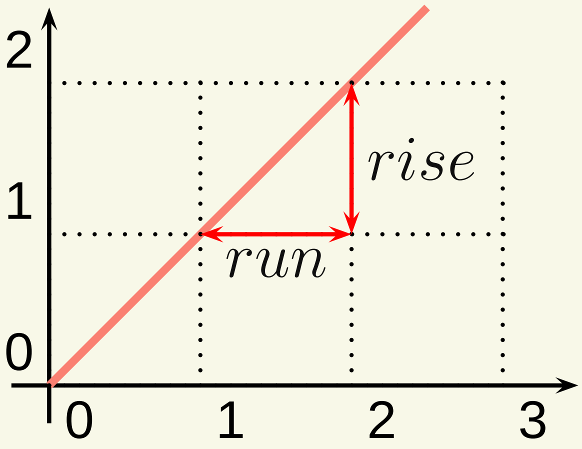

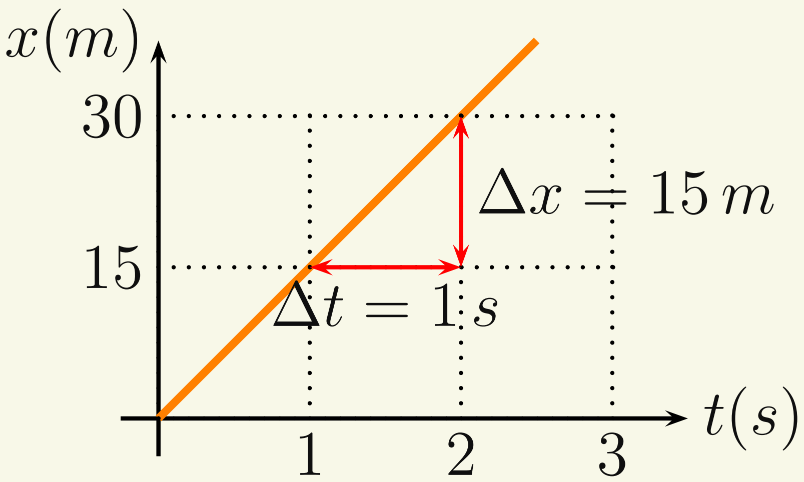

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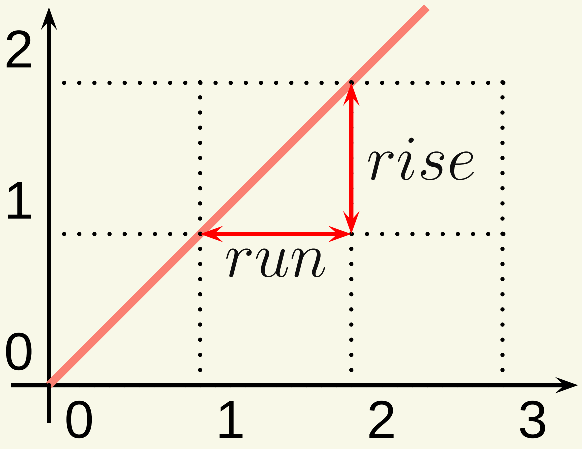

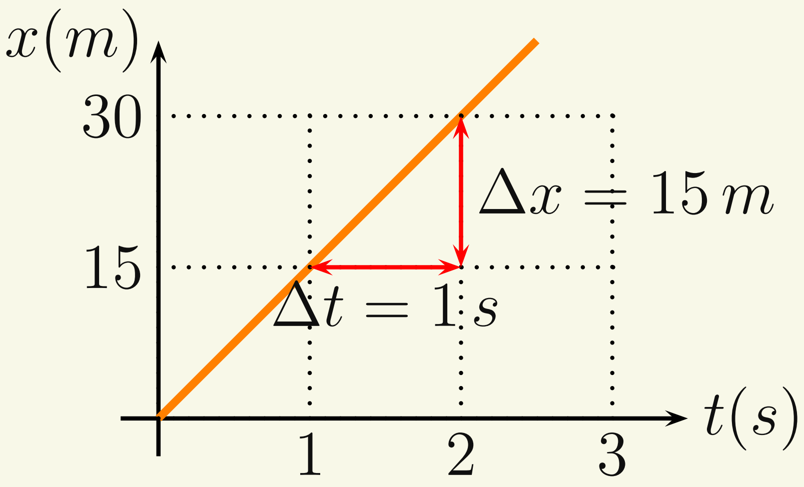

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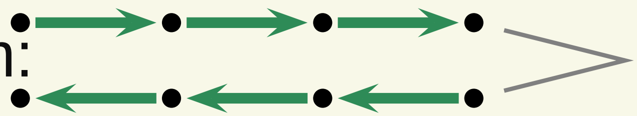
Slope = Velocity: $v_x = \dfrac{\Delta x}{\Delta t} = \dfrac{15\,m}{1\,s} = 15\,m/s$

Position-Graph Exercise

A man walks some distance to the right with constant speed, immediately turns around and walks back to his starting point with the same speed. Which of the following is the correct position-versus-time graph?

Motion Diagram:



Same Point

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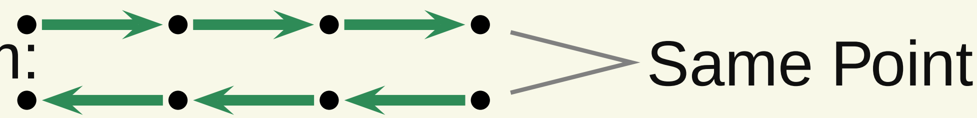

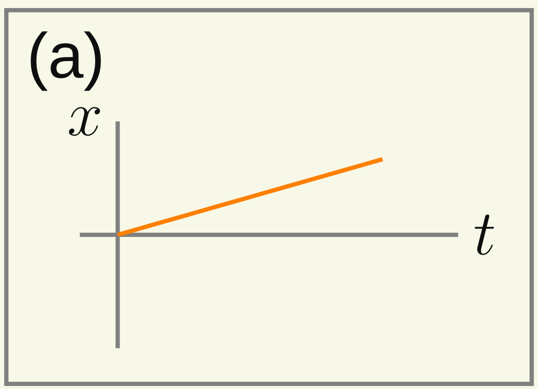

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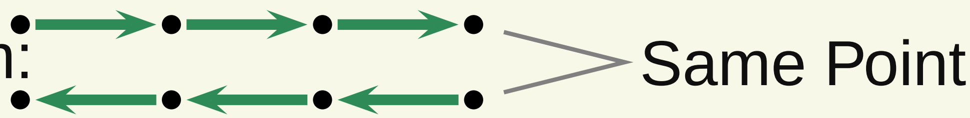

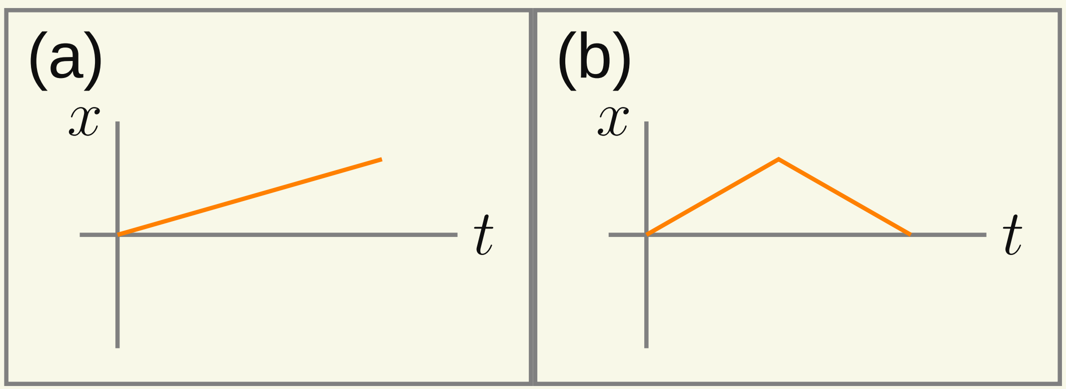

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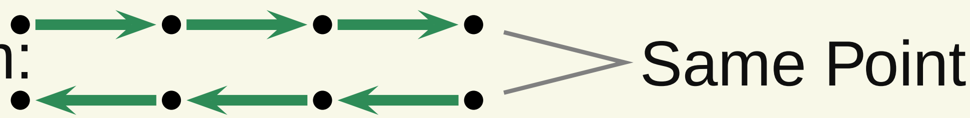

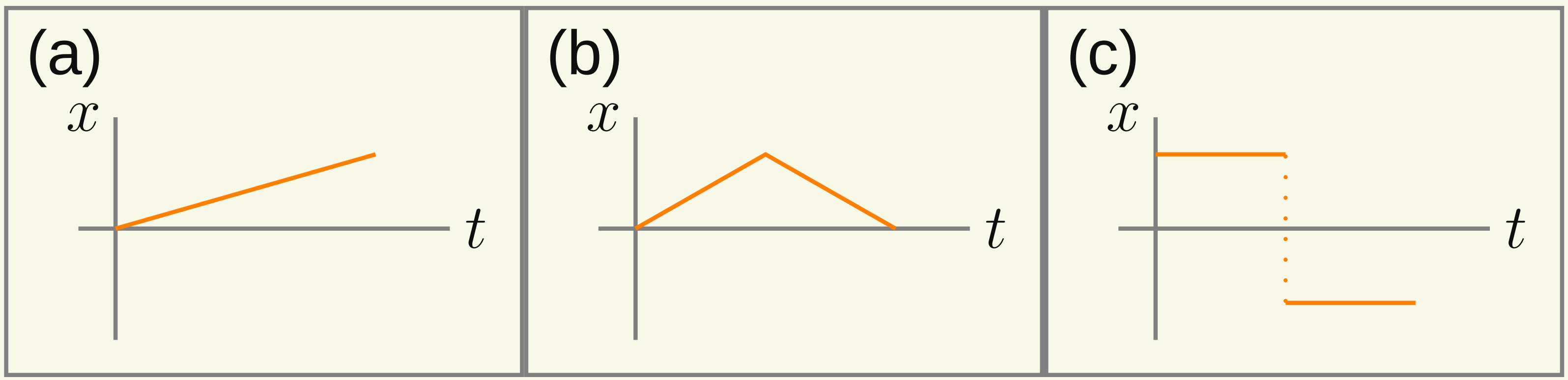

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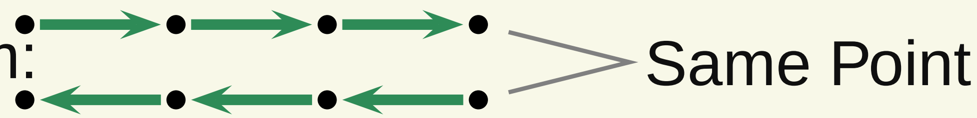

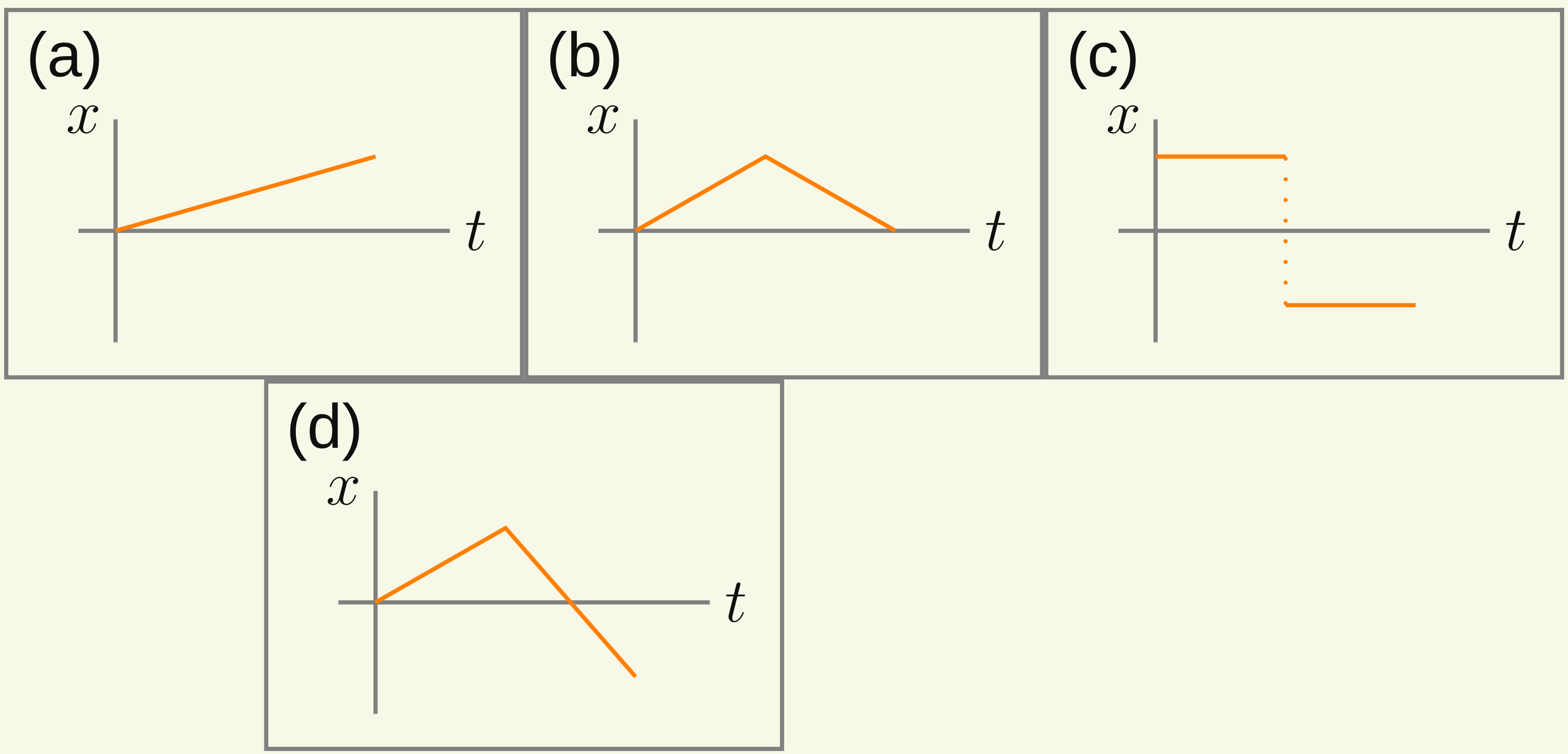

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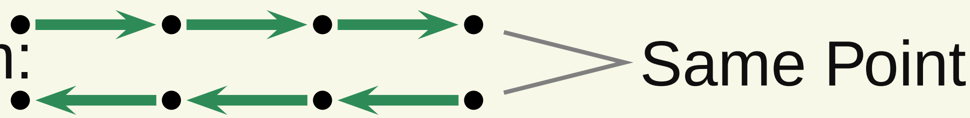

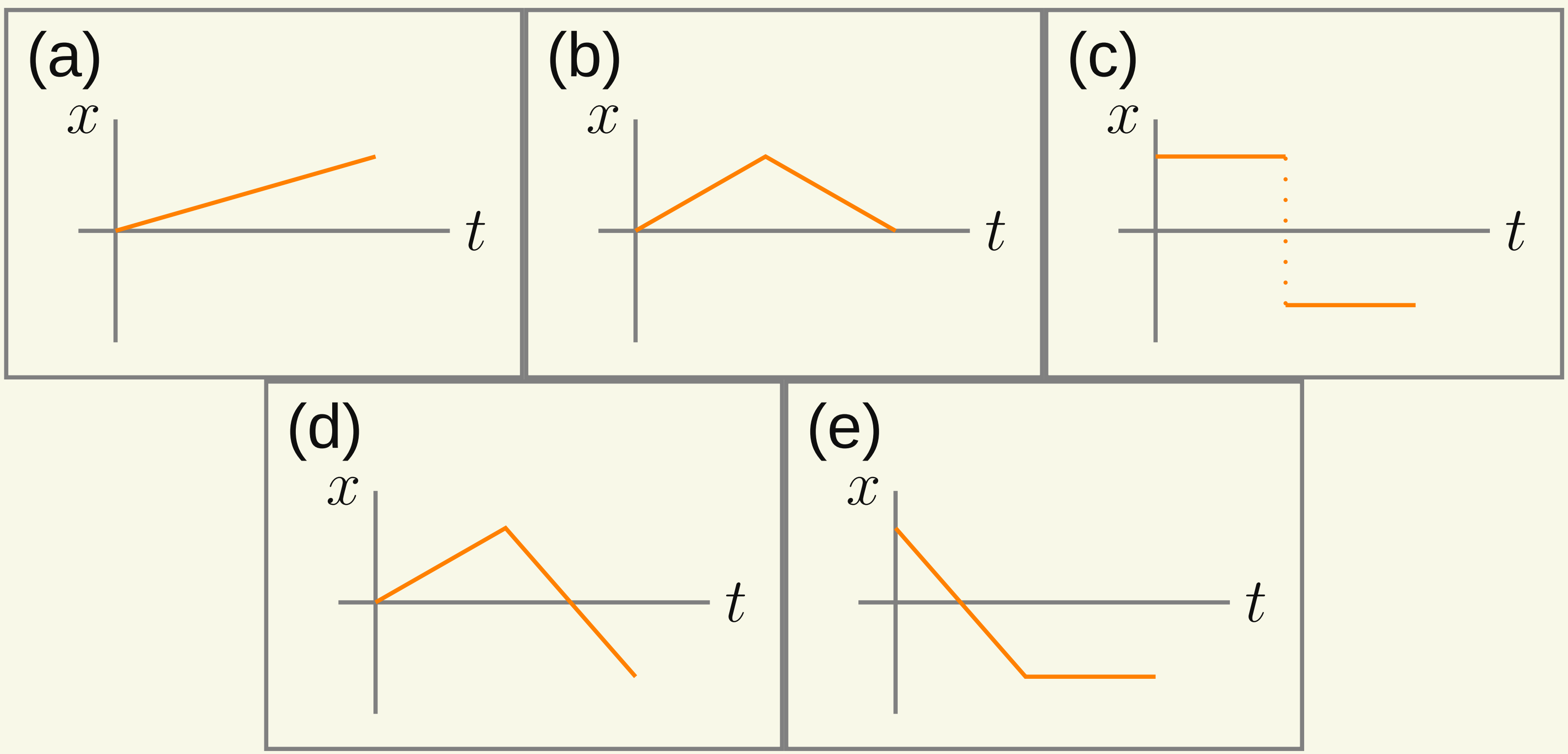

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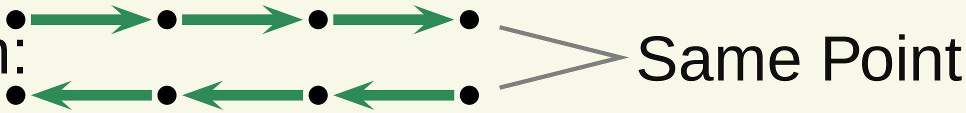
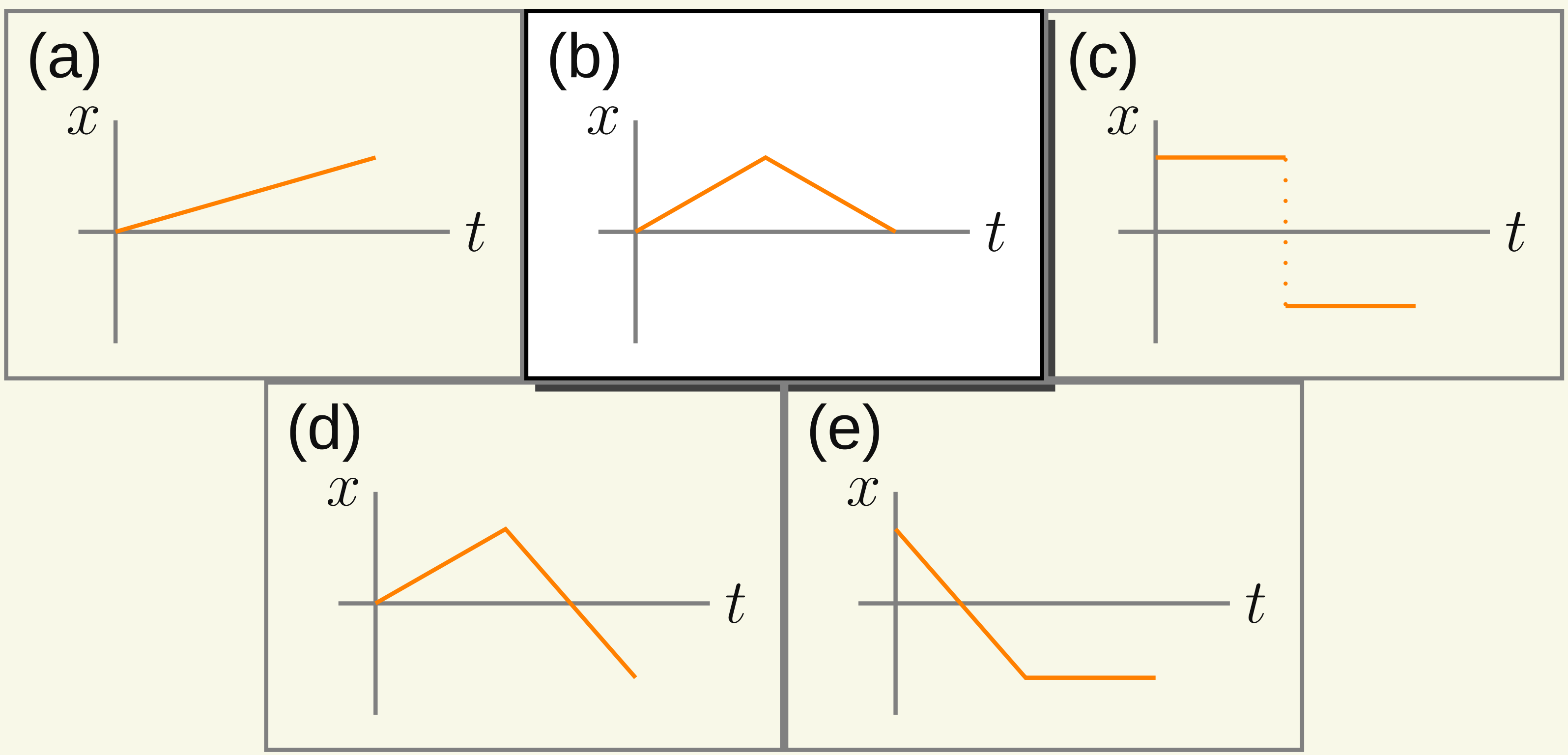
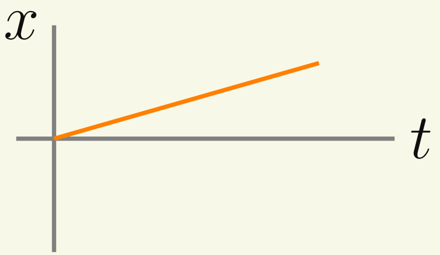




Position-Graph Followup

(a)



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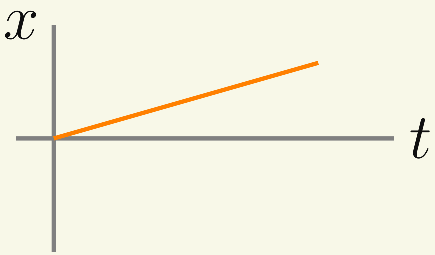

Man walks to the right with constant speed the whole time.

Position-Graph Followup

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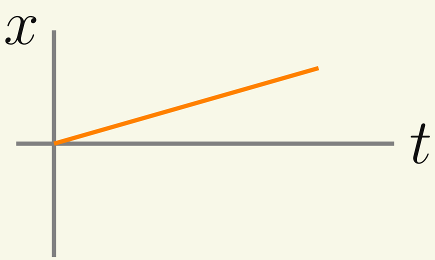

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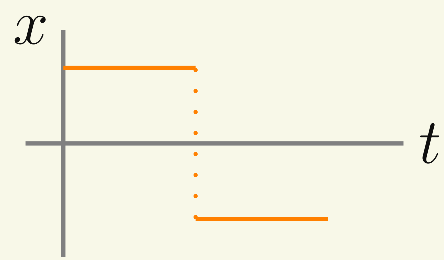

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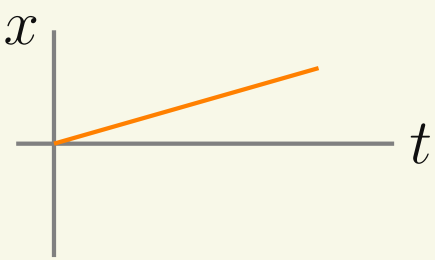

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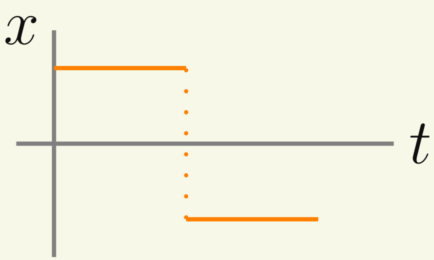

Man stands to the right of origin, magically appears to left of orgin, stands there.

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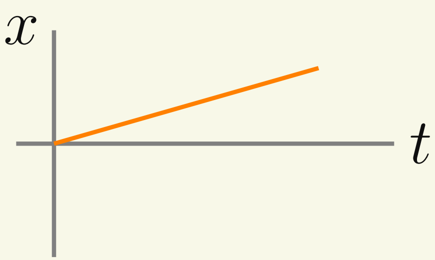

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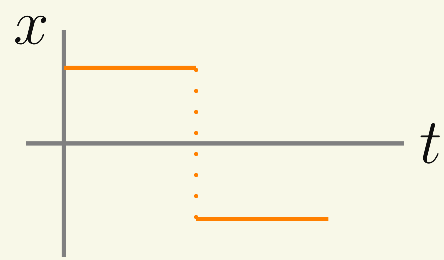

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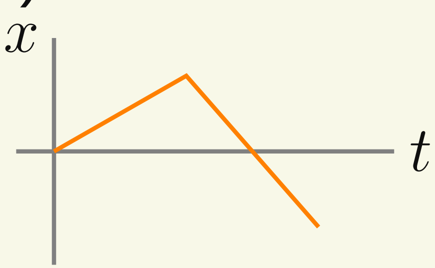

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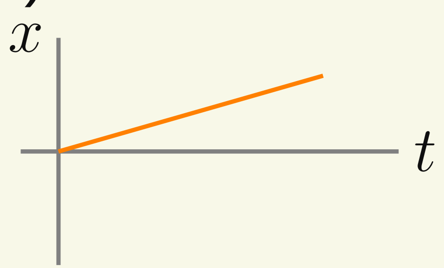

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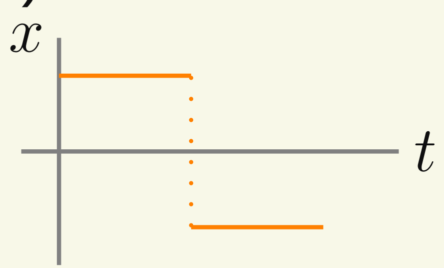

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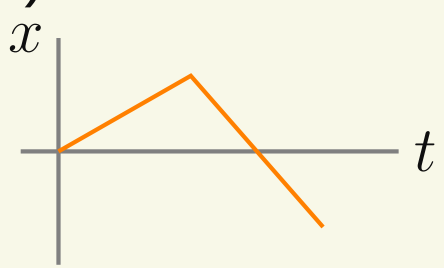
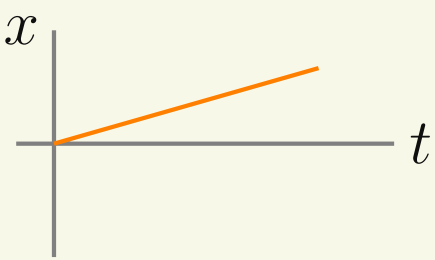


Man goes to the right with constant speed. Man turns around. Man goes to the left with faster speed and crosses origin.

Position-Graph Followup

(a)



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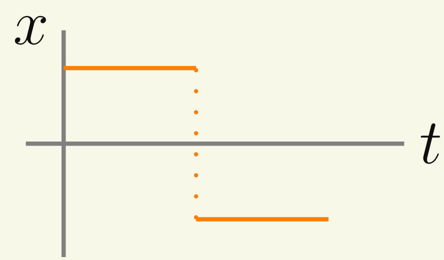

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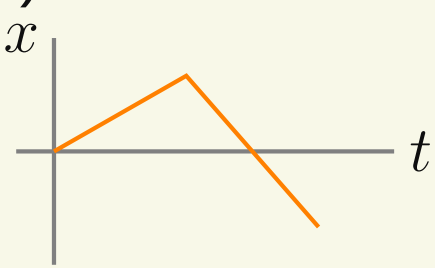
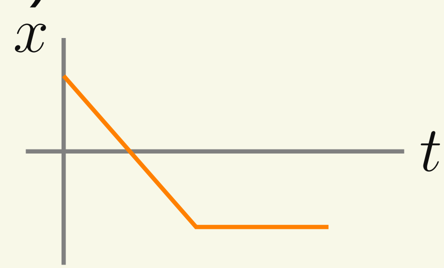


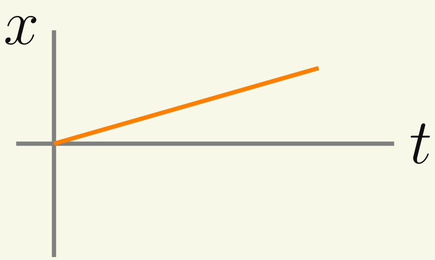
Man goes to the right with constant speed. Man turns around. Man goes to the left with faster speed and crosses origin.

(e)



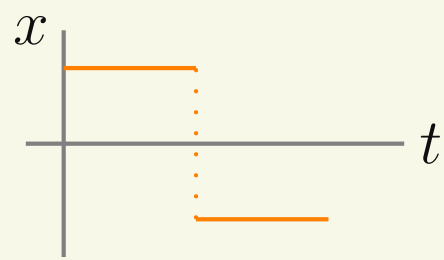
Position-Graph Followup

(a)



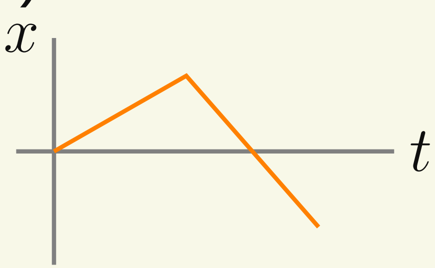
Man walks to the right with constant speed the whole time.

(c)



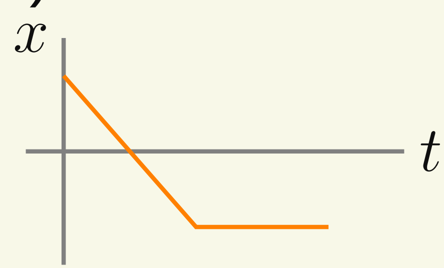
Man stands to the right of origin, magically appears to left of orgin, stands there.

(d)



Man goes to the right with constant speed. Man turns around. Man goes to the left with faster speed and crosses origin.

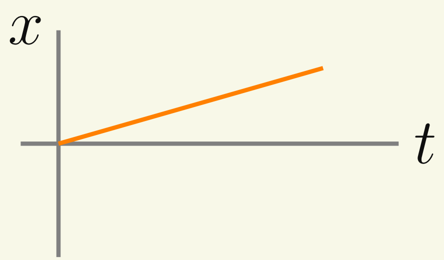
(e)



Man starts to the right of origin. Walks to left with constant speed. Passes origin. Stands in place.

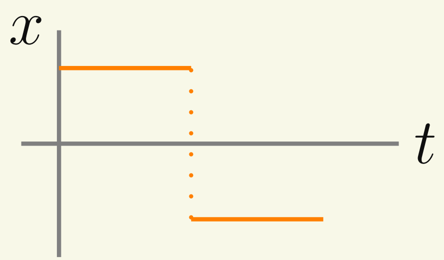
Position-Graph Followup

(a)



Man walks to the right with constant speed the whole time.

(c)



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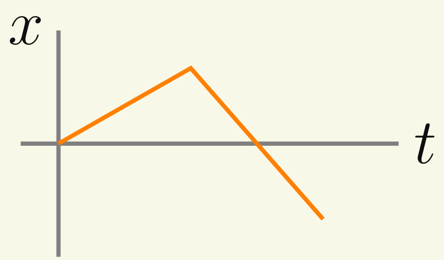
(d)



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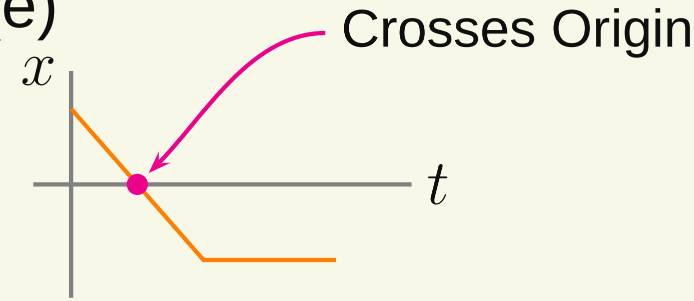
(e)



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Position-Graph Followup

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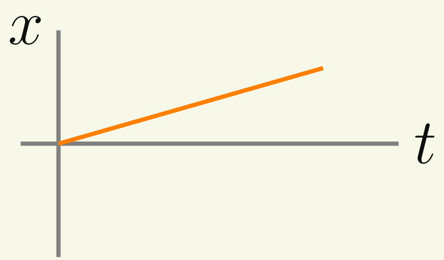
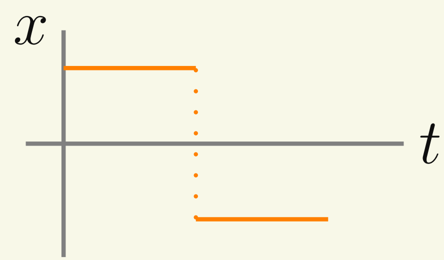


Man walks to the right with constant speed the whole time.

(c)



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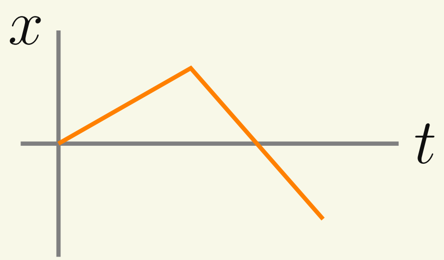

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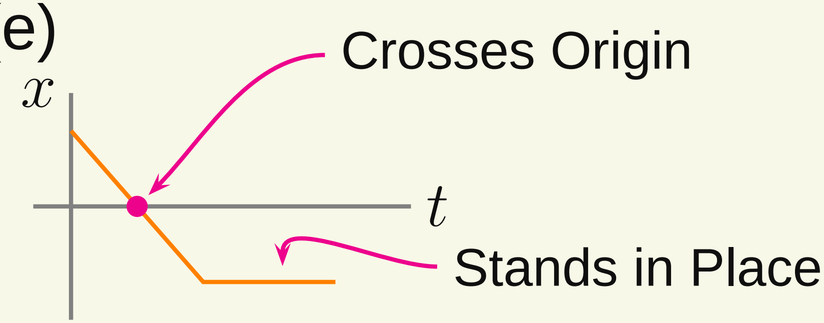

Man starts to the right of origin. Walks to left with constant speed. Passes origin. Stands in place.

Uniform-Motion-Velocity Graph

The simplest graph is the velocity versus time for uniform motion.

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Uniform Motion - Constant velocity motion.

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Walking to right motion diagram: 

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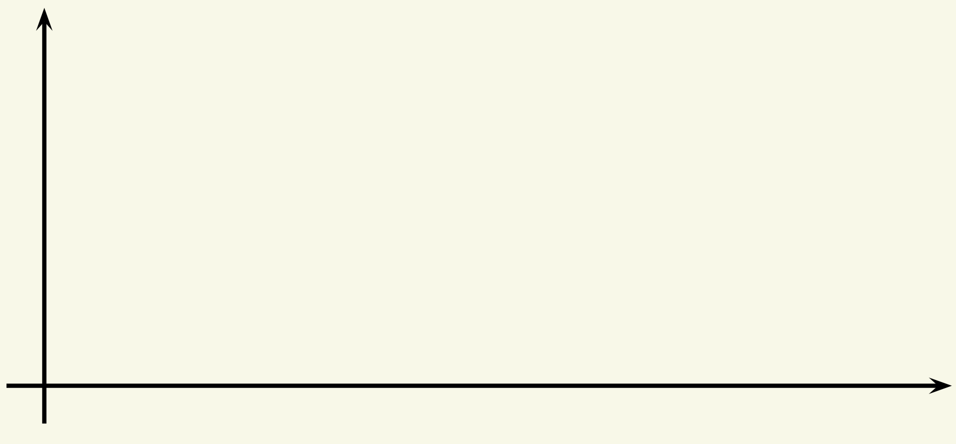
Velocity versus time



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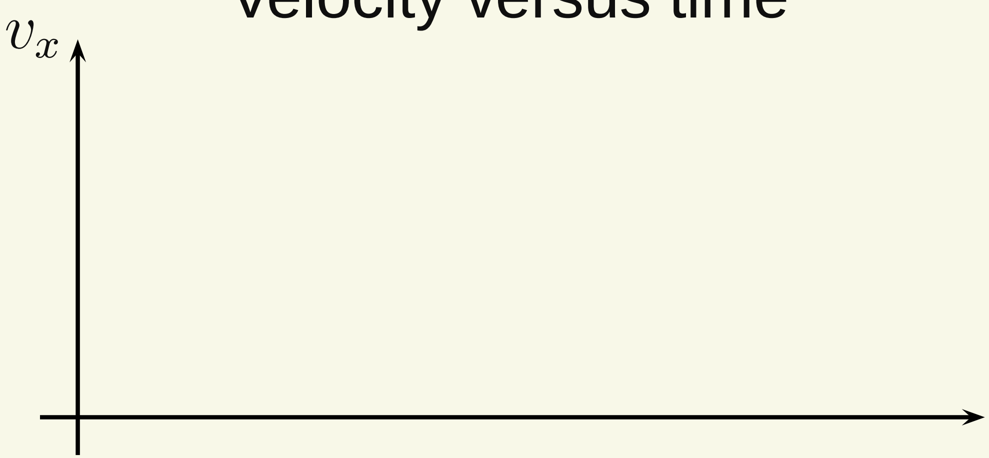

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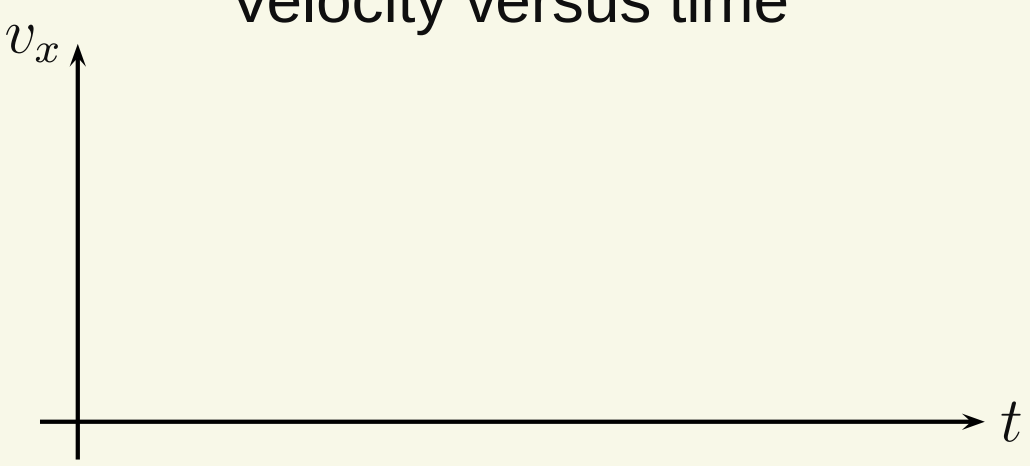

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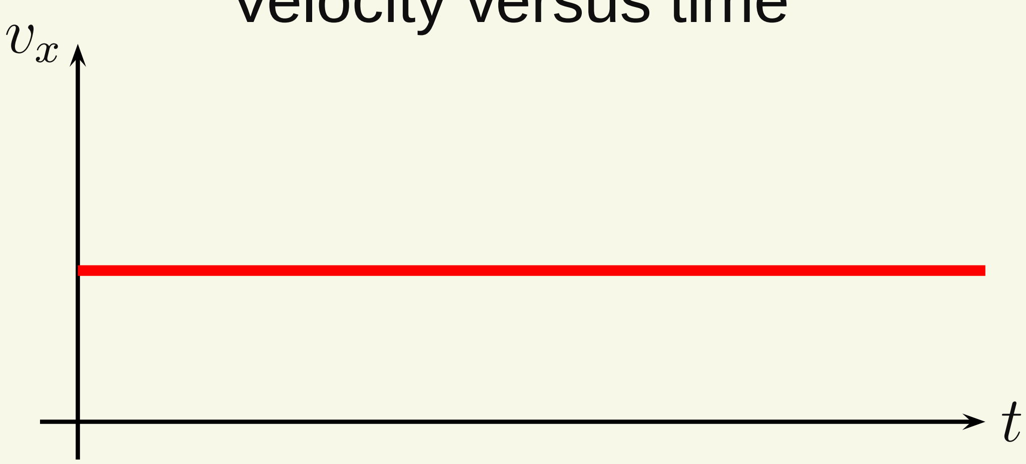

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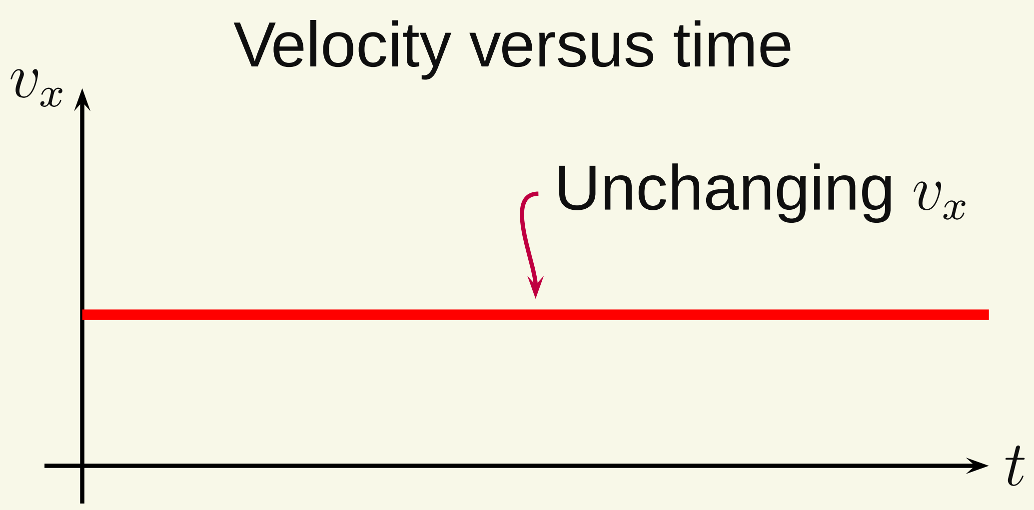

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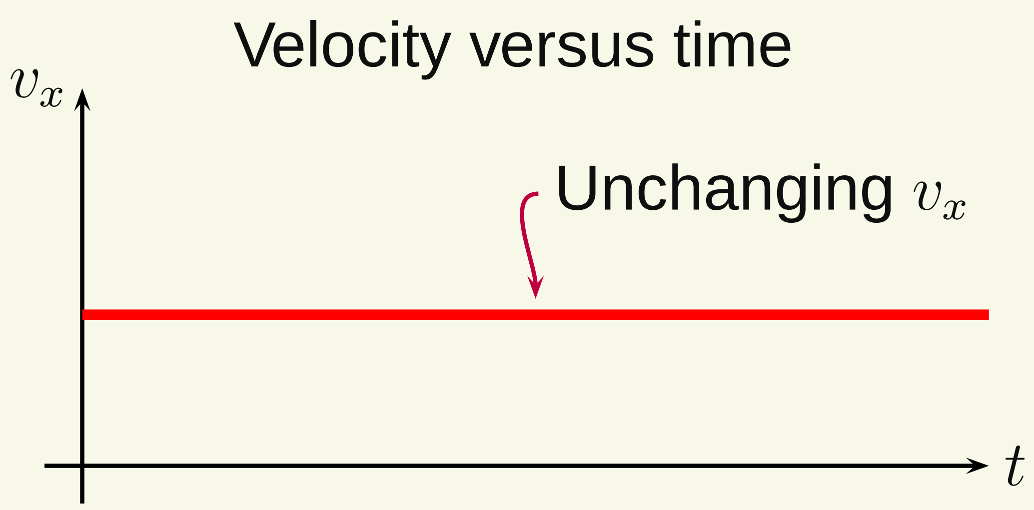
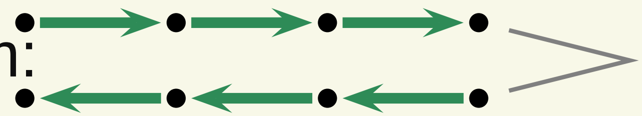


In uniform motion, velocity is a horizontal line

Velocity-Graph Exercise

A man walks some distance to the right with constant speed, immediately turns around and walks back to his starting point with the same speed. Which of the following is the correct velocity-versus-time graph?

Motion Diagram:



Same Point

Velocity-Graph Exercise

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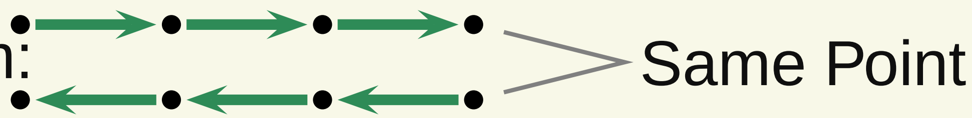

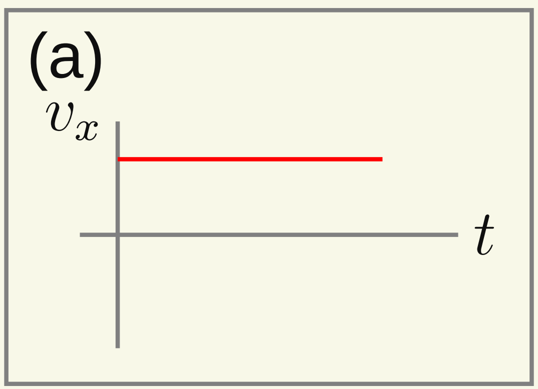

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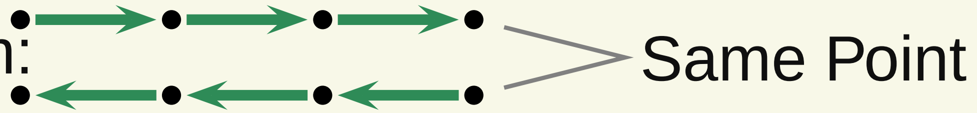

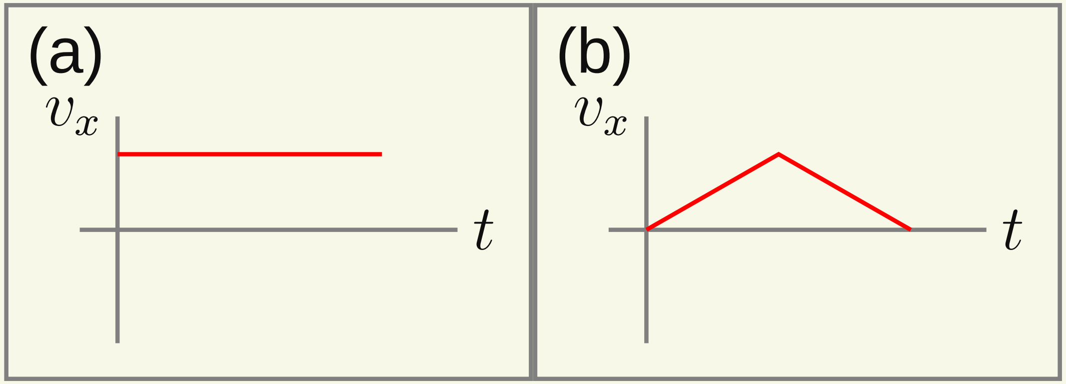

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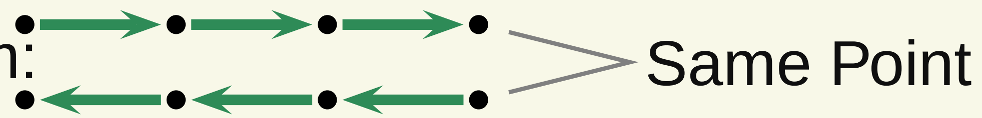

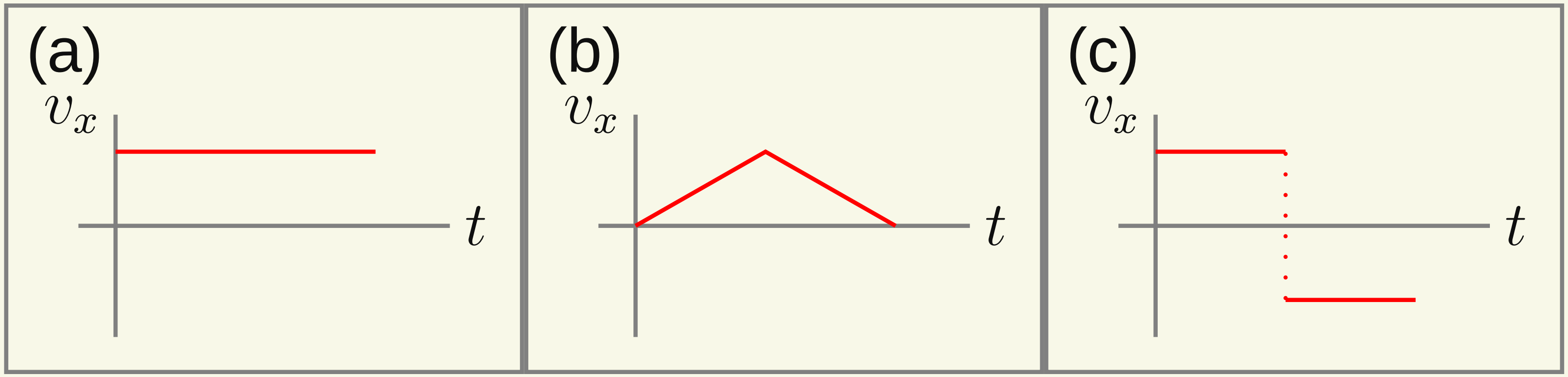

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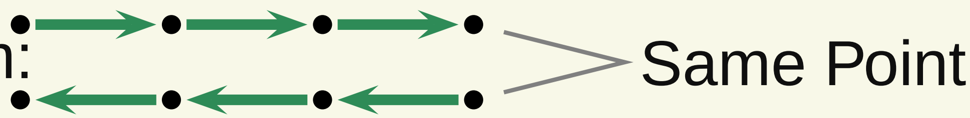

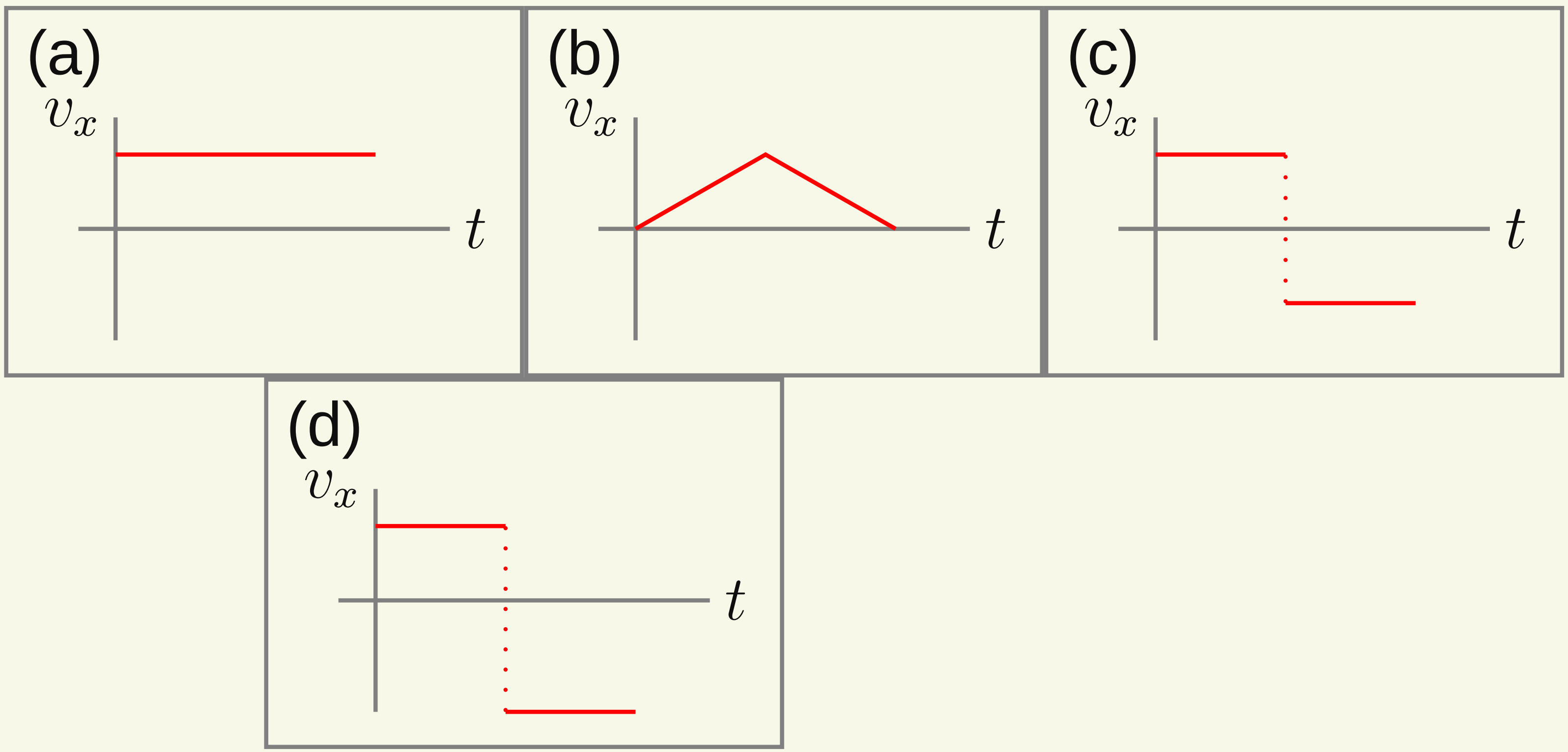

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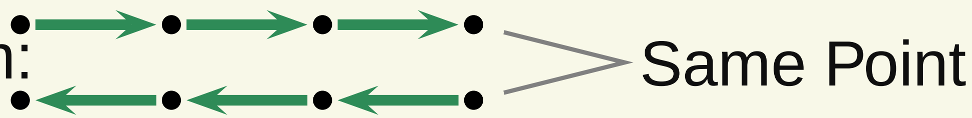

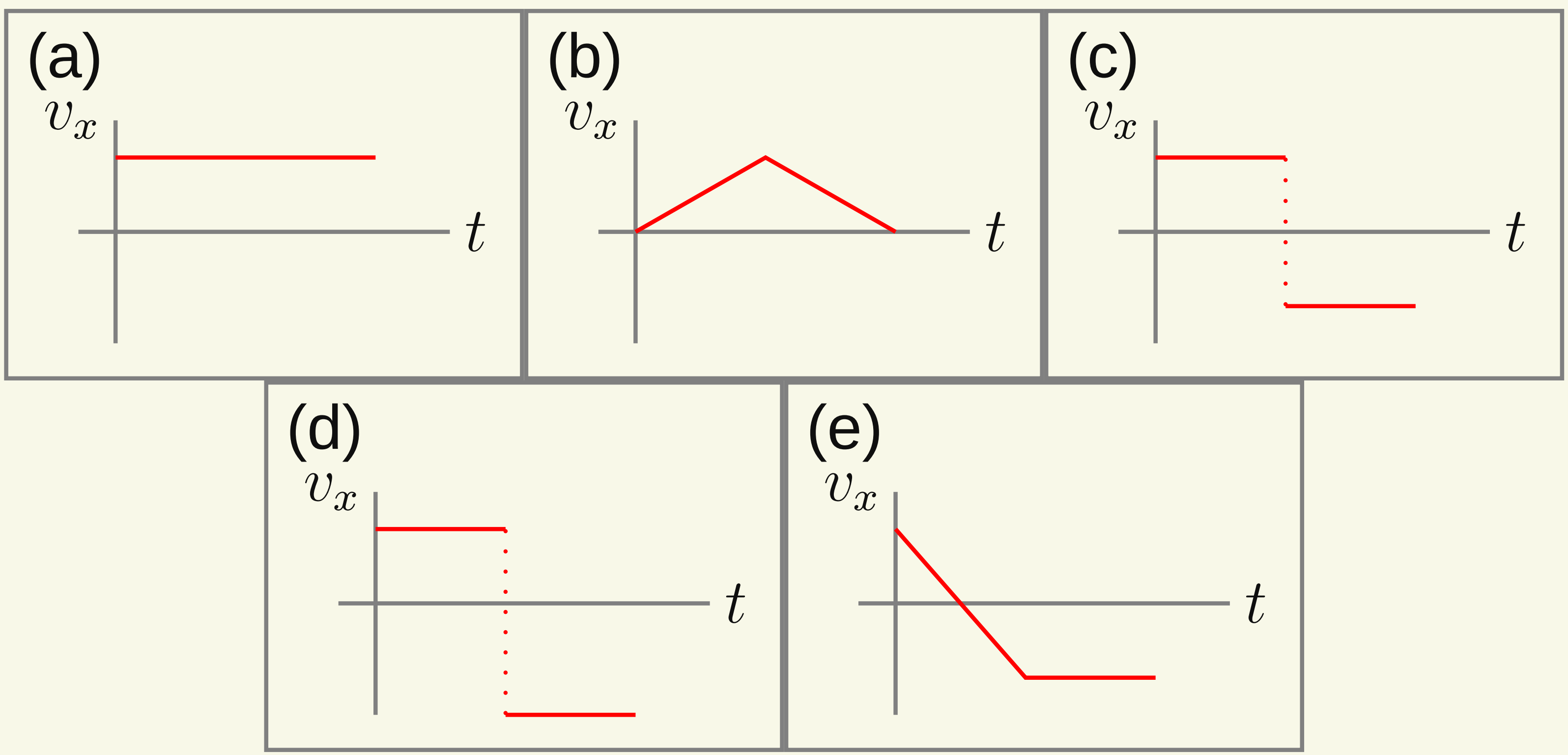

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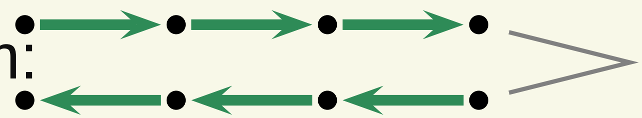
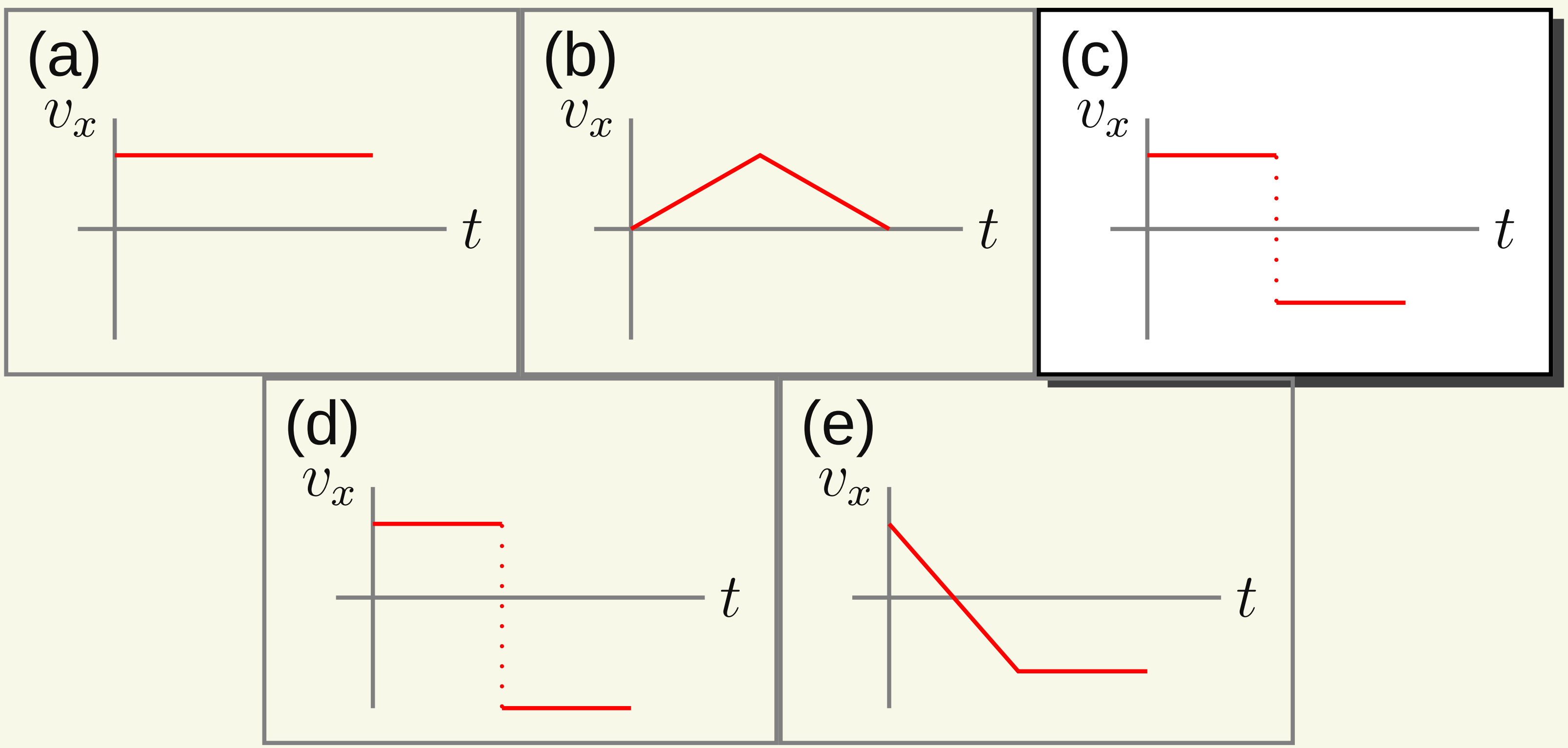
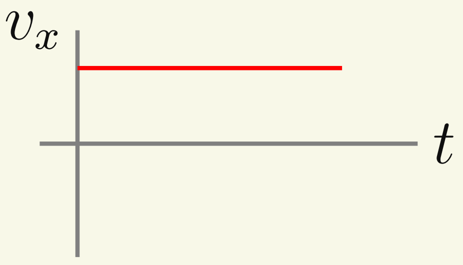
Motion Diagram:  Same Point



Velocity-Graph Followup

(a)



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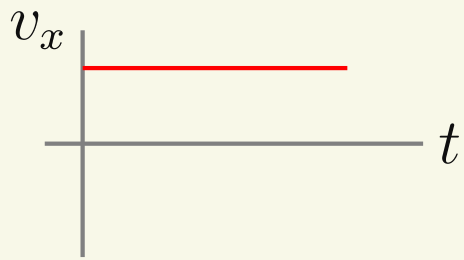
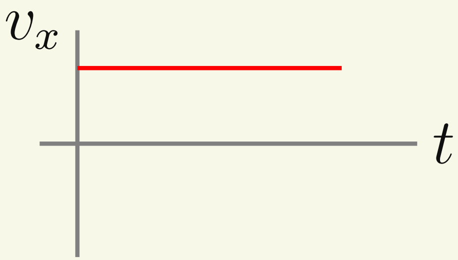


Man walks to the right with constant speed the whole time

Velocity-Graph Followup

(a)



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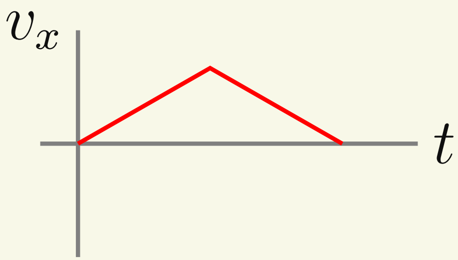
(b)



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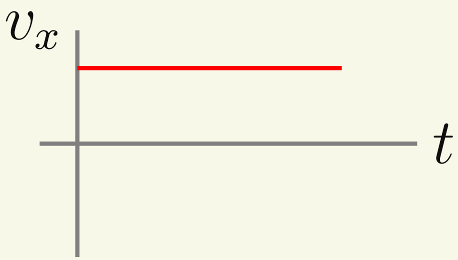
(a)



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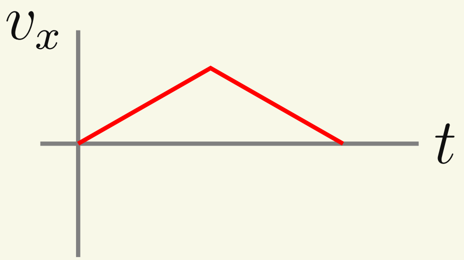
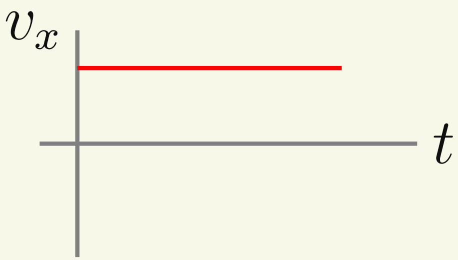
(b)



Man speeds up then the man slows down. Going to the right the whole time.

Velocity-Graph Followup

(a)



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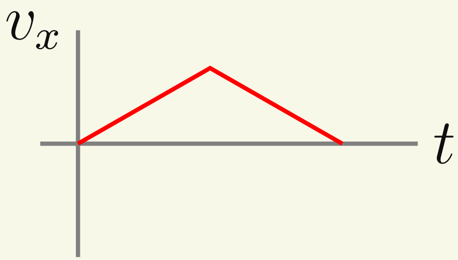
(b)



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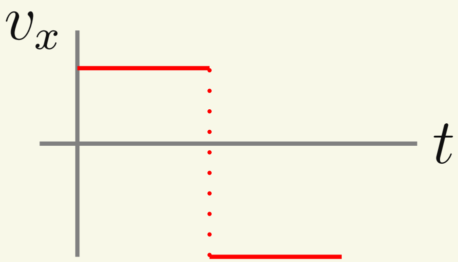
(d)



Velocity-Graph Followup

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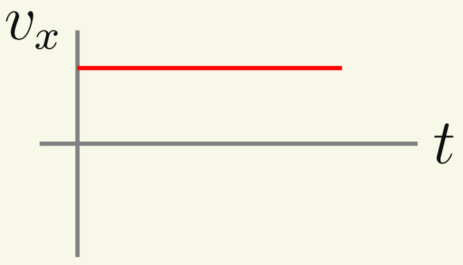

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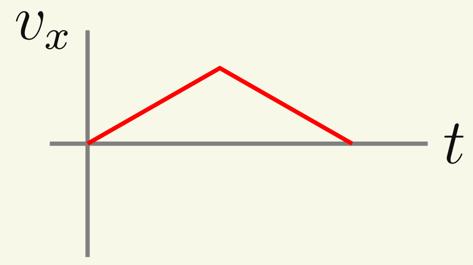

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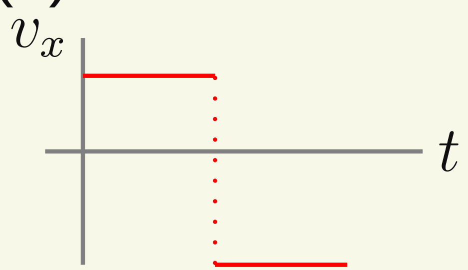
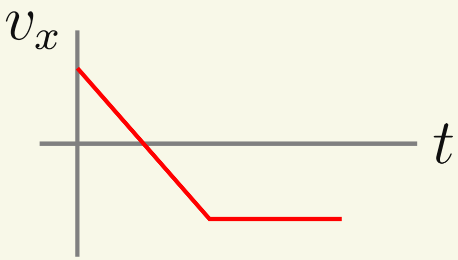


Man goes to the right with constant speed. Man immediately turns around. Man goes to the left with faster speed than before.

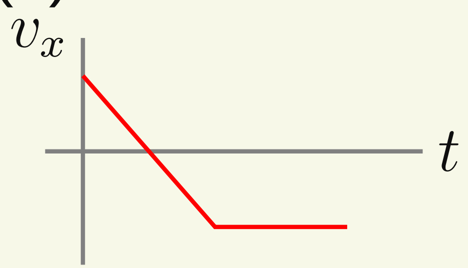
Velocity-Graph Followup II

(e)



Velocity-Graph Followup II

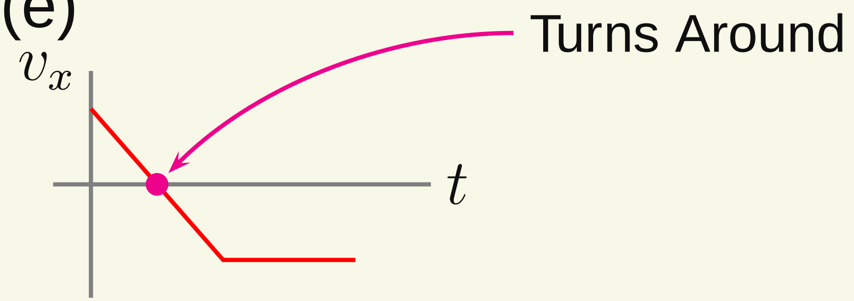
(e)



Man walks to the right but slowing down. Eventually he turns around. Goes to the left with increasing speed and then maintains constant speed to the left.

Velocity-Graph Followup II

(e)



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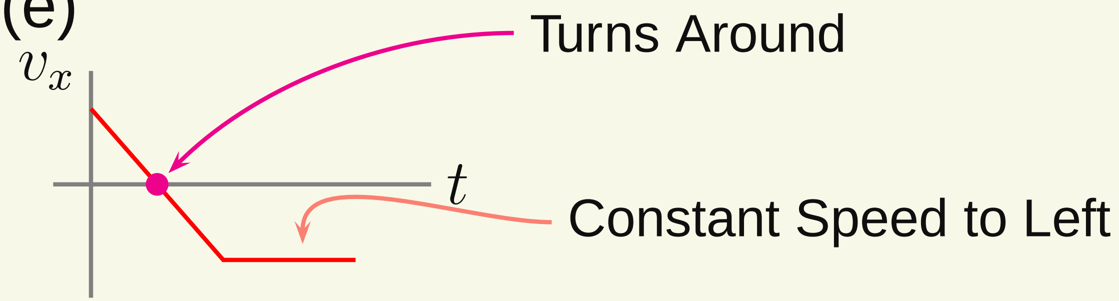

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Position from velocity

To find position from velocity, we use the fact that displacement is the area under the velocity-versus-time graph.

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Works for Uniform Motion:

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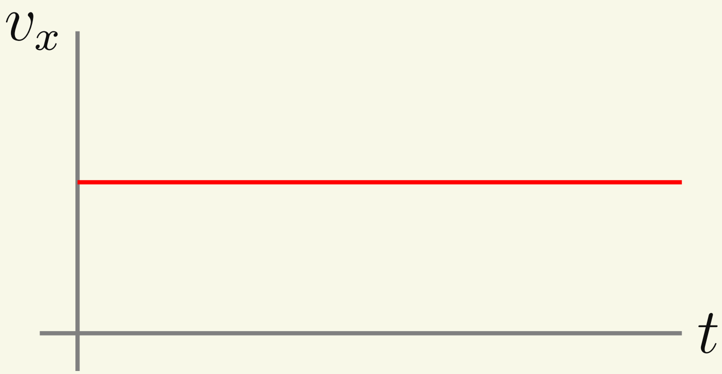
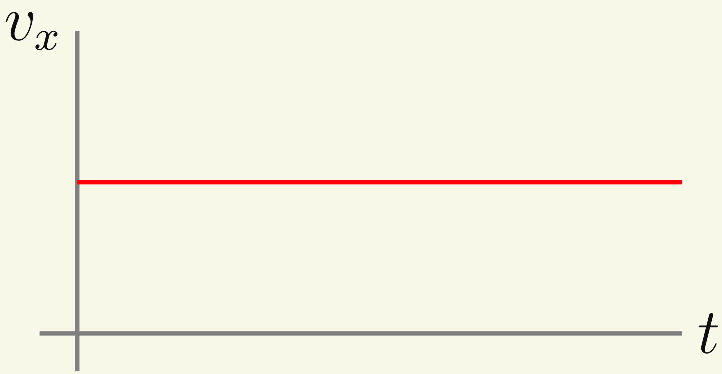


Position from velocity

To find position from velocity, we use the fact that displacement is the area under the velocity-versus-time graph.

Works for Uniform Motion:

$$v_x = \frac{\Delta x}{\Delta t} \Rightarrow \Delta x = v_x \left(\Delta t\right)$$



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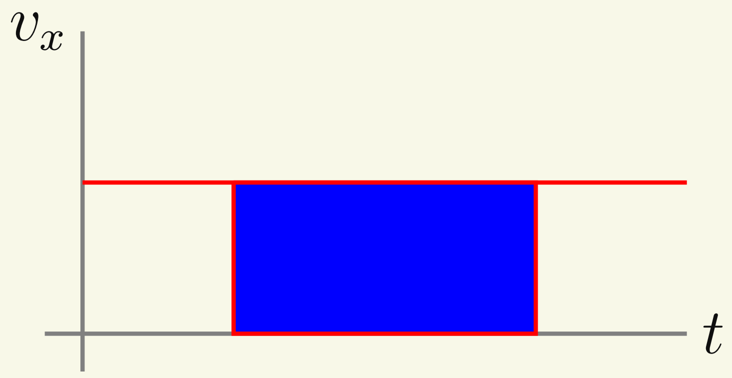

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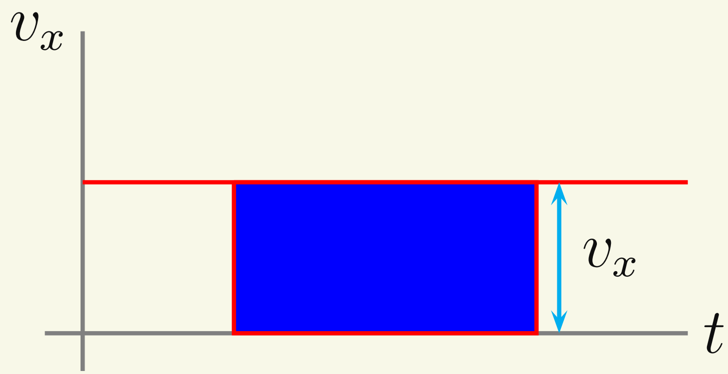

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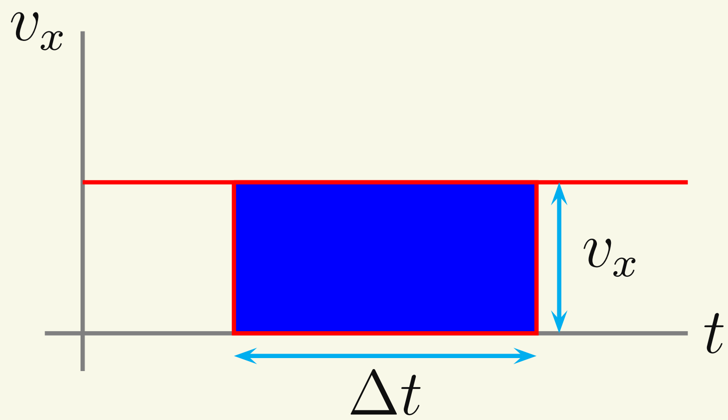

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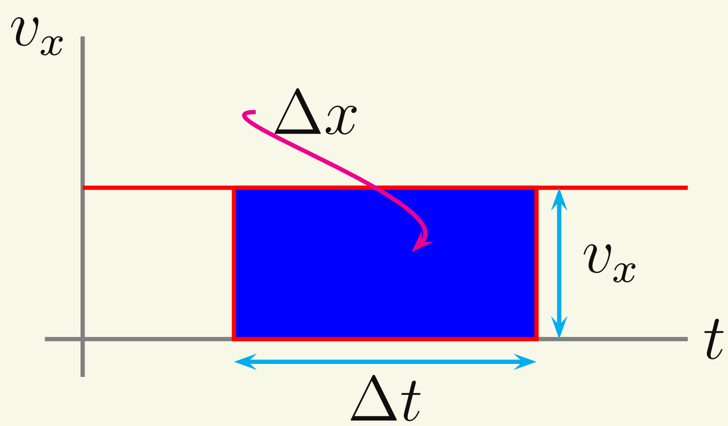

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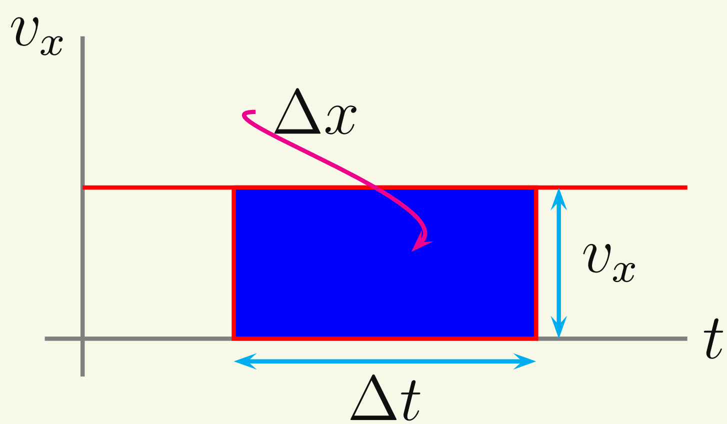
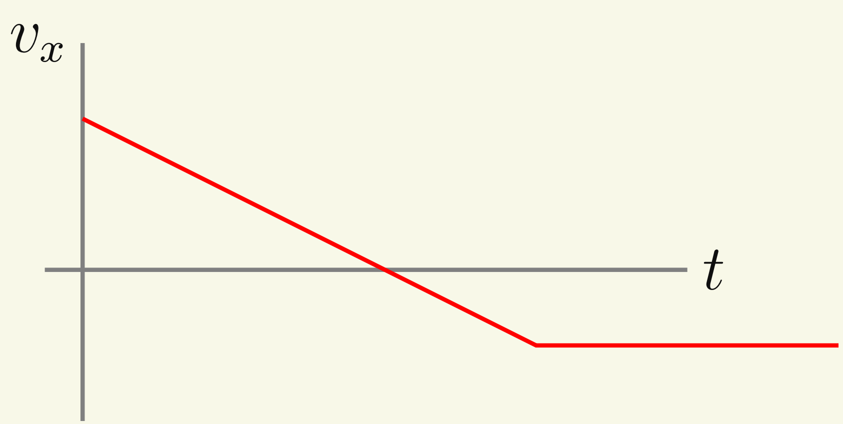


Also works here:



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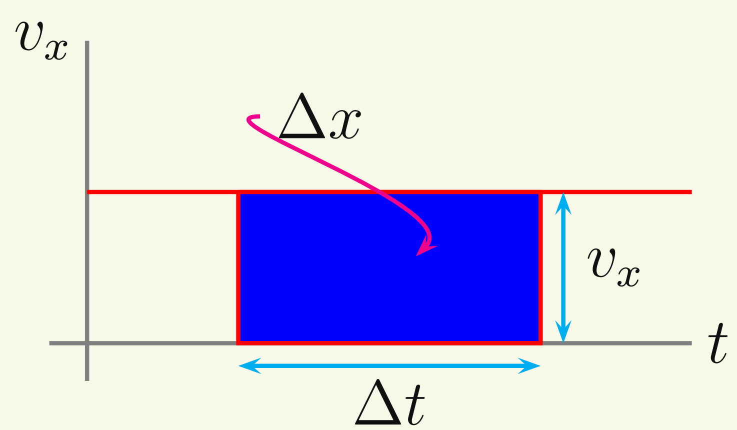
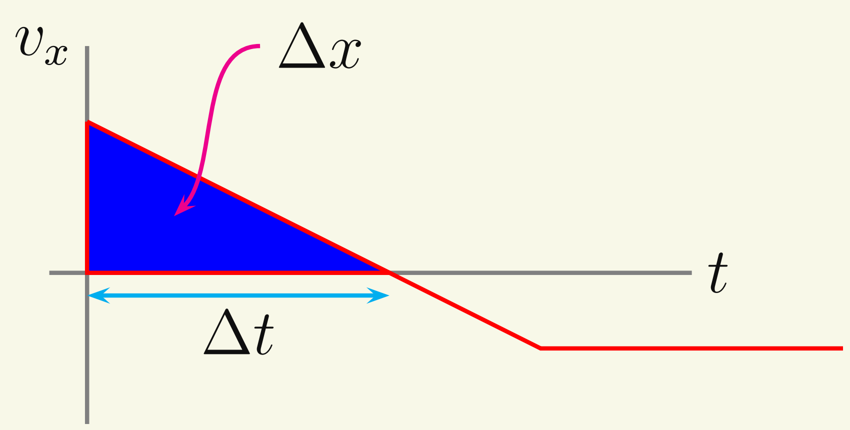


Also works here:



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Instantaneous velocity, v_x - How fast and in what direction for one instant of time t.

Changing Velocity

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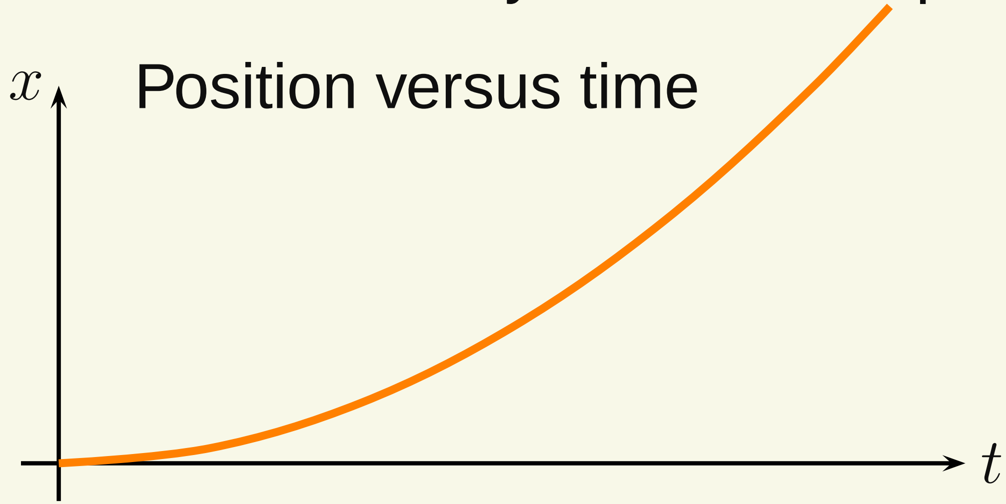

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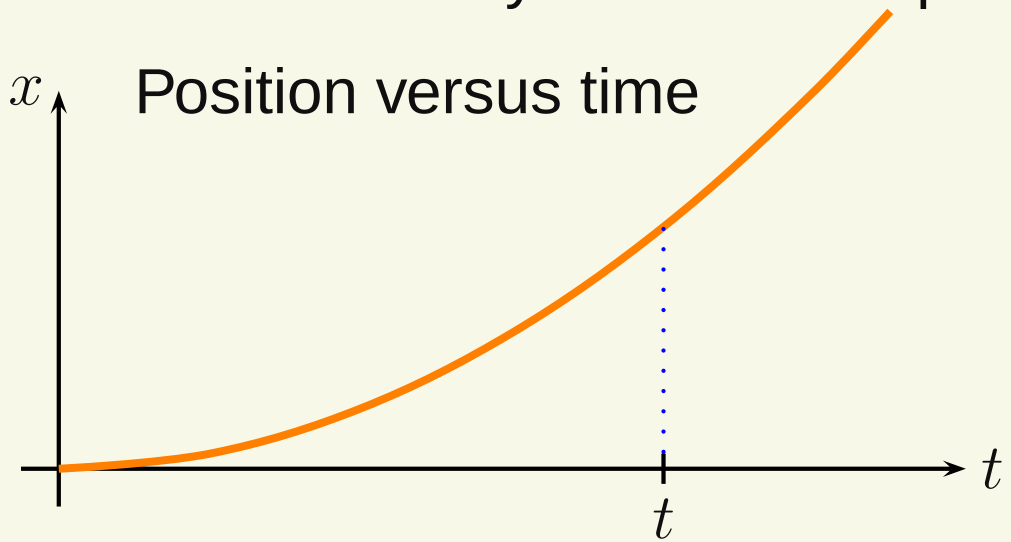

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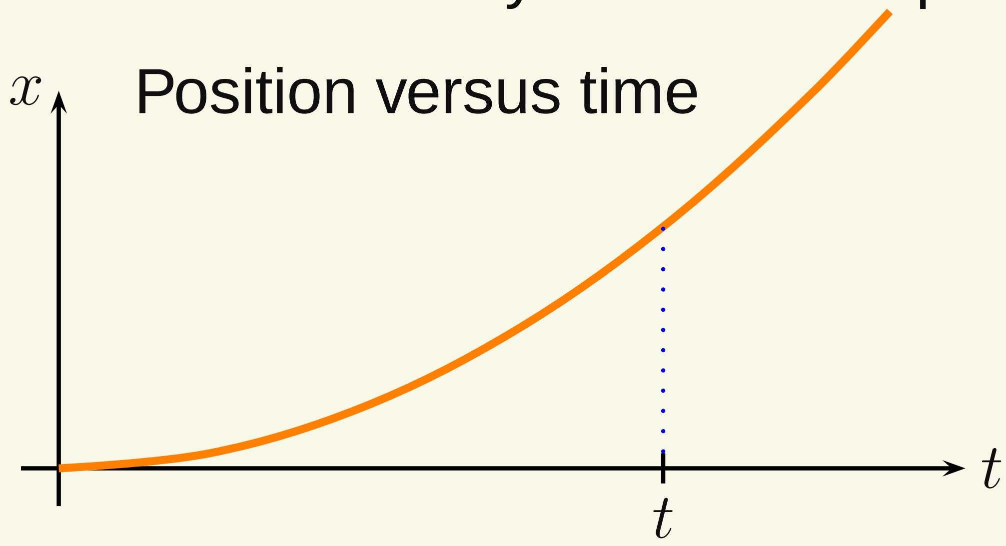

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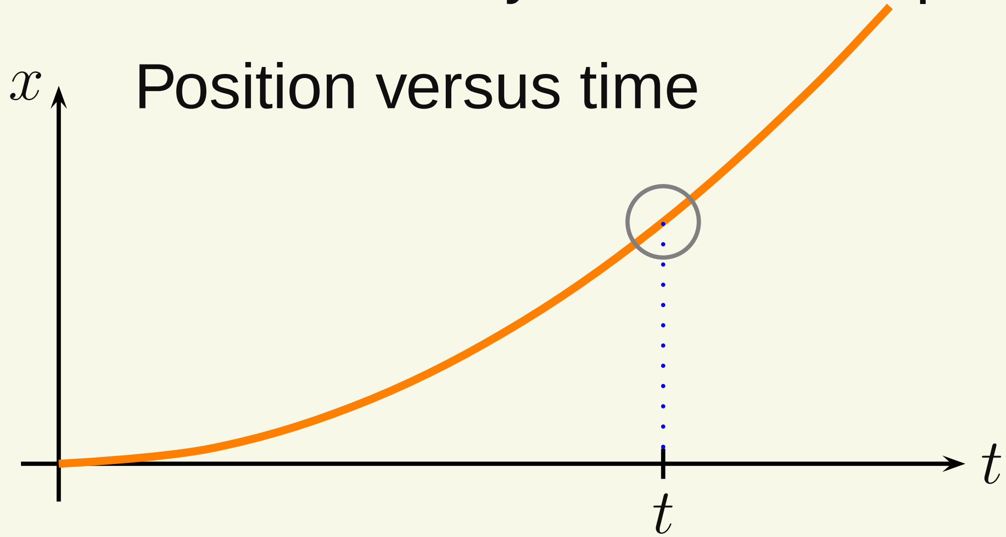

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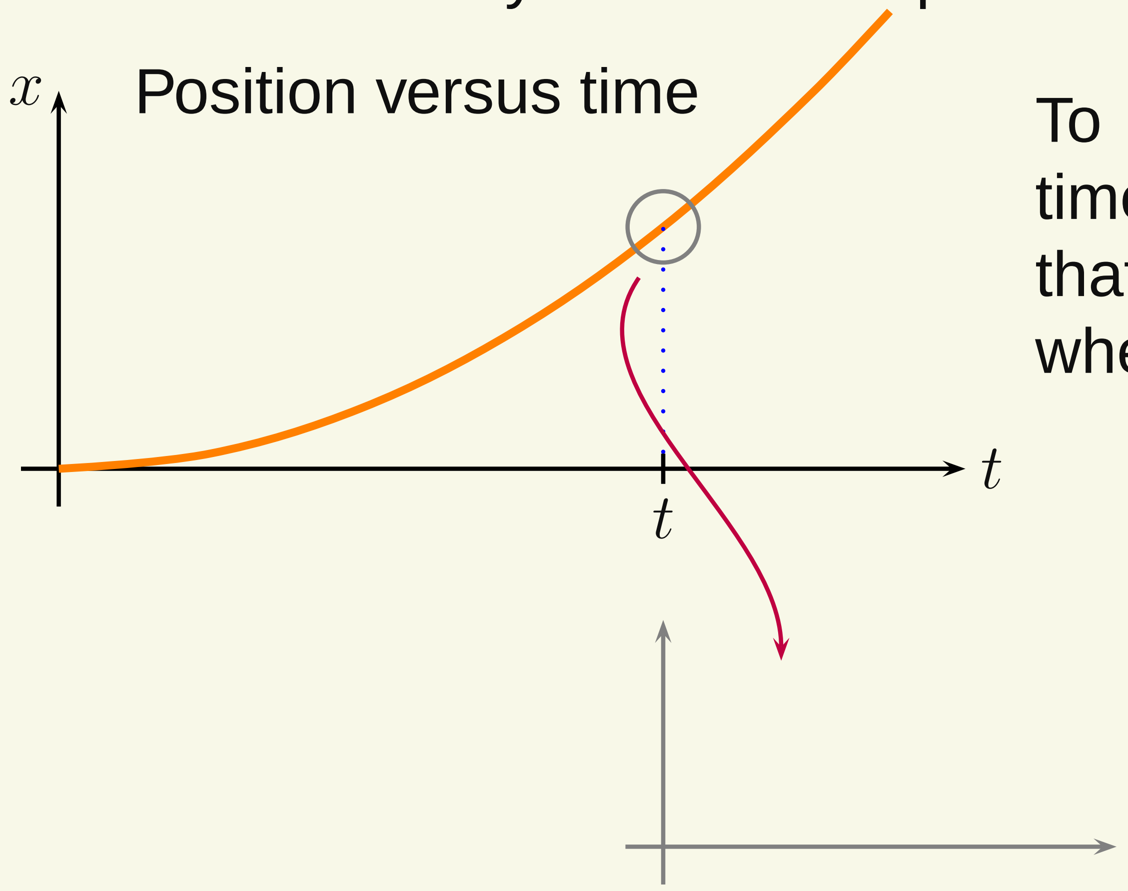

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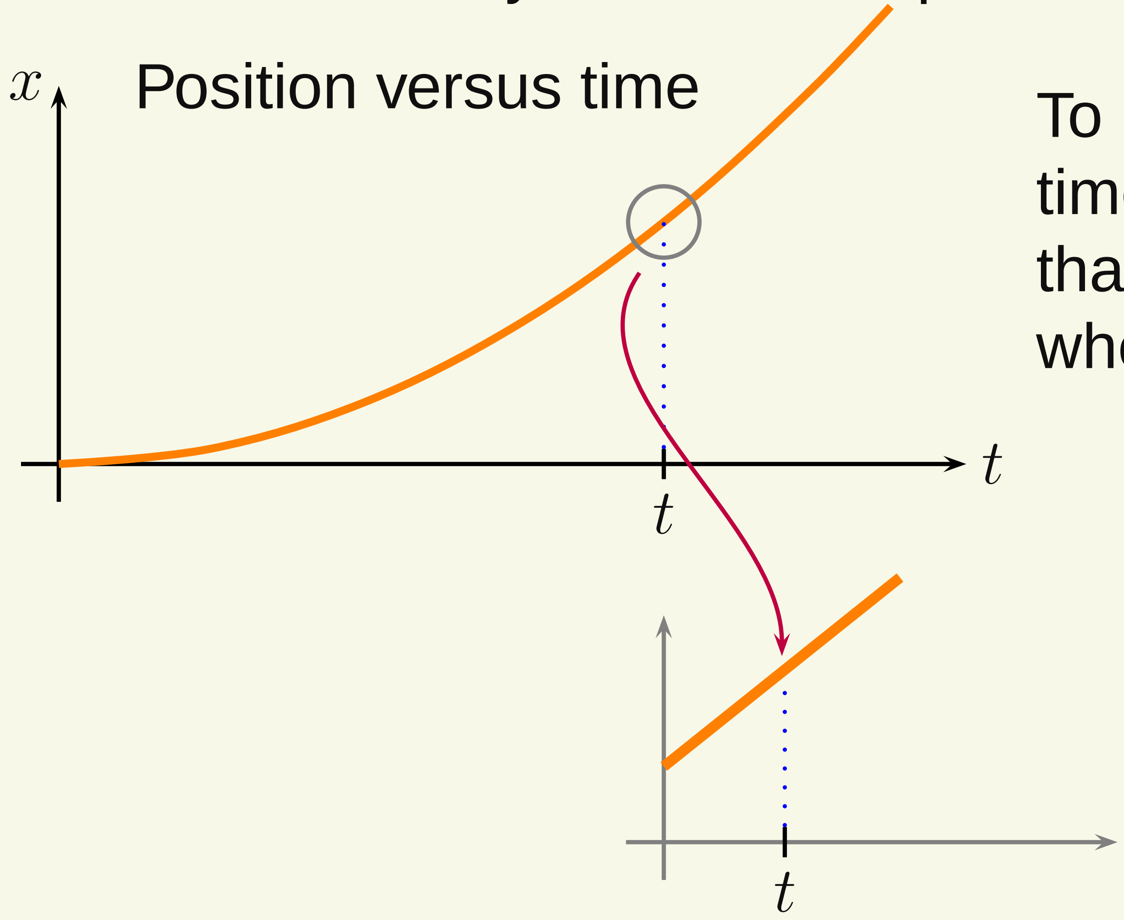

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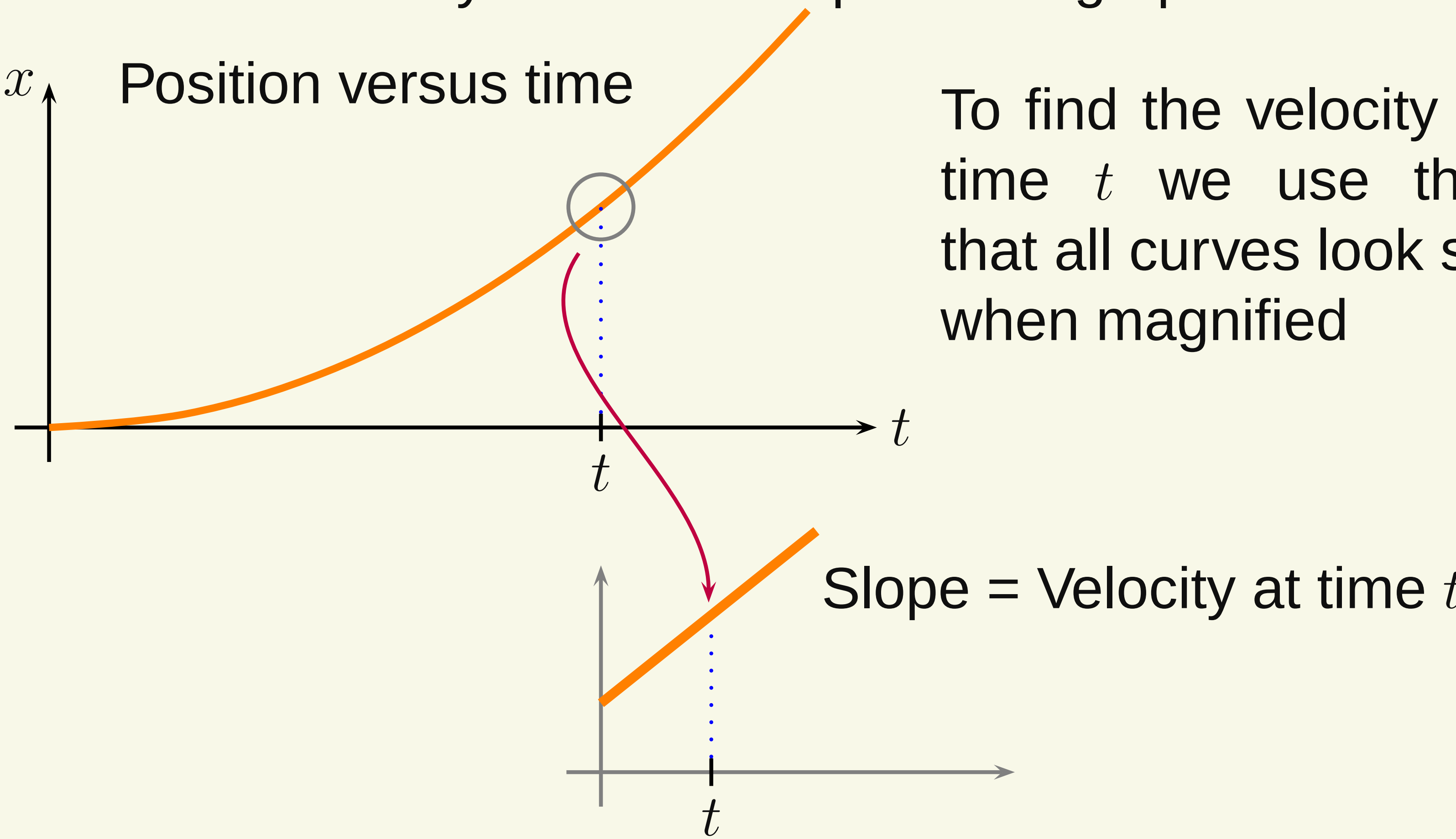

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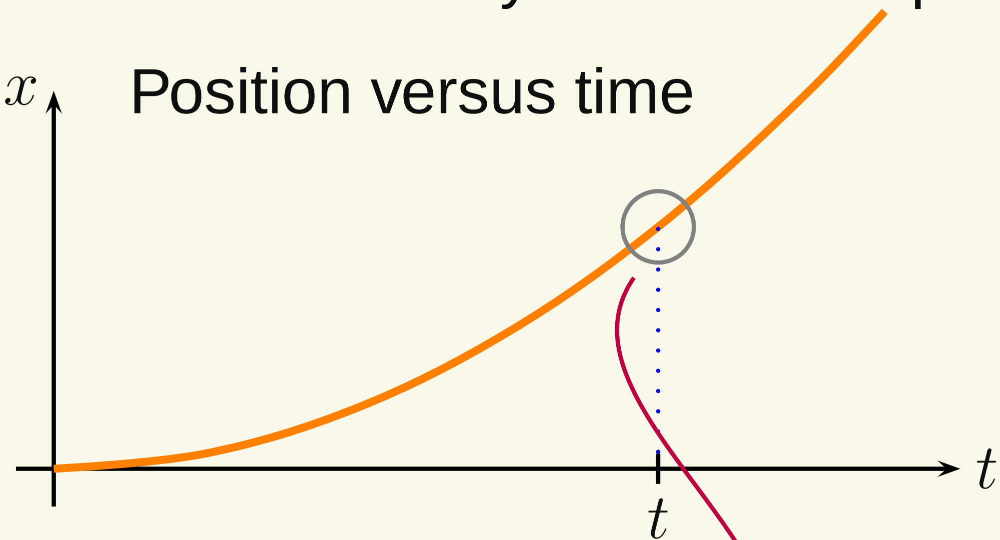

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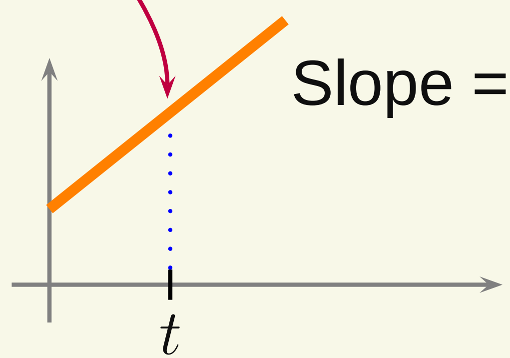

Note: To make this exact we have to make the magnification infnite. In calculus, this is called taking a derivative.

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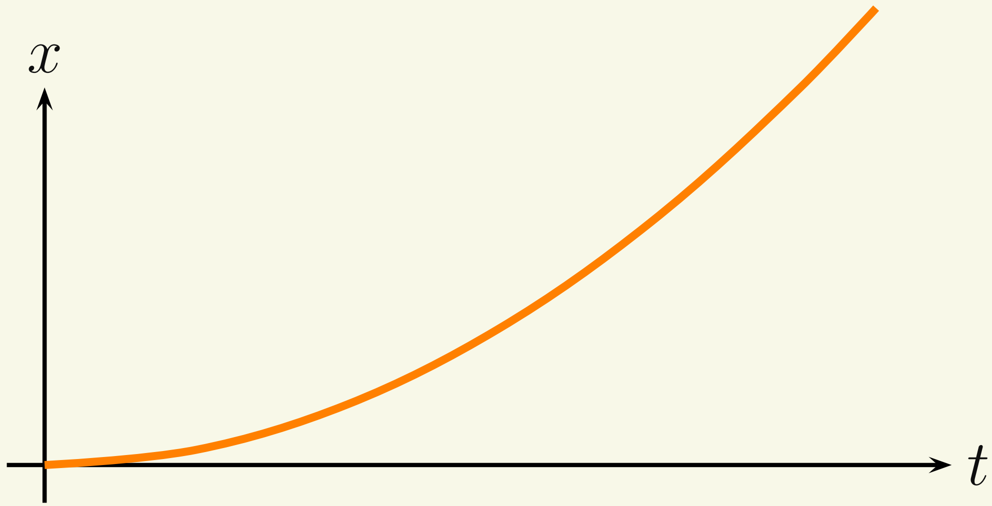

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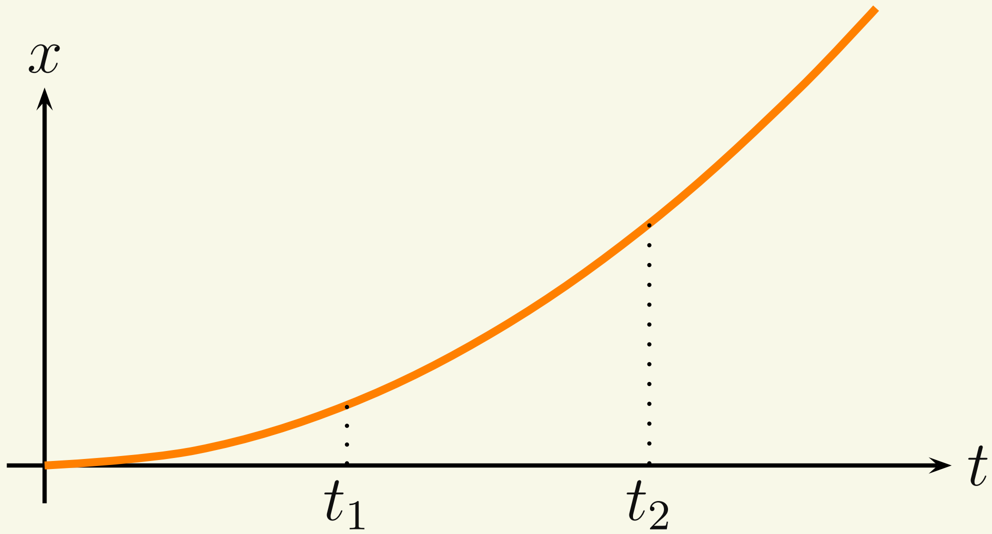

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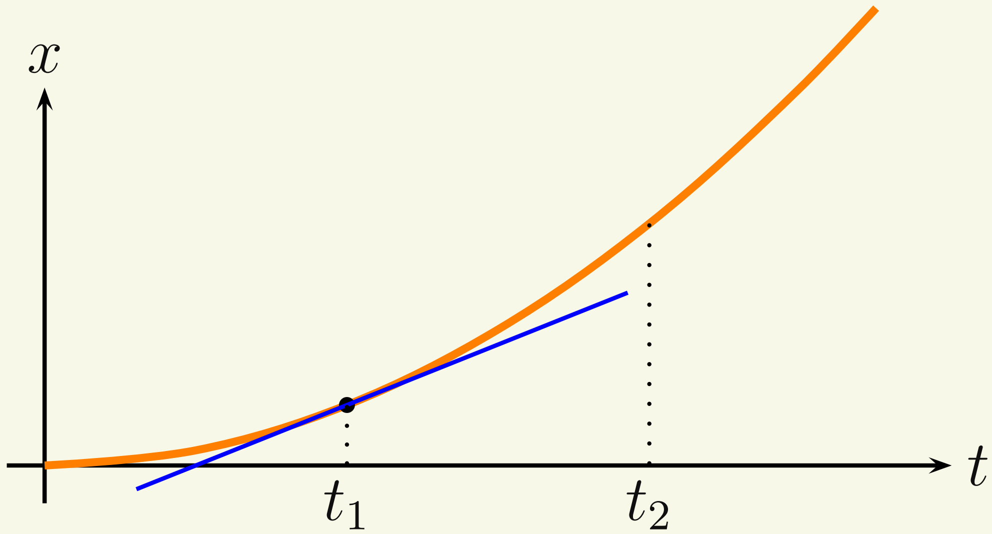

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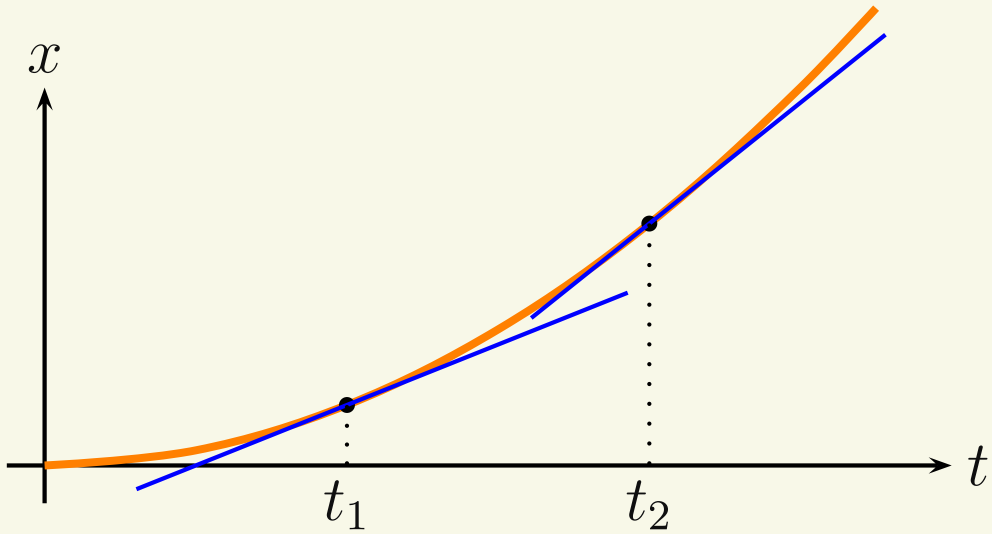

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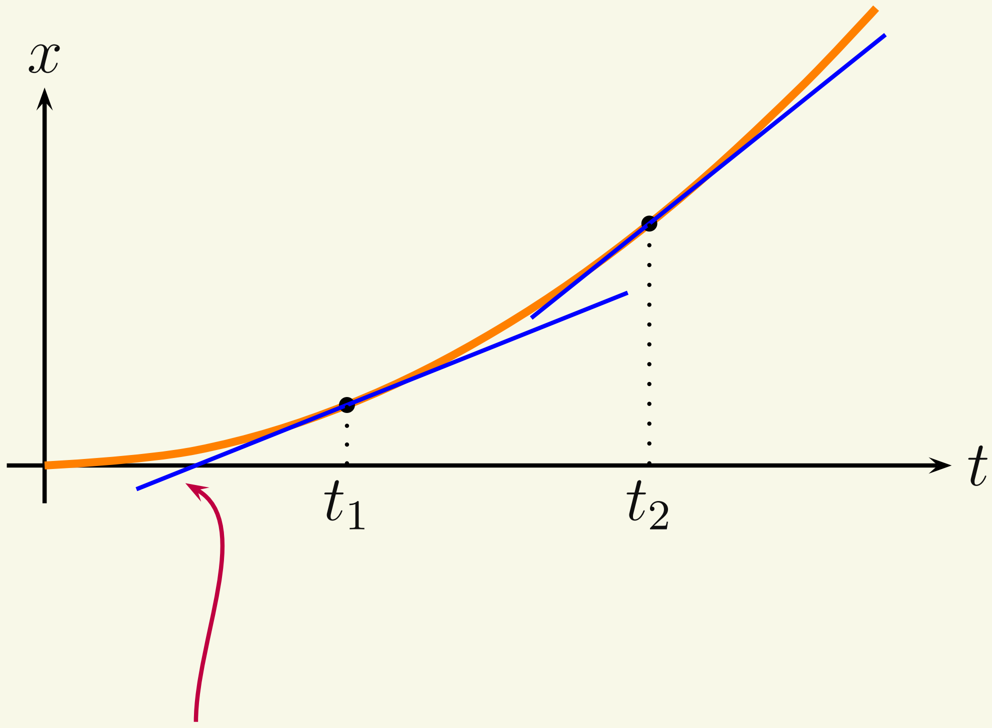

Slope = v_x at t_1

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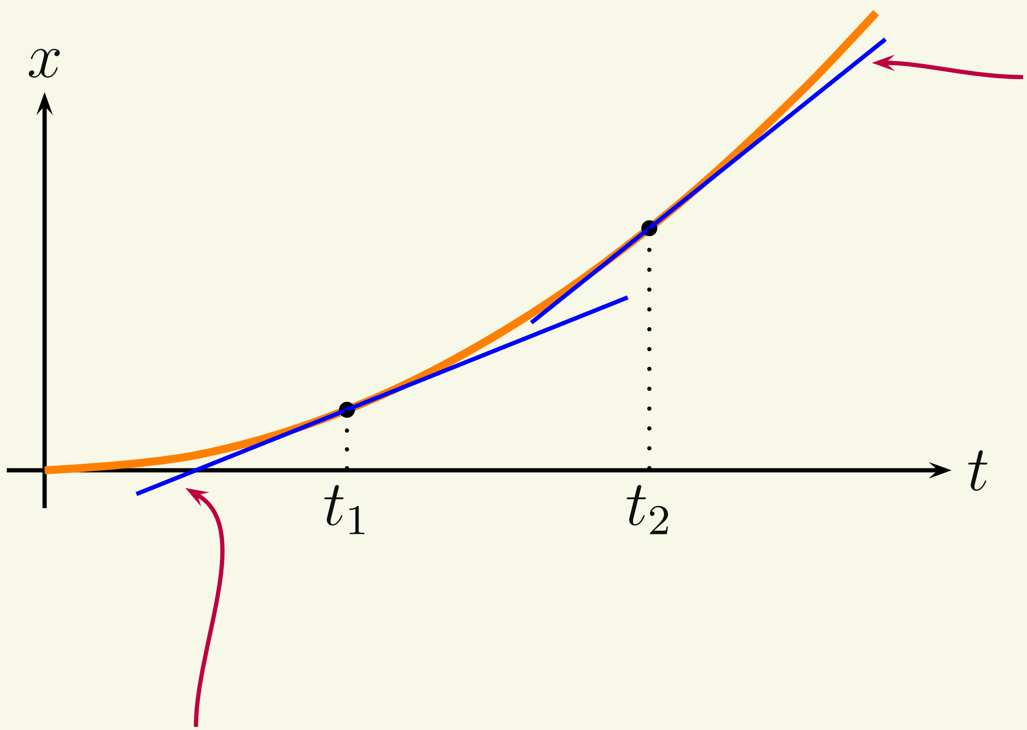
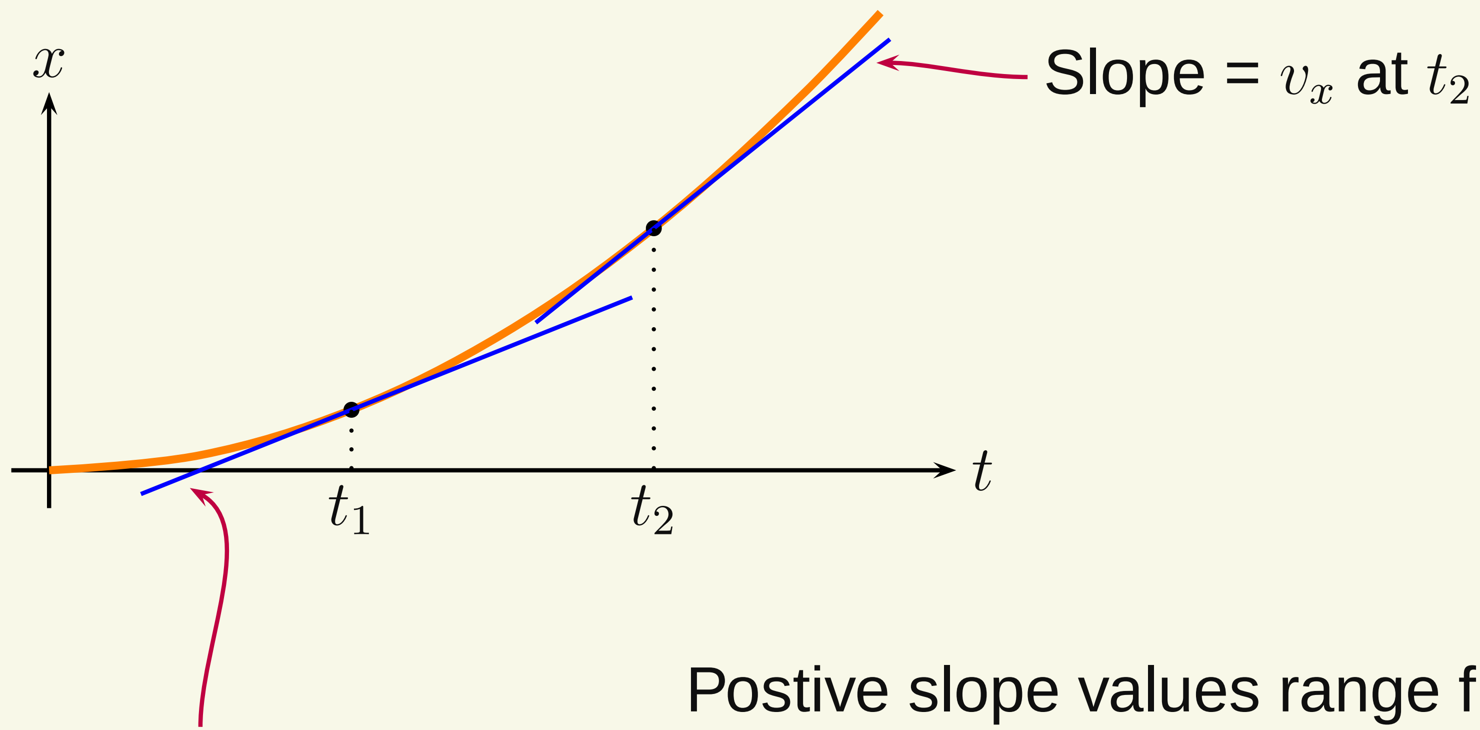


Slope = v_x at t_2

Slope = v_x at t_1

At different points on the curve, the slopes are different (and therefore so are the velocities).



Slope = v_x at t_1

Postive slope values range from 0 to ∞
Horizontal lines have 0 slope
Vertical Lines have infinite slope